



Application and Future of Data Analytics in Retail E-Commerce

Chaofan Deng^{1*}, Jinyi Zhang², Ruixuan Wu³

¹College of civil aviation safety engineering, Civil Aviation Flight University of China, Deyang, 618307, China, erxiaodcf@163.com

²Yixing High School Jiangsu Province, Wuxi, 214299, China, 2093127898@qq.com

³YewChung International School, Chongqing, 401122, China, 1836771734@qq.com

*Correspondence author email: Chaofan Deng, erxiaodcf@163.com

Abstract

Retail e-commerce, a vital significant industry, developed greatly due to the advance in data science, particularly in covid-19 pandemic. Data analytics is becoming a wide application in retail e-commerce. In this paper, we firstly do an industry overview, which includes the history, current business dynamics and the challenges of retail e-commerce. Then, we integrate the value chain for the retail e-commerce industry and further demonstrate current applications of data analytics across the value chain. Lastly, the future applications of data analytics in retail e-commerce are contemplated.

Keywords: *Electronic Commerce, Value Chain, Data Analytics*

1. INTRODUCTION

The history of the online shopping industry could be traced back to 1979. In that period, to realize and promote online transactions between customers and businesses, and to develop cooperation between companies, a system connecting the TV to computers through a telephone line was invented. This system became the foundation of the online shopping industry, later called e-commerce, which created a new world that both consumers and businesses could conduct their trade online [1]

From 1982, many companies created different online system. Boston Computer Exchange, the first e-commerce company, launched an online market for people to buy and sell used computers. Ten years later, a company called Book Stacks Unlimited became the first online book marketplace and used a dial-up bulletin system. However, it stopped selling books online in by 1997. In 1995, Amazon was launched as an online book retailer. In just 30 days, Amazon shipped goods to 45 different countries around the world. Three years later,

the first e-commerce payment system PayPal was launched. Within 3 years, the company had already handled \$3 billion in transactions from more than 12 million customers. [2]

When other companies observed the progress done by PayPal, they started to put forward new ideas on payment, this is critical as it determines whether a site has a good service. In 2000, Google launched AdWords, which is an online advertising tool for corporate marketing and customer online search. Because of these inventions, people started to see advertisements and entrance of the website, which they started to know where they could find the websites they need. Five years later, Amazon offered free, fast shipping and exclusive discounts to users who subscribed to Amazon Prime annually. In 2010, “Cyber Monday” was born through the National Retail Federation, referring to the high online sales on the Monday after Thanksgiving in the United States. During Cyber Monday, online sales in the United States had exceeded \$ 1 billion surprisingly. Just one year later, Google Wallet launched a peer-to-peer transfer service, now called Google Pay and three years later, more online

payments were launched, including Apple Pay, which allowed users to pay on iPhone. [3] This was a very important breakthrough in the development of the online shopping industry, before people could use PayPal or any other online payment, people have to fill in a bunch of information in order to make payments through credit cards. With online payment, they could pay faster hence increasing their satisfaction with the whole online shopping process.

2. CURRENT BUSINESS DYNAMICS

The year 2020 marked is a major inflection point in e-commerce. During this pandemic period, people could not go to offline stores, so they increased the demand for goods through online shopping. This included their demand for new clothes, entertainment products such as video game players, and most importantly, the necessities such as tissues, food, and masks. Using Pakistan as an example, during the pandemic, there was a 15% rise in



Figure 1: value chain

3.1 Merchandising

The first and foremost section in the value chain of e-commerce is merchandising. Merchandising is the process of selecting, displaying and selling products to customers. We should choose the right merchandise and ensure that merchandises appear at the right place and at the right time on the website. Whether online or offline, merchandising is used to influence customer intent and reach sales goals. With the advance in data analytics, merchandising is becoming more and more accurate and efficient. [4]

3.2 Marketing

Marketing is an action that companies take to improve their sales. It is very essential in today's online shopping industry as competition between companies is getting stronger and becoming more competitive, companies need to use marketing strategies to attract more consumers in order to increase their sales. Amazon is a company that has excellent marketing strategies to make itself stand out in the online shopping industry. For example, there are three significant kinds of advertisement: display advertisement, sponsored brands

internet users and a 30-40% surge in demands for products. With the rapid development of e-commerce, and low barriers to enter this market, more and more companies joined the market and expecting to share the growing profits. It is essential for companies to find a way to make themselves outstanding in the industry. At the same time, the importance of customer loyalty maintenance should not be ignored.

3. VALUE CHAIN

The value chain of the online shopping industry has changed compared to the beginning of this market. The changes have been most impactful in the marketing area. In the past, not many people were skilled in using mobile phones, but almost everyone knows how to use technologies. This is more convenient for the companies to collect data they need, by sending surveys or analyzing their behavior according to their choices made during online shopping. Below is the value chain of e-commerce.

advertisements, and website advertisement, which could be observed and seen virtually in the shopping mall, on the TV shows, on websites, etc. Amazon has always been the leader in the e-commerce marketplace. It had a market share of 45% in the United States in 2020. It competes with a range of firms around the world, while it controls 13% of the merchandise volume of the global e-commerce customers, Alibaba group--- including Taobao, Alibaba and T-mall, Jindong, Pinduoduo, and eBay each account for 25%, 9%, 6%, and 2% of the market.

3.3 Sales

Sales activities are very important in the value chain because it is a factor that can affect consumers' purchasing behavior and increase people's intention to purchase online. Since the birth of online shopping, the way of sales has become more and more diverse and convenient. For example, back in 2000, Amazon had already introduced one-click buying to circumvent the typical shopping cart form (name, address, and credit card information) and allowed people to make purchases with just one click. Today, processes are even more well-development, and more applications such as upselling are

coming up. Upselling is about offering web store customers a better or additional item when they browse your online catalog, add a product to their shopping cart, or check out. [5]

3.4 Logistics

E-commerce logistics refers to the kinds of services involved in getting goods that are ordered online from the supplier to the customer. Providing a great e-commerce logistics experience can not only increase customer loyalty but also reduce the pressure on after-sales services. In recent years, there are significant changes in the growth of the supply chain and logistics industry. Many of these changes such as Supply Chain Visibility should give the credit to the impact of data analytics. Take JD for an example to explain Supply Chain Visibility, JD built many big warehouses to hold the products rather than products delivered from the seller to the buyer, it makes sure that the production phase to the last mile distribution of goods can be managed and keep track of the shipment. In this case, the delivery becomes faster and more stable.

3.5 After Sales

After-sales service means to support or services a business provides to its customers after they buy products. After-sales services provide a sustainable relationship between consumers and companies after the purchase. By ensuring reliability and quality of products, in order to increase satisfaction and consumer loyalty.

4. CURRENT APPLICATIONS OF DATA ANALYTICS AND LINKS TO THE VALUE CHAIN IN ONLINE SHOPPING

The e-commerce industry has shown a large interest in data analytics recently. By realizing the fact that companies who have used Big Data Analytics into their work experience 5–6 % higher productivity than their competitors. A research by BSA Software Alliance manifests that Big Data Analytics make 56 % of companies' profits increase by 10% or even more. As a result, 91 % of 1000 companies are doing research in Big Data Projects, which increased by 85% from last year. [6] Data analytics plays an important role in the e-commerce industry. Moreover, data analytics are applied in every part of the value chain of this industry.

4.1 Supply Chain

Usually, planning is the most important contribution of data analytics in the supply chain. Retailers can use new data sources to improve the planning process and their demand awareness. For instance, blue yonder has developed a data intensive forecasting method, which has been deployed in the retail industry, of which 130000

SKUs and 200 influence variables generate 15000000 probability distributions every day. This greatly improves the accuracy of prediction; Be able to better understand the logistics capacity needs of the company; And reduce obsolescence, inventory levels and shortages. Recently, the growth of third-party cloud services such as blue yonder has also made it easier for other retailers to access such activities. [7]

4.2 Sales

Price is important when customers purchase goods. Most of the time, in comparison with performance, good A is better, but it turns out that customers will prefer good B because B is cheaper. Thus, setting a good price is a significant task. Data analytics will recommend the most suitable price due to customers' consuming habits to ensure the purchase rate. Amazon's dynamic pricing system checks out competing prices and warns Amazon every 15 s, which lead to a 35 % increase in sales. To give suitable prices to customers on the eve of possible increases in sales (like Halloween and some special holidays), Amazon deal with big data by accounting every behavior of other competitive companies. Using the data which has been collected may lead to companies who sell products online to build up a dynamic pricing system. Otto consolidates the place where it collects data into a database, simplifying the development of all-round customer profiles, analyzing competitor data, and determining which sales channels perform best. Otto, the biggest online retailer in German, can now easily use big data to optimize pricing, develop more targeted marketing campaigns, and improve its on-site advertising bidding strategy. So, it is able to compete with giants like Amazon. Its order volume increases about 14% each and the quantity of sales takes up 36% of the sales quantity in Europe. [8]

4.3 Marketing

Marketing is a crucial way for companies to let customers become interested in their products. Analysts can measure your marketing performance and the effectiveness of your marketing campaigns. Specifically, marketing activities include customer specific content and promotional activities. By tracking the records of consumption of the customers and measuring the effectiveness of marketing activity, using data analytics, we can provide personal service and customized products. Real-time data analytics make companies able to provide personalized services comprising special content and promotions to customers. These personalized services assist firms to separate loyal customers from new customers and making promotional offers accordingly. [9] By tracking the records of consumption of the loyal customers, the corresponding reward will be given to stimulate the next consumption. Also, data analytics will recommend the most suitable price due to customers'

browsing patterns, login counts, and past purchases to ensure the purchase rate. Analyzers surprisingly found that most people prefer to purchase products with a discount. And then a new corresponding marketing strategy will be given to stimulate the next consumption. For instance, T-mall will give you 30 yuan off if your consumption is up to 300 yuan at a time, but the discount will only last for a month. So, the customers will be in a hurry to manage their next consumption to get the discount. By doing this, the profit of each product earned will decrease but the total profits will increase by 1000 yuan for each merchant every month. [10]

4.4 Logistics

The merchant takes responsibility for not causing any customer to be out of stock, and handling inventory and inventory levels, which means that the supplier is responsible for making replenishment decisions based on the needs and constraints of all customers. An inventory

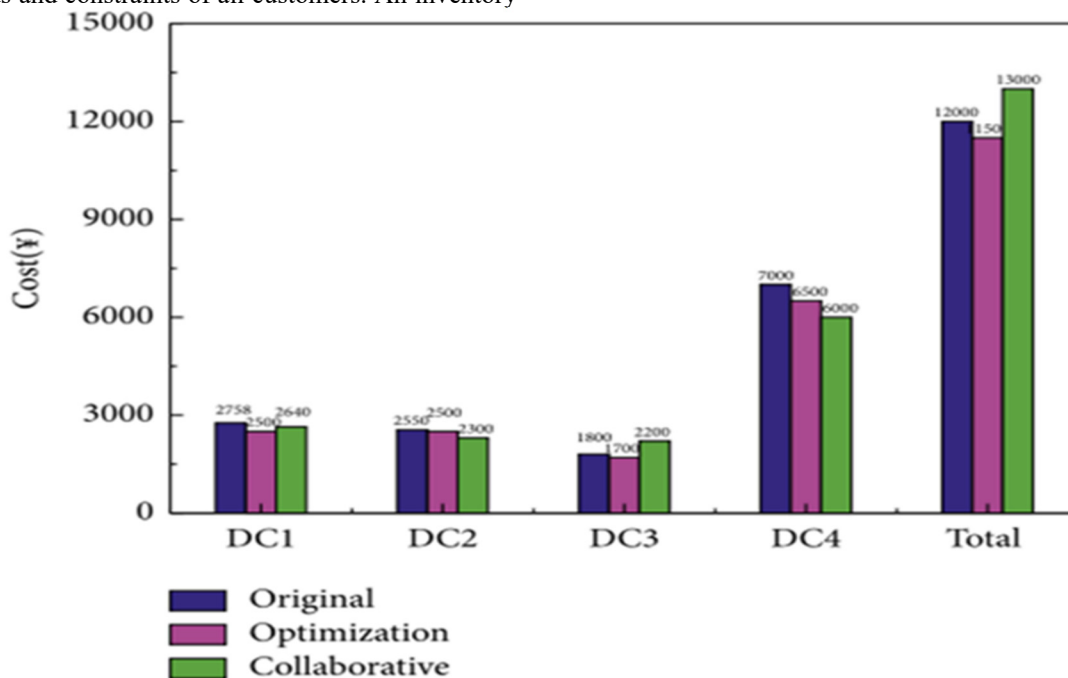


Figure 2: Which has been shown in the Figure below, we can see that compared with the initial state, the non optimized solution has doubled the service of DC 1, thus reducing the total cost by 9.15%; DC 2 still uses the service of 3 trams, and the total cost is reduced by 0.9%; DC 3 also uses the service of 3 delivery vehicles, which reduces the total cost by 0.57%. The total cost of combined network is reduced by 4.13%. This proves the validity of the nonconforming optimization solution

4.5 After Sales

The service after sales will also influence the attitude of the customers towards the company. If some problems like broken products are not dealt with properly, this will leave a bad impact on customers. Customer complaints are communicated through the contact form in the online store and twitter, so that e-commerce companies can make customers feel valued when they call the service center, so as to provide services quickly. Similarly, Miller explained that by using big data obtained from sensors

routing problem, which is considered as NP complete problem, has emerged, which means that it is computationally impossible to check all possible solutions to solve the best solution. A special algorithm called genetic algorithm uses the provided data to check whether it is more effective to use the physical supermarket network rather than just the central hub. The expected benefits in terms of cost can be roughly quantified, and the performance can be evaluated according to other indicators such as fleet and vehicle utilization. Take Amazon as an example. As the biggest online shopping company, Amazon hopes to make the logistics speed more convenient and shorten the time from goods delivery to customers. Amazon made a big data algorithm in terms of commodity distribution. As a result, merchandise has arrived at the warehouses in the customer region, so customers can receive the product mostly in just one day and the cost of the delivery will be minimized..

rooted in products to provide active maintenance, data can be collected and uploaded to the company, and e-commerce companies can provide innovative after-sales services. [11] With the help of the data, companies can realize customers' real attitudes towards the products and make improvements according to customers' favor.

4.6 Impact on Value Delivery to Customers

Today, data analytics is widely used in sales, logistics, etc. But at the same, there are many risks in the

application of big data technology due to the development is still incomplete.

Risk plays an important role in consumer value because it influences the process of making consumer purchasing decisions and reduces consumer intention to make online purchases. What we should do is to reduce the risks for customers. There are basically two risks: one that focuses on the uncertainty of the decision to make a purchase and the other focuses on the consequences of the results of online purchases. Consumers always have different statements in judging risk, and there are also differences in consumer attitudes towards risk. As a result, the risk to consumers after shopping is hard to predict. So, it is not only we should make good use of data analytics, but also it is really necessary to provide sales and after-sales services to reduce consumers' perceived risk.

It seems like we still face many challenges such as how to reduce the risk for customers that we cannot perfectly solve today. However, the future is always full of possibilities. With the application of analytics in e-commerce in the future, maybe we can solve these challenges.

5. DIRECTION OF ONLINE SHOPPING GROWTH AND CHANGE

As we mentioned above, applications of data analytics in online shopping have been widely used, but there are still many shortcomings. In our opinion, the future application of analytics in e-commerce may be based on predictive analytics. Predictive analysis is the use of historical data to predict the future behavior and trends of consumers. With the process of predictive analysis, e-commerce provides a platform to make use of some advanced applications of data analysis, such as machine learning, which learns from historical data, analyzes data, and makes further predictions.

5.1. *Advanced Application Analytics*

In the future, there are many opportunities to use value of customers, such as providing customized services based on the data analyzed from customers' emotions and habits after purchase. And these services can cover a lot of directions such as front-end design, advertisement pushed on the platform, and logistics after-sales.

And reinforcement learning is a kind of machine learning which can mainly represent the advanced application analytics of e-commerce. Reinforcement learning allows machines or software to learn their behaviors based on feedback received from the environment. Nowadays, applications can easily capture customer behavior data, do analytics, and make decisions. For instance, some applications can make emotional contact with customers. These applications analyze all

the data from customers and get their emotions, such as their feelings after shopping online. After the e-commerce platform obtains these customer emotional data, it can personalize the customer's needs by analyzing customer behavior and further making decisions for customers such as automatically canceling transactions for customers. In a word, personalized customization of customers' emotions is to make predictive analytics more accurate. In this way, the possible challenges will be solved.

Further making decisions for customers can be also applied in logistics, after obtaining the user's behavior data, we can advance the delivery of the items which frequently purchased by the customers to the warehouse close to those customers. So that when the customers buy the products, they will be delivered to the customer faster. And a faster delivery provides a better shopping experience for customers, furthermore, the greater consumer loyalty comes because they are already getting a guarantee of the money they spent. By providing after-sales services and ensuring the reliability of products, so as to increase satisfaction and customer loyalty. In this way, we solve the challenges of how to reduce the risk for customers and increase sales at the same time.

6. CONCLUSION

The E-commerce retail industry is significant in people's life, it was practically valuable during the Covid-19 pandemic. So understanding the whole industry and knowing how data analytics influences and elevates the industry's development have a great significance. In our research paper, we discuss each part of the value chain of e-commerce, data analytics application based on the value chain, and future direction as well as advanced application analytics. We hope that this paper can give readers a deep understanding of the data analytics in retail e-commerce and give them an insight into the future development of the industry.

ACKNOWLEDGEMENT

All authors share the same contribution being co-first author. We would like to thank our professor, supervisor and teacher, whose expertise were invaluable in formulating the research questions and methodology. Your insightful feedback brought our work to a higher level.

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