The Impact of E-Commerce on Customers' Purchasing Patterns in the Era of Big Data

Guanzhen Wu and Li Cheng
International School, Beijing University of Posts and Telecommunications, Beijing, China
Email: wgzh111@126.com, licheng@bupt.edu.cn

Liu Dong
School of Humanities, Beijing University of Posts and Telecommunications, Beijing, China
Email: dongliu43@163.com

Abstract—**E-commerce has played a significant role in economic development, particularly in contemporary China. With the rapid development of data technology and cloud computing, e-commerce has received increasing attention in recent years. Technical assistance, for instance, can help to enhance customers' shopping experience. In this research, the researchers used the method of case studies, described the technology applied to gather information about customers' shopping history, searching history and other behavior data and identified typical customers' purchasing patterns in order to classify and analyze them. The analysis can be used for both marketing purposes and business decisions. Manufacturers and online shopkeepers, through data analysis and cloud computing, can forecast customers' requirements accurately and send recommendations which can stimulate consumption. Therefore, it will be easier for customers to discover goods which can meet their needs. Finally, the researchers make suggestions for future development of e-commerce.**

Index Terms—**e-commerce, big data, case studies, purchasing patterns**

I. INTRODUCTION

In the past 15 years, people usually purchased commodities through supermarkets, shops and other physical stores. At that time, purchasing power was low and customers usually lacked enough product information. Their buying behaviors mainly depended on their ways of living and local stores. Now, in the era of big data, customers usually have a large amount of information, so they can purchase commodities in various ways. With the rapid development of e-commerce, there are hundreds of purchasing actions taking place every day all over the world. Through the application of high velocity processors, high-speed wireless networks and various sensors, the user's behaviors and operational data can be easily recorded and collected in real-time, which will generate a large amount of data. And those data contain the regular patterns of consumers activity. Through analyzing the behaviors and purchasing data of the consumers, the enterprise can learn about the psychological needs behind the purchasing behavior and classify these data so as to better understand the consumer's real needs, make more accurate predictions and thus adjust the marketing strategies.

This paper aims to investigate the impact of e-commerce on customers' purchasing habits. Many researchers have analyzed human behaviors and drawn the conclusion that the human behavior is not random but predictable. These conclusions support the feasibility of prediction of consumers' behaviors through big data technology. Moreover, people's behaviors can be influenced by many factors. The progress of cloud computing and algorithm shows that people's purchasing decisions are related to many factors including the evaluation of other consumers, the price, the sellers' locations, and similar commodity purchased by other consumers. The research questions of this paper are as follows:

1. How do big data show the regular patterns of customers' behaviors behind the customers' purchasing patterns?
2. What are those patterns?
3. How do they change the customers' purchasing patterns?

II. METHODS

In this research, the researchers used case-study method for analysis and searched the related literature from China National Knowledge Infrastructure (CNKI), Web of Science (WOS) as well as the reports from China Internet Network Information Center (CNNIC). Then, the researchers gathered the information about the current situation of e-commerce, big data and the development of the latest technologies in order to do the case study. It is hoped that through some e-commerce platforms as case analysis, factors influencing the customers' purchasing patterns of e-commerce will be identified.

III. RESULTS

According to [1], shown in Fig. 1, China's online retail sales in 2017 reached 7.18 trillion yuan, nearly 19.65

percent of the Total Retail Sales of Consumer Goods (TRS). The amount increased by 32.2% year-on-year. Online shopping has revolutionized the Chinese shopping model and it continues to affect people. Take Tmall "Double 11 Event" as an example. In the 10-year period, Double 11's sales volume has increased by a total of 3,700 times. On November 11 of 2017, the total

money spent on Tmall was 168.2 billion RMB. It can be seen that the scale of the e-commerce market in China is continuously increasing. More and more people have chosen e-commerce. At the same time their shopping behaviors have generated huge amount of data. Behind the data is the rule of consumers' purchasing behaviors.
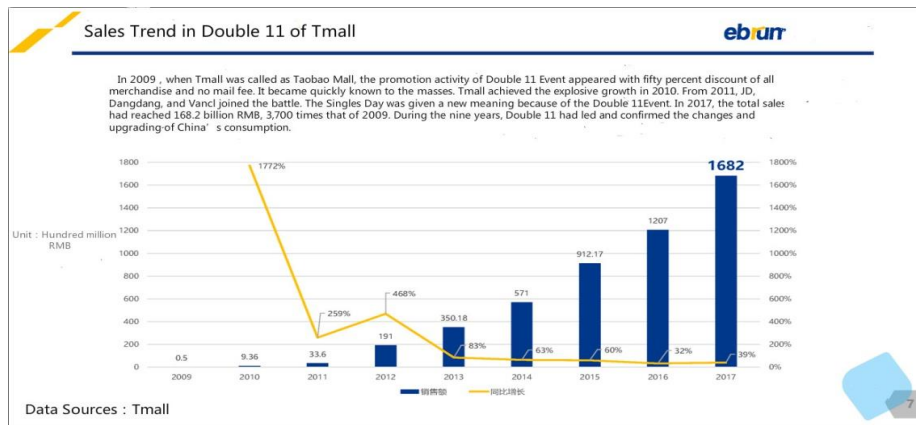

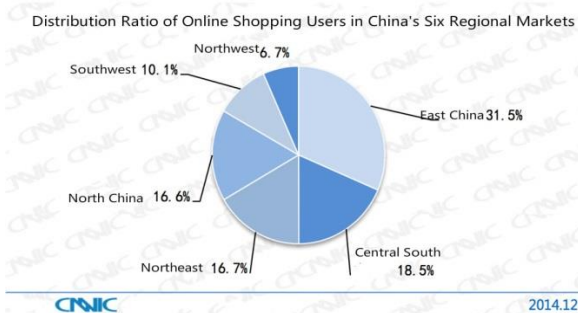Figure 1. Sales trends in double 11of Tmall [1]

Figure 2. Distribution ratio of online shopping users in China's six regional markets [2]

By analyzing the data of online shopping [2], we can get the distribution of user scale and commodities. Fig. 2 shows that in the past few years, data analysis was mainly used to analyze the consumption characteristics and regions of consumers. For example, according to the analysis, nearly half of the online shopping users were

from the rich areas in China: East China and the Central South which account for 31.5% and 18.5% respectively [2]. Developed cities with a large population, well-developed network communications and many companies, are among those regions such as Shanghai, Shenzhen and Guangzhou. People work in those cities are much busier so that they have less time shopping. Therefore, peoples in the developed cities have become the main groups of online shopping. On the other hand, most parts in the northwestern China are rural and has a small population. People working in rural areas do not have as much pressure as those in cities. They tend to have more spare time to wander around and purchase things. Also, it is relatively difficult for shops to transport daily goods due to the traffic limitations in the rural areas. Under-developed traffic and lower demand of online shopping, these are some reasons why the proportion of Northwest online shopping users is minimal.
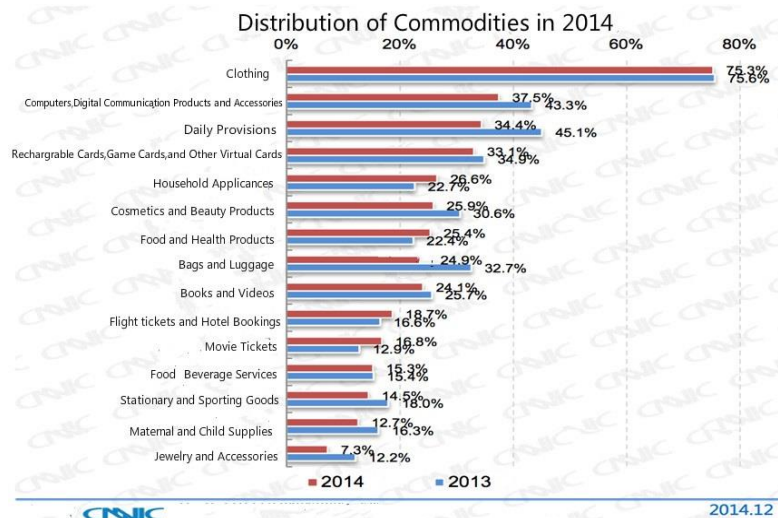

Figure 3. Distribution of commodity in 2014 [2]

Big data technology is widely used not only to analyze regions but also to predict demand trends through a large number of calculations. As the Fig. 3 shows that the proportion of online shopping commodities such as household appliances, health products, fly tickets booking increased in 2014 compared to that in 2013 [2]. Meanwhile, other categories were declining. Therefore, the platform which managing related products will adjust sales plan based on analysis in order to adapt to market competition. This kind of behavior can also guide consumers and reduce unnecessary waste which is consistent with sustainable development. With the development of online shopping user scale, however, sales of all types of goods had a huge increased. Major e-commerce platforms began to fully develop goods which made consumers have more choice. However, they need to worry about the quality.

On the other hand, e-commerce platform is constantly updating technology to adapt to consumers and understand their needs. Take Taobao for an example. Taobao introduced the MapReduce [3], a programming model for parallel operation of huge data sets, which greatly improved the ability of information retrieval, analysis of massive data and the processing capability of the input demand. It is mainly based on two functions - map functions and reduce functions shown in Fig. 4. Firstly, users input keywords of goods which they wanted. Then map functions will classify the data, store it as a key-value and randomly output the key-value. Finally, the reduce functions read the key-value and pair each key-value in order to achieve big data classification. Through the MapReduce big data processing mode, Taobao can rapidly identify which product most customers have searched and purchased according to user differences, e.g. interests, demand characteristics, age, consumption habits, etc. For example, in 2017's Double 11 Event, through cloud computing and big data analysis, Taobao found that the number of people who purchased rock-climbing equipment with an age more than 40 years old and loved outdoor sports had increased by 40%. When people searched keywords relating to "outdoors", algorithm will determine whether users meet the classifications of users group which in the previous situation, and equipment about rock climbing will be recommended to the users.
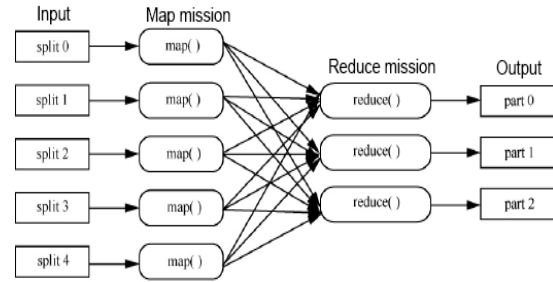

Figure 4. MapReduce parallel computing process [3]

Data from Fig. 5 show that the shopping user scale has increased from 2014 to 2017 [4], and the growth of mobile shopping user scale is particularly rapid. In particular, the widespread use of mobile phones provides an opportunity to access the information by different business e-commerce platforms and software. This kind of behavior of jointly obtaining the information from users' mobile phone is called as data linkage.

In the era of big data, data linkage is constantly stimulating consumers' purchasing psychology [5]. In many mobile phone software, mass advertisements are recommended based on the user's purchase intention or historical data searched in online stores such as Taobao and JD.com. For example, if one searches the keyword *mobile phone* on Taobao and then browses web pages, the sidebar or advertisement recommendation on the web pages will be related to the mobile phone. Moreover, even non e-commerce software, such as video software or social apps, can capture users' searching information and recommend it to the appropriate e-commerce platform. This shows that the consumers' searching history is shared with other applications and used for advertising. When customers use their mobile phones, the advertisement will always stay in sight. According to the principle of human memory, it will continuously show the relevant information about consumers' searching history and stimulate neurons in the relate areas of brain. Then it will form a stronger sense of purchase and enhance consumers' purchase memory which will in turn encourage customers to purchase more [6]. This is also a way in which e-commerce influence consumers' purchasing patterns.
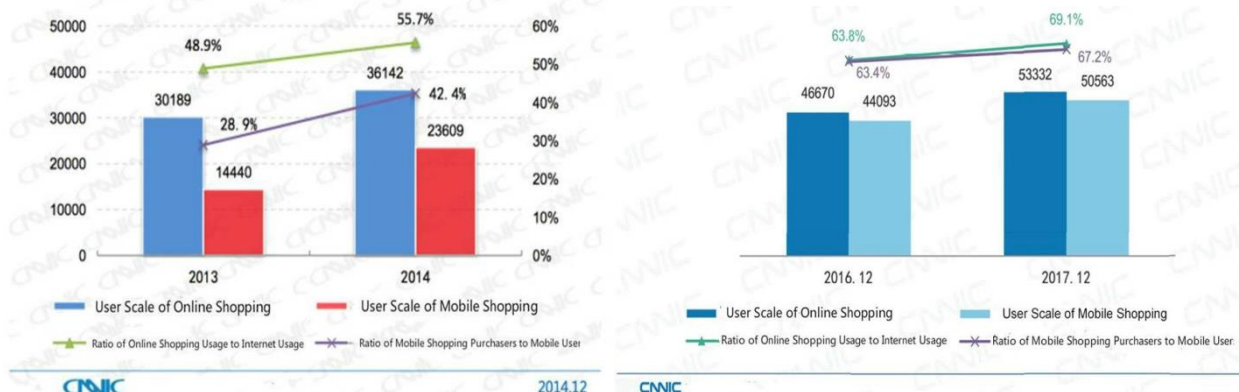

Figure 5. User scale of online shopping from 2014 to 2017 [4]

Figure 6. The main considerations of online shopping users when buying goods in 2014 [2]

IV. DISCUSSION

E-commerce analysis uses the information which is related to the users. Cloud computing has been used to search related products and customer's needs, and then recommends consumers to purchase the products they need [7]. However, this algorithm analyzes the user's behavioral information. However, some users' information is obtained directly from the users' mobile phone. The users' privacy issues involved are not discussed in this article.

The development of e-commerce in the future is facing the following three major challenges: privacy protection, cultural differences and the relationship between online and offline stores.

First of all, we need to improve the security of electronic online payment. Security is critical to the development of e-commerce. If security cannot be guaranteed, it is impossible for major e-commerce platforms to establish trust [8], [9]. Also the privacy protection needs work and efforts from the government, the online shopping platform and the customer [10]. Customers should know which software can get their information to avoid accidentally revealing their privacy. Government has issued some laws and regulations such as People's Republic of China Network Security Law in order to protect the network security. The online shopping platforms such as Tmall and JD.com have the R&D Department where engineers are trying their best to reduce the platform vulnerability and protect the platform against cyber-attacks. Here are some suggestions for customers: keep your passwords secretly, install antivirus software and keep it updated regularly.

Secondly, due to the differences in cultural backgrounds and languages, the way of searching keywords will have different results. With the development of international e-commerce, commodities from different countries are available to customers [11]. However the description to goods in another language might be ambiguous in another way, when users do not know the local language. So it is probably for customers to find other things that are not fit for their expectation especially when they are mixing different languages. Therefore, how to deal with the mixed analysis of different languages and people is also an important problem that people need to solve in the future.

Finally, as e-commerce sales account for a large proportion of Total Retail Sales of Consumer Goods (TRS), the impact on physical store sales is getting more and more far-reaching [12]. It is a matter how to balance the relationship and quantity between e-commerce and physical stores. More and more offline stores are changing to experience stores, and sales task is handed over to online stores such as Apple. Meanwhile, some sales-oriented stores have become service-oriented such as bookshop. The face to face services provided by bookstores, daily-use items in convenience stores, and emergency drugs provided by pharmacies are all services that people need in their daily life. So it is impossible for online stores to completely replace physical ones. However, e-commerce takes the major sales market, and the profitability of physical stores become very low and some of them are hard to continue to operate. Therefore, balance is a difficult issue that can be studied in the future.

V. CONCLUSION

In the era of big data, cloud computing and big data have been recognized as the hotspots and trends of information technology. This technical advantage has broken the bottleneck of e-commerce transactions and raised the ceiling for the development of the e-commerce industry on the basis of technology. E-commerce platform provides broader and faster services through big data and cloud computing technologies. More and more people choose online shopping instead of physical stores especially in economically developed areas. At the same time, consumers' requirements can be predicted accurately by data technology and their purchasing patterns will be more influenced by shopping platforms. People are able to buy goods more easily, and there are various categories to choose from, not even to screen themselves. The software will recommend the most suitable product for the user through calculating a large

number of similar situations. In the case that the quality of product cannot be determined online, the recommendation of the software and the comments of other users will become an important reference factor for the customer to purchase the product. This just a proof of the result of the CNNIC report [2] shown as Fig. 6. This kind of technical innovation can improve the development of the e-commerce industry, promote effectively the development of social economy and improve the quality and level of people's production and life. At the same time, companies that hold a large amount of user data should also take appropriate measures in order to protect the security of data. Therefore, researchers should pay more attention to this issue. In the process of continuous development and application, the entire e-commerce technology will be continuously optimized and innovated so as to achieve economic prosperity.

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Guanzhen Wu is a Year-2 undergraduate student in the International School of Beijing University of Posts and Telecommunications (BUPT).

He is majoring in Internet of Things engineering with management. He is now in charge of web design of an academic conference, which is part of a BUPT research project. His research interests include network security, big data, data mining and data analysis.

Mr. Wu is an IET student member.
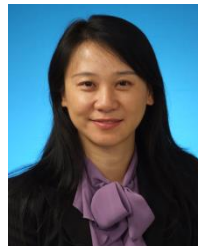
Dr. Li Cheng, associate professor in International School of Beijing University of Posts and Telecommunications (BUPT), received her PhD degree in applied linguistics from the University of British Columbia (UBC), Canada.

Her career includes teaching and training experiences in English language education at Beijing Normal University, UBC, Sun Yat-sen University and BUPT. Her research interests are related to educational technology, computer-assisted language learning and second language acquisition.

Dr. Cheng was a recipient of 2018 Beijing Teaching Achievement Award in Higher Education, first prize.

Liu Dong received a BA degree in English from China Three Gorges University in 2016. Now, she is a graduate student of School of Humanities in Beijing University of Posts and Telecommunications (BUPT). Her major is contrastive linguistics.

From 2017 to 2018, she worked in dean's office of School of Humanities as an office assistant. Her research interests include computer-assisted language learning, second language acquisition and inter-cultural communication.