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Data-Driven E-commerce Techniques and Challenges in the Era of the Fourth Industrial Revolution

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Abstract

The E-commerce industry has a significant role in the national and international economy. E-commerce is vital in the implementation of the fourth industrial revolution, where information and communication technologies are tools in creating digital channels of trade. Understanding e-commerce is essential for it is development. The objective of this paper is to explore the popular techniques and data sources of e-commerce in addition to the current challenges that face e-commerce in the last five years. We used a literature review as a method for this research. According to the literature, sales records are the most popular data source used in the research community for e-commerce analytics, then followed by big data and social media. Besides, detecting and predicting customer behavior is the most used technique in e-commerce research followed by personalized recommendations. Also, we reported the main three challenges that face researchers in the field of e-commerce currently: First, e-commerce Security and privacy is a major concern for consumers and industries. Second, understanding the collected data from e-commerce systems and how to create business value from it efficiently. Third, providing personalized offers with the most appropriate items, still a difficult task.

Keywords: E-commerce, sales records, personalized recommendation, Industrial Revolution 4.0

1. INTRODUCTION

E-commerce is widely known as the buying and selling of products through the internet. But, Niranjanamurthy et al. [1] argued that e-commerce is any transaction that is conducted exclusively over electronic means can be considered e-commerce. In recent years, with the rapid expansion of Internet technology, online shopping has become a popular method for customers to purchase products and services [2]. The Internet has transformed the method of interaction between consumers and businesses [3]. Many customers like to shop on several e-commerce platforms. Customers can shop at any time and from anywhere, and do not have to wait to go shopping, which saves time and effort. Furthermore, the products on e-commerce websites are full of diversities and styles, and consumers can make shopping from home [4].

E-commerce significantly influences firms' performance and facilitate coordination among trading parties. E-commerce is important for both developed and developing countries for assisting their national economies by enabling businesses to become more productive and competitive [2]. One of the main objectives of e-commerce is to detect the purchase habits of consumers. E-commerce will not only increase the traffic and profit but also facilitates and simplifies the process of finding the item of interest more quickly and easily [5]. the fourth industrial revolution means changes in the sectors of the economy that use or produce innovative or new technologies, and where information and communication technologies are tools in creating digital channels of trade in which the trade is performed without business partners ever seeing each other. It took 75 years for the phone to start being used by 50 million people around the world, for the television it was about 13 years, while the Internet took only 4 years [6].

1.1 Related Works

The authors in [7] conducted a review on e-commerce trends and they discussed the devices used, networks, and how companies invest in e-commerce development. Raj Kumar addressed the customers' problems and prospects in the process of e-commerce and how businesses should interact with increasing online traffic in India [8]. The researcher observed that lack of trust is a real obstacle to the acceptance and implementation of e-commerce for customers in Business Industries. And analyze the recent technological trends of security factors in E-commerce industries [9]. Despite the advances of e-commerce in recent years it still requires more investment, especially regarding safety and security, also highlighted the challenge of forecasting how new industries will grow. They discussed the success factors of modern businesses in e-commerce [10]. Premkumar and colleagues assessed the changing factors for e-commerce trends and explored the tools of e-commerce [11].

The objective of this paper was to shed light on e-commerce research for the last five years to discover the hidden trend from the literature. We reported the e-commerce challenges, techniques used for e-commerce solutions, in addition to, data sources trends collected by e-commerce systems. The rest of this paper is organized as follows: section 2 methods, e-commerce categories in section 3 methods, section 4 challenges of e-commerce, data trends are discussed in section 5, followed by techniques trends in section 6, results and discussion in section 7, the conclusion in section 8, and last Future Research in section 9.

2. METHODS

2.1. Data Collection

For this research, we collected secondary data of the existing literature of e-commerce for the last five years. We searched the popular publishers. We classified the literature according to the technique used and the data source used and content analysis was done. The purpose of this literature survey was to discover the trends

of e-commerce research directions and the challenges facing the research community and the industry.

2.2. E-Commerce Categories

E-commerce is classified into three main categories: business to business or B2B such as (Oracle), business to consumer or B2C (Flipcart), and consumer to consumer or C2C. In this method, one individual sells services or products to another individual (citizen-to-citizen) directly using electronic platforms and the most popular example is (eBay). Consumers face threats concerning money, quality, supply time, and information security [12]. Business-to-consumer (B2C) analysis is more advanced compared to Business-to-business (B2B) analysis. B2C and B2B markets often have different Features, and this is revealed in the development of data policies and platforms. Internet and smartphones have accelerated the development of global business-to-customer (B2C) e-commerce [13]. Detail e-commerce main categories shown in Figure 1.

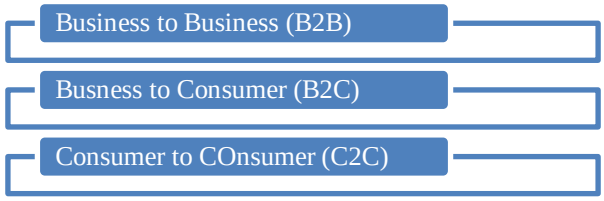

Figure 1. E-commerce main categories.

E-commerce features differ from traditional commerce. E-commerce requires the availability of different regulatory and legislative rules. Globalization is the ability to access e-commerce services from anywhere in the world [14]. E-commerce improves customer service quality, facilitates marketing through the internet, and provides a more secure environment to exchange products and services [1]. In addition to, reducing operational costs.

2.3. Challenges of E-commerce

The analysis and compatibility of e-commerce websites have become more complicated [15]. Understanding the collected data from E-commerce activities and how to create business value from it; is the central challenge of many businesses currently. To what degree the industries would be able to analyze the data, and recommend products and services that meet its consumers' desires [16]. D. Chen et al. Explored the effective methods for understanding customer voices [17]. Identifying users' behavior and interest is necessary to adjust e-commerce systems to meet customers' needs [18]. Nan et al. reported the importance of links structure for recommendations to locate relevant items especially for new users [19]. Customers can get a long list of presented items to select within e-commerce websites and among many websites [20]. Facilitating the process by limiting the choices with a personalized product, that will improve the purchases. However,

selecting the most appropriate items is a difficult task [21]. Classifying consumers' preferences in groups is a basic challenge in organizing e-commerce websites to meet consumers' requirements [22].

However, only 29 % of e-commerce visitors turn their search into a purchase, due to security and usability problems [23]. E-commerce security and privacy is a major concern for consumers and industries as well with the increase of identity theft and impersonation, and any concern for consumers must be considered as the main obstacle for the e-commerce industry. Security from a technical perspective is another concern associated with e-commerce websites especially for online transactions [24]. Y. Wang et al. Reported the customer's hesitation from online shopping because of security and privacy issues, e-commerce websites do not provide them with the same sense of security satisfaction compared to traditional shopping [25].

3. RESULT AND DISCUSSION

3.1. E-commerce Data Trends

Due to the increase and spread of the Internet in the last three decades, the world became open and connected, and data existed in static format (where databases were the main data sources). That is produced from customers' transaction data, is the information documented from regular transactions of customers, in which a transaction record contains a set of products bought by a customer in one basket [26]. which include such as bookings, purchases, payments. This reality required applications to use other data sources more adaptable than datasets (known as data streams) is transmitted at high rates [27]. C. P. Holland and colleagues, used consumer clickstream data, as an important type of big data [28]. Log data contains a series of messages in time-sequence that describe activities happening within the e-commerce system like user navigation, item reviews, items selected, and time spent on the website. Generally, data analysis tools process e-commerce server logs to extract the sequences of user browsing into events.

Log data can be a rich source for analysis and understanding of user behavior. Log analysis is the process of interpreting these messages to gain insights [29]. Authors in paper [30] used an online review system to encourage customers to post their opinions and preferences, and that data proved to help in decision making for production [31], [32]. They used customer implicit feedback data to make a personalized recommendation. Table 1 shows the e-commerce data sources and their trends in the period (2016-2020).

Table 1. E-commerce Data Source

Data Source	Trend
Stream Data	[27], [14], [33], [34]
Big Data	[35], [28], [36], [37], [38], [39]
Sales Records	[40], [30], [41], [26], [42], [43], [44], [21], [22]
Logs Files	[18], [45], [38], [40]
Social Media	[46], [47], [48], [49], [50], [51]

Table 1 above presents the most popular e-commerce data sources used by researchers and industries.

3.1 Data Streams are defined as an infinite data flow, where data are communicated at high rates, imposing the impracticality of storing them for off-line analysis. Processing time and reducing memory usage for data streams are currently a hot research topic because knowledge discovery depends on them. Also, data streams need specially designed algorithms to address these matters [21].

3.2 Big Data researchers reported many definitions, but they all agree on two ideas: data analysis and storage which indicates a large volume of data. Hurtado in [35] the key challenge is to ask the right business questions. T. Boone et al. [36] argued that what data must be stored and for how long? Big data have a wide range of applications with a higher prediction accuracy to provide answers to business questions.

3.3 Sales Records are the data collected from customers about sales transactions. Sales data are stored in the form of electronic records. Transaction data are completed transactions and payment information within tables

3.4 Logs Files are used by data analysis tools to extract the sequences of customer browsing events. These data usually consist of a summary of what occurred during the consumer's navigation [18].

3.5 Social Media is a common space for individuals to express their opinions about various subjects including services, purchases, and brands. They also can use and share their life events. Social network data could help to identify the expected customer, recommend similar products to others with the same interests. Social data enables companies to understand and provide customers with more personalized recommendations [16].

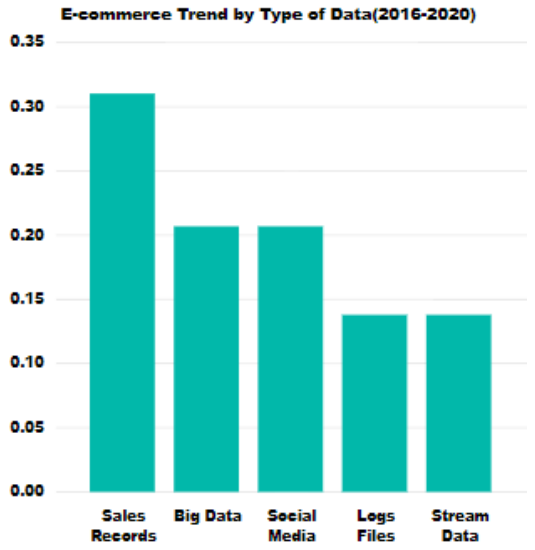

Figure 2. Trends of e-commerce data sources.

From the Figure 2 it is we can notice that the trends of e-commerce data. Sales records are the most data used in e-commerce research and applications with 31 percent then followed by big data and social media with about 21 percent both.

3.2. E-Commerce Techniques Trends

Table 2 shows the e-commerce techniques and their trends from (2016-2020).

Table 2. E-commerce techniques and trends

Technique	Trend
Customer behavior	[18], [41], [5], [36], [45], [43], [52], [40], [53], [34]
Personalized Recommendation	[44], [5], [21], [54], [48], [37], [55], [46],
Sentiment Analysis	[30], [31], [56], [49], [50]
Customer Satisfaction	[57], [58]
Customer segmentation	[18], [59],

Table 2 shows the most popular e-commerce techniques used by researchers and industries.

1) Customer behavior is the process of tracking users on the e-commerce website during a session, can be of great interest to discover more hidden behavioral patterns. Behavioral analysis help to understand different types of users' actions and ways clients use the website [18].
2) Personalization technique is gaining popularity among researchers and professionals, personalization is the offering of personalized services and products to customers, it has become one of the hot topics for successful businesses in this competitive environment [44]. Personalization has a significant role in improving user experience and retains customer loyalty [5].
3) Sentiment Analysis is collecting customer reviews for service or product or and analyzing those reviews in terms of using sentiment analysis techniques [60]. Research works are carried out frequently on sentiment analysis. But they are mainly concentrating on public sentiments. They had not focused on reporting causes leading to sentiment differences. The process of classifying a piece of text (reflects opinions) as is positive, negative, or neutral is sentiment technique [49].
4) Customer Satisfaction is a consumer opinion about the product or service. It helps to sustain a strong relationship with the customer; also, customer satisfaction is a primary objective for any successful business in this new competitive environment [24]. Marketing intelligence has been used widely to assess customer satisfaction or dissatisfaction. It can be achieved through analyzing the company's internal and external environments and the related with the customer and the competitors and then using the discovered information to support decisions [50].
5) Customer Segmentation is the process of dividing customers into a specific number of groups. Segmentation is a very significant technique especially, for retail businesses, because it is usually the initial process for customer behavior analysis. Customer clustering is based on the collected data from customer transactions [26].

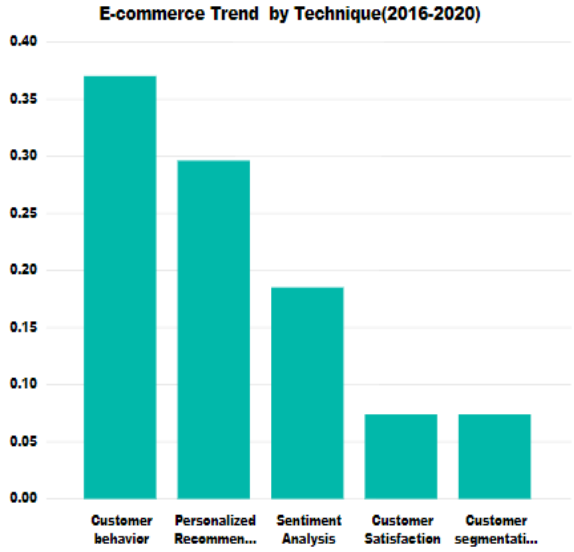

Figure 3. Trends of e-commerce techniques (2016-2020).

According to figure 3, customer behavior is the most widespread technique used by the e-commerce research community with 37 percent followed by personalized recommendations with about 29 percent. But, customer satisfaction and segmentation are the least techniques used with about seven percent for both.

3.3. Discussion

We surveyed e-commerce literature for the last five years. It appears that sales records are the most popular data source used among the research community, with about 31 percent then followed by big data and social media with about 21 percent for both. Also, customer behavior is the most popular technique used by e-commerce research with about 37 percent followed by personalized recommendations with about 29 percent. We reported the main three challenges that face researchers currently: First, e-commerce Security and privacy is a major concern for consumers and industries. Second, we need to understand the collected data from e-commerce databases, and the right methods to create business value from it efficiently. Last, providing personalized offers with the most appropriate items.

This survey provides unique information about the current techniques and challenges that facing e-commerce as research filed as well as industry and their trends in e-commerce. This work offers guidelines for authors about the challenges of e-commerce to be addressed in future works. Also, we have introduced the most used techniques for solving e-commerce problems.

4. CONCLUSION

In this paper, we surveyed the literature of e-commerce to enable researchers to understand the current trends of e-commerce data sources and techniques used in research. From figure 1 big data and social media are increasingly getting attention by researchers. Furthermore, discovering the current challenges in the field of e-commerce and that highlighted the advantage to redirect the research to address them. Customer behavior reflects the intention of customer

5. FUTURE WORK

This work focused on the current challenges which will turn into future topics for research. More data is coming from social media platforms; it is a rich source that may enable us to understand customer behavior more effectively. Businesses need to develop methods for a personalized recommendation. Also, more work should be directed to e-commerce security and privacy to gain customers' confidence.

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