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Research Article

Application of Big Data Analytics on Bhinneka.com E-Commerce for User Behavior Prediction

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Abstract: This study examines the application of big data analytics on Bhinneka.com, a leading e-commerce platform in Indonesia, to tackle the increasing in complexity of online user behavior in a swiftly changing digital environment. The primary issue is too challenges in evaluating extensive, unstructured, and heterogeneous user data, which obstructs personalization, marketing efficacy, and operational decision-making. The study seeks to assess the efficacy of big data instruments, specifically Artificial Intelligence Recommendation (AIRec) and Customer Data Platform (CDP), in improving user behavior forecasting. Service customization, and data-informed strategies. This study utilizes a qualitative case study methodology, including literature review and platform observation, to synthesis the many forms of big data analytics (descriptive, diagnostic, predictive, and prescriptive) and their implementation at Bhinneka.com. Significant findings indicate that the integration of AIRec and CDP has augmented the platform's capacity to predict consumer preferences, improve marketing accuracy, and optimize logistics. However, obstacles stay the same, such as disjointed data systems, data quality concerns, and internal opposition to embracing a data-driven culture. The study suggests that although big data analytics substantially enhances Bhinneka.com's digital competitiveness, ongoing investment in data infrastructure and organizational competence is crucial to fully harness its potential and preserve a competitive advantage in Indonesia's e-commerce market.

Keywords: Bhinneka.com; Big Data Analytics; E-Commerce; User Behaviour.

1. Introduction

The development of digital technology has brought about major changes in the lifestyle of people today. More and more people are using the internet in their daily lives- is one of the most prominent changes. The internet has evolved from just a communication tool to an essential component of the country's social, educational, work, and economic life. With internet usage increasing along with the ease of access through mobile devices, today's internet users come from all walks of life and ages. In Indonesia the internet has been in almost every mobile phone and people are also very easy to surf the virtual world in social networking sites [1]. This trend also shows the tendency of modern society to depend on digital technology to fulfill their various needs such as shopping, ordering food, and getting medical care [2]. This shows the increasing dependence of people on digital technology, not only in big cities but also in small areas. This happens due to increased digital literacy and easy access to technological devices.

Based on these trends, it can be concluded that most internet users prefer to conduct online shopping transactions through internet providers rather than having to conduct conventional buying and selling transactions, which bring together sellers and buyers at the same time and place. Consumers consider convenience when making online transactions because they tend to save more time and money due to the free shipping feature. Conventional or traditional stores have product limitations and much higher selling costs than online stores [3]. So this will make it easier for customers to use the internet for their

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sales. There is a physical evidence of the quality of the product or service and prices that tend to be more expensive and difficult to negotiate which is the reason why conventional stores are still designed to exist [4]. In the research by Mahendra (2022), discussing one example of a digital marketing strategy that uses the internet through e-commerxe to increase sales of Etawa goat milk products by SMEs in Lumajang [5].In this article it can be seen that the application of digital technology in marketing SMEs has a good impact and many have finally used the internet output to provide their services. This can be seen from year-to-year data on the number of internet users:

Table 1. APJII, Ministry of Communication and Information, 2024.

No	Year	Number of Internat Users (Million)
1	2020	196.71
2	2021	210.03
3	2022	210.03
4	2023	215.63
5	2024	221.56

According to a report from the Indonesian Internet Service Providers, the number of people in Indonesia who use the internet has reached more than 221 million people, and most of them are actively conducting online transactions [6]. This is in line with other research which states that digitization increases efficiency and democratizes access to various services that were previously geographically and financially limited [7]. With this extraordinary number of internet users, there will be great opportunities for e-commerce players, one of which is businesses that use the Bhinneka.com platform. Bhinneka.com has a direct purchase facility through the website but can now also be downloaded through the playstore for android users. This e-commerce offers a variety of attractive features, including clear product information, an attractive web display using blue colors, product reviews made by previous customers, promo prices of products placed, and free shipping offers. The payment also uses the same methods as those used by other e-commerce, such as transfer, installment, instalment, and even online bank. Bhinneka.com is also an authorized agent of well-known vendors such as Microsoft, Apple, IBM, and others.

Bhinneka started in 1993 as an e-commerce pioneer founded by Hendrik Tio. Bhinneka.com is a B2B e-commerce that builds a business ecosystem that makes it easier for governments and companies to operate [8]. Its tagline "Indonesia's #1 Webstore" is explicitly meant to be a player on its home turf and possibly the best e-commerce choice for Indonesians. They have helped millions of customers in managing their business through three main categories of excellence that meet the needs of various industries and business scales, namely the IT, MRO (Maintenance, Repair, Operation), Solution and Services categories via the internet or e-commerce and remain conventional by opening offline stores. This is supported by some research where many consumers still want to see real products first rather than directly using e-commerce for shopping [9].

As a pioneer e-commerce site in Indonesia, Bhinneka.com faces many problems in predicting user behavior. These include problems with cross-channel data integration, sub-optimal quality and completeness of user data, and problems with personalization as the site serves both B2C and B2B customers simultaneously. Since static predictive models are not updated in real- time, rapid changes in consumer preferences are another problem. In addition, increasing demands for laws protecting personal data, privacy issues, and data security are also concerns [10]. Bhinneka.com must be able to adapt to more limited resources when competing with e-commerce giants. To overcome this, this study aims to analyze how the implementation of big data analytics through the integration of Customer Data Platform (CDP) and Aritifical Intelligence (AI) helps Bhinneka.com overcome those challenges.

Many studies have looked at how big data analytics might help e-commerce platforms improve, particularly in terms of forecasting user behavior and providing better services. However, there is still limited study on how big data is used in Indonesian e-commerce platforms that serve both businesses and consumers. This study fills that gap bu demonstrating how Bhinneka.com employs big data tools to address various user needs and improve their online offerings.

2. Literature Review

2.1. User Behavior

Understanding user behavior is a key topic in e-commerce research, especially when digital platforms create massive volumes of user interaction data. User behavior refers to the patterns of behaviors that people conduct when navigating digital environments, such as browsing, clicking, searching, adding to cart, and making transactions. According to Pradana and Luxianto (2020), evaluating this behavior with big data techniques such as clustering and association rule minging enables businesses to discover hidden patterns and preferences that can be utilized to personalize services and improve user experience [11]. Their findings showed that behavioral data may be efficiently classified to influence product recommendations, marketing campaigns, and inventory planning. The real-time data analytics enables businesses to respond proactively to client needs and quickly adjust tactics in response to evolving behavioral trends.

Recent article explores the use of semantic similarity knowledge recognition algorithms for analyzing e-commerce behavior data [12]. This approach enables precise measurement of semantic similarities between services and inquiries, allowing for more effective analysis of behavioral data based on user preferences and semantic compatibility. These information eneble e-commerce platforms to tailor recommendations and marketing strategies, ultimately increasing user engagement and conversion rates.

However, the interpretation of user behavior has limitations. Predictive analytics might be useful for people with complete digital footprints, its efficiency decreases dramatically for anonymous or first-time users [13]. Their findings revealed that more than half of online sessions are anonymous, resulting in inadequate data that reduces the predicted accuracy of behavioral models. Furthermore, ethical concerns such as user privacy and permission must be considered when analyzing behavioral data, particularly when personal identifiers are included. These problems indicate that, while big data analytics offers significant prospects for understanding user behavior, its success is dependent on data quality, user identity, and ethical data handling.

2.2 Big Data Analytics

Big Data itself can be defined as a collection of data that is very large and diverse because it has a large size and can grow over time. The type of analysis that can be done with the data, such as data analysis or predictive analysis, determines the definition of Big Data itself [9]. Big data, created by leading internet companies, emerged as a solution that allows people to access large databases in real-time. There are three main characteristics that big data has known as the three V's: Volume, refers to data with a large size as a determinant of whether the data can be categorized as big data or not. Velocity, refers to how quickly data is generated, processed, and analyzed to meet specific needs. Variety, refers to the various types of data that exist in big data in the form of structured, semi-structured, and unstructured [14].

It is difficult to ascertain big data because its sheer size in the context of data volume differs greatly among various industries. So there is a need for big data analytics, which is a systematic process of collecting and analyzing data to reveal trends and patterns in large amounts of raw data. One of the study's examples underlines the importance of Business Intelligence (BI) to gather data from a variety of sources. Its function is to use previously collected data in making more accurate decisions [15]. It also emphasizes how historical data predict future outcomes and prescribe actionable strategies [16]. Here are the types of big data analytics :

a. Diagnostic analysis, helps to identify the cause of problems and find patterns of anomalies
b. Descriptive analysis, helps provide an overview of current or past conditions
c. Predictive analysis, helps predictive planning and decision-making based on predictive data
d. Perspective analysis, helps to provide the best advice based on the data and simulations that have been carried out. [17]

2.3 E-Commerce

E-Commerce is the sale and purchase of goods, services, or information over a computer network (internet) [18]. As sellers and buyers interact online, business operating costs can be reduced, and productivity and delivery can be increased. It can boost home economies through deregulation of local services and faster integration with international manufacturing industries [19]. Global trade will not be the only topic of discussion and negotiation as it will also include oversight of countries' domestic policies such as in telecommunications, finance, and distribution. So that later e-commerce will unite domestic trade with international trade. E-commerce has five types:

a. Business-to-Business (B2B), involves a transaction between two business entities where the company will be the seller of products or services to another company, rather than directly to consumers. An example would be an electronics distributor selling components to an assembly plant
b. Business-to-Consumer (B2C), involves the company being the seller of the product or service directly to the end consumer. For example, Netflix sells streaming services directly to customers
c. Business-to-Government (B2G), involves private companies providing products or services to government agencies through authorized platforms. An example is the procurement of goods through the e-procurement system of the Government Goods and Services Policy Agency (LPP)
d. Consumer-to-Consumer (C2C), involves transactions between individual consumers. For example, transactions through Tokopedia or Shopee by individual sellers
e. Mobile Commerce (M-Commerce), involves all forms of e-commerce transactions conducted through mobile devices (smartphones or tablets) [20].

3. Proposed Method

The type of research used in this research is descriptive qualitative with a case study approach. This method is used to analyze documentation and observation of activities on the Bhinneka.com e-commerce platform to show how the application of big data analytics in the Bhinneka.com operational system is not detailed into numbers or variables. Data taken from existing literature sources, both from journals and articles that have been published, are then summarized into a new literature that can be a guide for readers and future researchers. This is done with a thorough and in-depth search of the types of analysis of big data itself; diagnostic, descriptive, predictive, and perspective analysis. With this method, researchers will gain an in- depth understanding of Bhinneka.com's use of big data analytics by collecting data from real observations.

4. Results and Discussion

4.1. Big Data Analytics in Bhinneka.com's E-Commerce

Bhinneka.com can record a digital footprint capable of generating big data by simply searching for items on it without buying them. They have integrated Artificial Intelligence Recommendation (AIRec) technology to improve user experience through the utilization of big data analytics and machine learning. Furthermore, Bhinneka.com uses this data to offer ads on social media that showcase snippets of items that we have searched for previously on the platform. AIRec has supported more than 1,000 requests per second to learn the long and short-term shopping habits of its users. After seeing these habits, it will generate content recommendations that match the user's interests and increase the click-through rate. This shows that Bhinneka.com uses deep learning on its recommendation engine to provide shopping recommendations that can be tailored to users' needs.

Bhinneka.com caters to B2C by directly selling technology goods such as laptops, smartphones, and office supplies through its website and mobile applications. On the other hand, they also work with government and private institutions for bulk procurement, including through national e-procurement platforms. With this combination of models, Bhinneka.com has a wealth of complex transaction data, which includes retail behaviour and organizational demand patterns. Since each market segment has different behaviour patterns and preferences, this diversity of transaction types creates both challenges and opportunities for applying big data analytics.

In this context, Bhinneka.com optimizes big data to understand market segmentation more accurately. The platform uses descriptive analysis to identify product preferences based on user categories. For example, corporate customers prefer IT products with high specifications, and individual customers prefer promoted products. In addition, Bhinneka.com can create quick campaign strategies, such as personalized email marketing or push notifications, by processing historical data from transactions and user interactions through predictive analytics. This allows Bhinneka.com to estimate the shopping time of a typical customer. In addition, Bhinneka.com enhances its big data analytics capabilities to provide a contextual and responsive shopping experience through analyzing customer interaction data within the m-commerce channel. This will show that Bhinneka.com's digital transformation strategy is centered on combining different types of e-commerce and the use of big data analytics.

4.2. Big Data Analytics in Predicting Bhinneka.com User Behavior

Research shows that big data analytics can significantly improve the prediction of user behavior. By applying machine teaching algorithms to sales transaction data, prediction of product demand can be improved by 20%. Social media sentiment analysis can help predict user behavior and understand customer preferences. Several previous studies have shown that predictions about user preferences and shopping behavior tendencies can be made better by combining transaction data, search history, and social media sentiment. This method not only improves operational efficiency, but also helps formulate policies that are more responsive to changes in the digital market. This analytics method is crucial for platforms like Bhinneka.com to build a data-driven competitive advantage in Indonesia's e-commerce industry.

This finding is in line with Bhinneka.com's strategy, which actively utilizes big data analysis to support data-driven operations and decision-making. By using descriptive analysis methods based on clear market segmentation, Bhinneka.com can discover consumer search trends and the most frequently searched items. In addition, the platform can use diagnostic analysis to evaluate factors that lead to low sales conversion, such as the behavior of users who abandon shopping carts or short visit times. Predictive analytics are used to predict market needs and create more flexible marketing strategies. Meanwhile, perspective analysis helps in making more strategic decisions, such as determining discount schemes for employees and properly organizing logistics based on customer demand. With these methods, Bhinneka.com demonstrates its capacity to focus on predicting the behavior of its users.

4.3. Challenges in Implementing Big Data Analytics at Bhinneka.com

Limitations in system integration and consolidation of data from various sources are the main obstacles in implementing big data analytics at Bhinneka.com. They have a system infrastructure that was built in phases and has not been fully integrated. This makes real-time data collection more difficult and hinders cross-functional analysis, such as knowing if there is a correlation between actual purchase trends and website user behavior. Despite the use of Artificial Intelligence Recommendation (AIRec), unifying data from online channels, social media interactions, customer service, and activities on third-party marketplaces is still a big challenge. The resulting analytics results may be biased or not show the full customer behavior if the data infrastructure is not connected and standardized.

The quality and accuracy of the data collected is another challenge. While the amount of data collected from user interactions is huge, not all data is clean and can be analyzed properly. Bhinneka.com can be challenged with data cleansing, noise filtering, and handling duplicate or missing data that can compromise the accuracy of analytics models. This becomes more complex as user data can come from different types of platforms and devices, such as social media channels, websites, and mobile apps that have different behaviors and data formats. In addition, an updated analytics system is required due to the rapid shift in shopping trends due to large e-commerce promotions and based on the lifestyle of the digital society. If this is not done, the recommendation system may become irrelevant or obsolete in a short period of time, reducing the efficiency of marketing campaigns and the overall user experience.

Human resources and organizational culture are the third challenge. To implement big data analytics, not only advanced technology is required but also digital talent capable of turning data into strategic insights. For Bhinneka.com itself, the shift to a data-driven culture still presents internal challenges. Data-driven decision-making processes can be delayed if there are no data analysts proficient in e-commerce and machine learning. In addition, there

are departments in the company that disagree on how important data is in long-term plans. Therefore, to ensure that the entire company is able to optimally utilize big data analytics, Bhinneka.com must make continuous investments in digital training, recruit data-driven talent, and build cross-team collaboration. If these methods are not utilized, the potential of big data will only create an infrastructure burden rather than provide a competitive advantage.

5. Comparison

The application of big data analytics at Bhinneka.com represents a significant advancement above old and modern Indonesian e-commerce platforms. Unlike platforms that still rely on static data analysis or segmented marketing techniques, Bhinneka.com uses a more integrated systems, AIRec and CDP, which allows for real-time analysis of user activity and dynamic content recommendation. Unlike Tokopedia and Bukalapak, which largely focus on B2C models with generic promotional algorithms, Bhinneka.com uses a hybrid model (B2C and B2B) that necessitates more precise user segmentation and predictive modeling. Bhinneka.com now leads in the use of diagnostic, descriptive, predictive, and prescriptive analytics to address a wide range of client needs.

Internationally, platforms such as Amazon and Alibaba have enhanced AI-driven recommendation engines and consumer data integration. However, Bhinneka.com's strategy, despite its modest infrastructure, represents a big step forward in aligning Indonesian e-commerce with global trends. For example, AIRec's ability to manage over 1,000 user requests per second while learning from both short- and long-term patterns is comparable to machine learning-based customization systems used by worldwide leaders. This comparison highlights Bhinneka.com's ability to bridge the technology gap by strategic deployment of scalable big data analytics, despite confronting constraints in infrastructure and digital talent.

6. Conclusions

This study shows that leveraging big data analytics using AIRec and the CDP has enabled Bhinneka.com better understand and forcast customer behavior, personalize services, and make better marketing and logistics decisions. According to the study, Bhinneka.com uses a variety of big data analytic techniques, inclusing diagnostic, descriptive, predictive, and prescriptive, to support more successful and responsive business strategies. These findings demonstrate that incorporating big data into daily operations can improve efficiency and the overall customer experience.

The analysis also demonstrates that Bhinneka.com's strategy enables them to react effectively to Indonesia's rapidly evolving digital market. Bhinneka.com uses more advanced real-time analytics than other local platforms, which is similar to what global e-commerce companies do. This research provides insights for other Indonesian e-commerce platforms to adopt similar techniques. However, difficulties such as disconnected systems, variable data quality, and a shortage of experienced digital workers persist. Future research should investigate how these technologies directly effect sales and how to mix data from several platforms to improve accuracy and decision-making.

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