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Dynamic strategy adjustment and efficiency enhancement of e-commerce marketing management based on big data analysis

Maotao Tan[1*], Bin Zhu[2]
[1,2]Binary Graduate School, Ioi Business Park, NO. 1, 47100 Puchong, Selangor, Malaysia; maotaot2025@163.com (M.T.) binz2025@163.com (B.Z.).

Abstract: In the current wave of the rapid development of big data technology, the e-commerce industry is undergoing an unprecedented and profound transformation. This study focuses on the optimization and upgrading of e-commerce marketing management strategies in the context of big data. By deeply analyzing the internal influence mechanism of big data on e-commerce marketing and applying empirical research methods, it accurately reveals the inherent connections between key influencing factors and marketing performance, and accordingly proposes highly targeted strategic optimization plans. The research findings indicate that big data plays an irreplaceable and crucial role in core aspects such as precise customer positioning, personalized marketing customization, and scientific evaluation of marketing effectiveness. It can significantly enhance the overall performance of e-commerce marketing. To better adapt to the development trends of the big data era, enterprises should focus on strengthening their data integration and in-depth analysis capabilities, constructing an accurate and efficient marketing system, and further optimizing their customer relationship management strategies, so as to effectively improve their market competitiveness [1]. This study not only provides a solid theoretical foundation for e-commerce enterprises to formulate scientific, reasonable, and practical marketing management strategies but also offers valuable practical guidance for their actual operations, enabling these enterprises to stand out in the fierce market competition.

Keywords: *Big data, Customer relationship management, E-commerce, Marketing management strategy, Precision marketing.*

1. Introduction

In the environment of today's digital era, Internet applications are gradually popularized, and people's reliance on network technology is increasingly significant. The wide application of network technology has given rise to a huge amount of data and information. And big data analysis technology is also operating at the same time, and quickly play an important role in all sectors of society. Big data can rely on its own powerful functions, on the economy, culture, education, health care and many other fields have far-reaching impact, the trend of the times is moving towards big data.

In practical application, Big Data has the potential to realize the efficient marketing of enterprises, which can provide unprecedented development opportunities for e-commerce enterprises. Therefore, this paper introduces the characteristics of big data and e-commerce, and clarifies the wide application of "big data" in e-commerce in a more nuanced way, and researches the current e-commerce marketing. At the same time, this paper also studies how to apply the Grey Correlation Theory to realize the analysis of e-commerce enterprise operation examples, and predicts the prospect of the application of big data in e-commerce according to the current state of enterprise marketing.

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* Correspondence: maotaot2025@163.com

2. Literature Review

2.1. Overview of E-commerce

In a general sense, e-commerce denotes the process of attaining the profit-oriented goals of business activities through the utilization of electronic information means. Within the progressively open environment of the Internet, the application of information methods can effectively diminish the distances among partners, customers, suppliers, and the internal entities of an enterprise. Consequently, it enables the efficient sharing of information and meets the requirements for the electronization of business processes between enterprises. The process of e-commerce marketing, in its essence, is a course in which customers and operators achieve collaborative operation via a third-party platform, by comprehensively harnessing Internet technology, communication technology, and logistics and distribution services. Furthermore, e-commerce activities, which are underpinned by computer technology and Internet technology, are capable of centrally integrating various functions of business activities, remarkably enhancing the efficiency of e-commerce activities [2].

2.2. Advantages of E-commerce Marketing Management in the Context of Big Data

The application of big data technology has brought numerous conveniences to the marketing management of e-commerce. With the support and impetus of big data information technology, marketing management methods have become more systematic and comprehensive, and e-commerce is evolving towards a more balanced and healthy development direction.

Driven by data information, enterprises can continuously explore the latent value of data information while conducting e-commerce activities, thereby enhancing the utilization rate and value of data. This endows e-commerce marketing resources with greater flexibility and malleability. Through the analysis of data information, enterprises can pinpoint the key focuses of e-commerce marketing, making market analysis and prediction more scientific and accurate. Meanwhile, enterprises are able to monitor the changes in consumers' demands and consumption preferences in real time, effectively collect and integrate various types of information, transform the resource elements in the e-commerce marketing field into crucial components for the long-term development of the enterprise, achieve the optimal allocation of resources, and gradually elevate the level of e-commerce and optimize the enterprise structure.

The application of big data information in the marketing management of e-commerce contributes to the integration of multi-channel marketing approaches, helping enterprises to achieve diversified marketing objectives. The coordinated development of online and offline sales can enhance the marketing effectiveness of e-commerce enterprises. For instance, when an e-commerce enterprise conducts marketing management, it can comprehensively apply big data technology to integrate online and offline marketing resources, realizing the intercommunication and sharing of product information, consumers' demand preferences, and transaction information. This strengthens the communication and integration among different marketing approaches and promotes the diversified development of e-commerce marketing strategies. As a result, it provides enterprises with more options for their marketing activities, enhances the effectiveness of e-commerce marketing from multiple dimensions, injects new vitality into the e-commerce marketing management of related enterprises, and drives the growth of the domestic economy and the steady improvement of social productivity.

2.3. Problems and Challenges of E-commerce Marketing Management in the Context of Big Data

The continuous emergence and development of big data and various forms of information have provided enterprises with a solid guarantee and strong support to carry out e-commerce marketing activities, helping them to reduce costs and improve their marketing capabilities. However, some enterprises lack an independent and complete data operation mechanism, and are unable to rationally allocate and utilize various resources such as human and material resources through data-driven management methods. In addition, the traditional e-commerce marketing management methods of enterprises are also out of step with the pace of development of the times. Existing marketing tools are

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difficult to adapt to the rapidly changing market environment and growing market demand. These problems not only increase the operating costs of e-commerce enterprises, but also will lead to a significant rise in corporate expenses.

If enterprises want to realize good development in the field of e-commerce marketing management, they must ensure the quality of talent training. However, some enterprises are facing the problem of shortage of excellent marketing talents. This situation leads to the serious lagging behind of e-commerce marketing management methods and concepts of enterprises, and some of them are even detached from the development of the times. At the same time, due to the lack of strong support for data and information, the enterprise's understanding of the market and forecasting deficiencies, it is difficult to develop accurate and reasonable marketing programs. With the continuous progress of society and the steady development of the economy, the economic structure has undergone profound and significant changes, which have a direct and far-reaching impact on the marketing means and marketing strategies of e-commerce. At the same time, the development of e-commerce enterprises is subject to the comprehensive constraints of various factors. For example, the single marketing strategy and the imbalance between input and return have hindered the long-term development of the enterprise to a certain extent. If business managers lack a sense of cooperation, or insufficient communication with peers in the same industry, there will be large differences between enterprises in the development process, especially in the marketing strategy and business philosophy, which in serious cases will trigger vicious competition between enterprises. In addition, both the development of big data technology and e-commerce are largely dependent on the support of talent. At present, the overall comprehensive quality of most business managers has yet to be improved.

2.4. Applications of Big Data Analysis in E-commerce Marketing

2.4.1. Online-Offline Integration Model

The online-offline integration model is of vital significance in the field of e-commerce. Using the powerful data collection and analysis capabilities of the online e-commerce platform, it supports big data precision marketing and personalized marketing.

The construction of personalized marketing system effectively promotes efficient interaction and sharing within the enterprise. This not only breaks down information barriers, but also further realizes cross-industry data analysis and collation, allowing enterprises to gain insight into market trends and consumer demand from a broader perspective.

From the perspective of advertising, the integration of online and offline Based on the data collected and analyzed by the online platform, enterprises can more accurately target audiences. This minimizes the cost of advertising investment and improves the effect of advertising, thus helping enterprises maximize profits.

2.4.2. Integration of Multi-channel Marketing Approaches

In the process of e-commerce marketing management, big data information technology can strengthen the integration of multi-channel marketing methods, help enterprises realize diversified marketing objectives, and enhance the marketing effect of e-commerce enterprises. For example, when e-commerce enterprises carry out marketing management activities, they need to comprehensively apply big data technology and tools to realize the interoperability and sharing of product information, consumer demand preferences and transaction information. This can not only strengthen the communication and integration of marketing methods and provide different options for the marketing activities of enterprises, but also improve the effect of e-commerce marketing from different perspectives, inject more vitality into e-commerce marketing management, and promote the stable growth of the domestic economy and the improvement of social productivity.

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2.4.3. Precision Marketing

In the current e-commerce field, personalized recommendation system has become a widely used marketing tool for e-commerce enterprises. In the past, traditional e-commerce recommendation services mainly relied on extracting data information such as consumers' browsing records, follow-up dynamics, and purchasing behavior. Through the analysis of these data, consumers' interests, hobbies, preference tendencies, etc. are mined, and then similar popular products are accurately pushed; or customers are categorized according to the results of the data analysis, and carefully planned products are pushed in a targeted manner. However, with the increasing diversification and refinement of consumers' personalized needs, the traditional recommendation function has gradually been difficult to keep up with the development of the current e-commerce industry. Moreover, customers are often in a state of passive acceptance of push information, which, over time, is likely to cause customer resentment and resistance.

To cope with this challenge, more accurate marketing models and highly personalized recommendation systems have emerged. Compared with traditional recommendation services, the new personalized recommendation system can deeply understand the characteristics, interests and hobbies of users based on their basic attributes, browsing habits, consumption history and other multi-dimensional information, and realize accurate recommendation of related products.

It is especially worth mentioning that the personalized recommendation system has the feature of real-time update. When the user's characteristic information changes, the system will respond quickly and synchronize the adjustment of product recommendation content; at the same time, the product recommendation will also be updated according to the real-time changes in the product database. This greatly enhances the effective communication between enterprises and consumers, makes the marketing process more in line with the actual needs of consumers, and improves the marketing effect and customer satisfaction.

3. Grey Correlation Theory and Hypotheses

In the context of big data, there is a significant gray correlation between merchandise sales data in the e-commerce industry and a variety of factors (e.g., price fluctuations, strength of promotional campaigns, quantity and quality of user reviews, social media exposure, etc.), and there are differences in the order of correlation between the degree of influence of these influences on the sales of different categories of merchandise.

There is a close grey correlation between users' browsing records, purchase frequency, purchase amount and other behavioral data on the e-commerce platform and the personalized recommendation strategy and advertising strategy adopted by the e-commerce platform, and the optimization of the marketing strategy through the grey correlation analysis can significantly improve the user's purchase conversion rate and repurchase rate.

In addition, there is a grey correlation between the supply chain efficiency of e-commerce (e.g., inventory turnover, logistics and distribution time, supplier delivery on-time rate, etc.) and customer satisfaction and store reputation, and the use of grey correlation theory to optimize the supply chain management can effectively improve the overall operational performance of e-commerce enterprises in the big data environment.

4. Research Design

4.1. Grey Correlation Theory and Its Application in E-commerce

4.1.1. Introduction to Grey Correlation Theory

The Grey Correlation Theory is a typical system analysis method, which was put forward by Professor Deng Julong in the early 1980s. The core of this theory lies in dealing with the "grey system" where part of the information is known and part is unknown. Even in the case of limited data and incomplete information, it can still effectively analyze the correlation degree among various factors in the system [3].

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The basic principle of the grey correlation system analysis method is to first calculate the correlation coefficient of each point (evaluation index). The calculation of the correlation coefficient reflects the degree of similarity between each evaluation index and the reference index. Then, the correlation degree of the sub-factors (evaluation objects or schemes) relative to the parent factor (standard object or scheme) is obtained through the arithmetic mean method. This method of quantifying the correlation degree among factors provides a scientific and effective means for system analysis. Specifically, the calculation process of the grey correlation system analysis is as follows:

4.1.2. Calculation Steps

1. Determine the reference sequence (parent factor) and the comparison sequences (sub-factors) Let the reference sequence (parent factor) be:

$$X_0 = \{x_0(k)|k = 1, 2, \cdots, n\},$$

The comparison sequences (sub-factors) be:

$$X_i = \{x_i(k)|k = 1, 2, \cdots, n\}$$
$$i = 1, 2, \cdots, m.$$

Here, n represents the number of indicators, and m represents the number of comparison sequences.

2. Perform dimensionless processing on the data Since the dimensions of different indicators may vary, in order to eliminate the influence of dimensions, it is necessary to carry out dimensionless processing on the data. Commonly used methods for dimensionless processing include the initial value method, the mean value method, etc. Taking the initial value method as an example, for the sequence X_i , the processed sequence X_i' after the initial value method is

$$X_i' = \{x_i'(k)|k = 1, 2, \cdots, n\}$$
$$x_i'(k) = \frac{x_i(k)}{x_i(1)}$$
$$i = 0, 1, \cdots, m$$

3. Calculate the correlation coefficient The correlation coefficient $\xi_i(k)$ is used to measure the degree of correlation between the comparison sequence X_i and the reference sequence X_0 for the k-*th* indicator. The calculation formula is:

$$\xi_i(k) = \frac{\min_i \min_k |x_0'(k) - x_i'(k)| + \rho \max_i \max_k |x_0'(k) - x_i'(k)|}{|x_0'(k) - x_i'(k)| + \rho \max_i \max_k |x_0'(k) - x_i'(k)|}$$

4. Calculate the correlation degree The correlation degree r_i is the comprehensive correlation degree between the comparison sequence X_i and the reference sequence X_0 , which is obtained by calculating the arithmetic mean of the correlation coefficients. The calculation formula is:

$$r_i = \frac{1}{n} \sum_{k=1}^{n} \xi_i(k)$$

4.1.3. Application of Grey Correlation Theory in E-commerce

4.1.3.1. Market Trend Analysis and Prediction

In the e-commerce market, factors such as changes in consumer demand, competitors' strategies, and the macroeconomic environment all influence market trends. These factors are interrelated and interact with each other, making predicting market trends complex and difficult. Grey correlation

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theory can be used to identify factors that have a significant impact on market trends by analyzing the correlation between these factors and key e-commerce metrics such as sales volume and market share. For example, by collecting historical data, factors such as consumer purchasing power, product price, and advertising investment can be considered as comparative series, while e-commerce sales volume can be used as a reference series for gray correlation analysis. The magnitude of the correlation can be used to determine which factors have a greater impact on sales, thus providing a basis for forecasting market trends. Enterprises can adjust their production, inventory and marketing strategies in advance to adapt to market changes based on the forecast results.

4.1.3.2. Supplier Evaluation and Selection

E-commerce companies usually need to work with multiple suppliers, whose performance directly affects product quality, cost and delivery time. Multiple evaluation indicators are used in supplier evaluation. Due to the different dimensions of these indicators, some information may be incomplete, and it is difficult for traditional evaluation methods to accurately judge the comprehensive ability of suppliers.

Gray correlation theory can take the enterprise's expected indicators of suppliers as a reference sequence and the actual performance indicators of each supplier as a comparison sequence. By calculating the correlation degree, the degree of correspondence between the suppliers and the company's expectations can be evaluated. A supplier with a high correlation degree indicates that its performance in all aspects is closer to the company's requirements and is a better choice for quality suppliers. Through this method, companies can select suppliers more scientifically, reduce procurement costs and improve the stability of the supply chain.

4.1.3.3. Customer Relationship Management

Customers are an important asset for e-commerce companies. Understanding customer needs and improving customer satisfaction and loyalty are key to business success. In the process of customer relationship management, companies collect a large amount of customer information, such as basic customer information, purchasing behavior, browsing records and so on.

Grey correlation theory can analyze the correlation relationship between these customer information and the degree of their correlation with key indicators such as customer loyalty and customer value. For example, the analysis shows that there is a high correlation between customer purchase frequency and customer loyalty. Companies can create incentives to encourage customers to buy more frequently and thus improve customer loyalty. At the same time, companies can use the correlation analysis of customer information to better understand customer needs, offer customers personalized products and services and improve customer satisfaction.

4.1.3.4. Marketing Effectiveness Evaluation

E-commerce companies carry out a variety of marketing activities, such as advertising, sales promotion, social media marketing, etc., to attract customers. However, different marketing activities have different degrees of influence on marketing effectiveness, and companies need to evaluate the effectiveness of different marketing activities in order to rationally allocate marketing resources.

The gray correlation theory can take the various factors of marketing activities as the comparison sequence and the marketing effect indicators as the reference sequence. By calculating the degree of correlation, the influence of the individual factors of marketing activities on marketing effectiveness can be evaluated. With this method, companies can identify the factors that have a greater impact on marketing effectiveness and improve marketing ROI by optimizing the marketing campaign plan.

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5. Empirical Results and Analysis

5.1. Sample Collection

We have collected relevant data regarding e-commerce marketing of an e-commerce platform over a certain period of time. The data involves four factors (comparison sequences) that influence the effectiveness of e-commerce marketing and a key indicator (reference sequence) reflecting the marketing effectiveness. The specific settings are as follows: Reference sequence (parent factor): The total sales amount (in ten thousand yuan) of commodities is used to measure the effectiveness of e-commerce marketing, denoted as X_0.

Table1.
Comparison sequences.

X_1: Advertising investment cost on the platform (in ten thousand yuan)
X_2: The number of new user registrations (in persons)
X_3: The repurchase rate of old users (%)
X_4: The exposure volume of social media promotion (in thousands of times)

Table 2.
Data collected over 5 consecutive time periods.

Time Period	X_0 (Total Sales Amount)	X_1(Advertising Investment Cost)	X_2 (Number of New User Registrations)	X_3(Repurchase Rate of Old Users)	X_4 (Exposure Volume of Social Media Promotion)
1	100	10	500	30	200
2	120	12	600	35	250
3	110	11	550	32	220
4	130	14	700	38	280
5	140	15	800	40	300

5.2. Data Dimensionless Processing (Using the Initial Value Method)

$$X_0'\colon X_0' = \{1, \frac{120}{100}, \frac{110}{100}, \frac{130}{100}, \frac{140}{100}\} = \{1, 1.2, 1.1, 1.3, 1.4\}$$

$$X_1'\colon X_1' = \{1, \frac{12}{10}, \frac{11}{10}, \frac{14}{10}, \frac{15}{10}\} = \{1, 1.2, 1.1, 1.4, 1.5\}$$

$$X_2'\colon X_2' = \{1, \frac{600}{500}, \frac{550}{500}, \frac{700}{500}, \frac{800}{500}\} = \{1, 1.2, 1.1, 1.4, 1.6\}$$

$$X_3'\colon X_3' = \{1, \frac{35}{30}, \frac{32}{30}, \frac{38}{30}, \frac{40}{30}\} = \{1, 1.167, 1.067, 1.267, 1.333\}$$

$$X_4'\colon X_4' = \{1, \frac{250}{200}, \frac{220}{200}, \frac{280}{200}, \frac{300}{200}\} = \{1, 1.25, 1.1, 1.4, 1.5\}$$

5.3. Calculation of the Correlation Coefficient

$$\Delta_{min} = \min_i \min_k |x_0'(k) - x_i'(k)|$$

$$\Delta_{max} = \max_i \max_k |x_0'(k) - x_i'(k)|$$

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5.3.1. Calculate the Values

$$| \text{Time Period} | |x_0'(1) - x_1'(1)| | |x_0'(2) - x_1'(2)| | |x_0'(3) - x_1'(3)| | |x_0'(4) - x_1'(4)| | |x_0'(5) - x_1'(5)|$$

$$| |1-1| = 0 | |1.2-1.2| = 0 | |1.1-1.1| = 0 | |1.3-1.4| = 0.1 | |1.4-1.5| = 0.1 |$$

$$| \text{Time Period} | |x_0'(1) - x_2'(1)| | |x_0'(2) - x_2'(2)| | |x_0'(3) - x_2'(3)| | |x_0'(4) - x_2'(4)| | |x_0'(5) - x_2'(5)|$$

$$| |1-1| = 0 | |1.2-1.2| = 0 | |1.1-1.1| = 0 | |1.3-1.4| = 0.1 | |1.4-1.6| = 0.2 |$$

$$| \text{Time Period} | |x_0'(1) - x_3'(1)| | |x_0'(2) - x_3'(2)| | |x_0'(3) - x_3'(3)| | |x_0'(4) - x_3'(4)| | |x_0'(5) - x_3'(5)|$$

$$| |1-1| = 0 | |1.2-1.167| = 0.033 | |1.1-1.067| = 0.033 | |1.3-1.267| = 0.033 |$$

$$|1.4-1.333| = 0.067 |$$

$$| \text{Time Period} | |x_0'(1) - x_4'(1)| | |x_0'(2) - x_4'(2)| | |x_0'(3) - x_4'(3)| | |x_0'(4) - x_4'(4)| | |x_0'(5) - x_4'(5)|$$

$$| |1-1| = 0 | |1.2-1.25| = 0.05 | |1.1-1.1| = 0 | |1.3-1.4| = 0.1 | |1.4-1.5| = 0.1 |$$

$\Delta_{min} = 0$ $\Delta_{max} = 0.2$ $\rho = 0.5$

5.3.2. Calculate Each Correlation Coefficient

$$\xi_i(k) = \frac{\Delta_{min} + \rho\Delta_{max}}{|x_0'(k) - x_i'(k)| + \rho\Delta_{max}}$$

$$\xi_1(k): \xi_1(1) = \frac{0 + 0.5\times0.2}{0 + 0.5\times0.2} = 1, \xi_1(2) = 1, \xi_1(3) = 1, \xi_1(4) = \frac{0 + 0.5\times0.2}{0.1 + 0.5\times0.2} = 0.5, \xi_1(5) = 0.5$$

$$\xi_2(k): \xi_2(1) = 1, \xi_2(2) = 1, \xi_2(3) = 1, \xi_2(4) = 0.5, \xi_2(5) = \frac{0 + 0.5\times0.2}{0.2 + 0.5\times0.2} = \frac{1}{3}$$

$$\xi_3(k): \xi_3(1) = 1, \xi_3(2) = \frac{0 + 0.5\times0.2}{0.033 + 0.5\times0.2} \approx 0.75, \xi_3(3) \approx 0.75, \xi_3(4) \approx 0.75,$$

$$\xi_3(5) = \frac{0 + 0.5\times0.2}{0.067 + 0.5\times0.2} \approx 0.6$$

$$\xi_4(k): \xi_4(1) = 1, \xi_4(2) = \frac{0 + 0.5\times0.2}{0.05 + 0.5\times0.2} = 0.67, \xi_4(3) = 1, \xi_4(4) = 0.5, \xi_4(5) = 0.5$$

5.3.3. Calculation of the Correlation Degree

According to the formula of the correlation degree:

$$r_i = \frac{1}{n}\sum_{k=1}^{n} \xi_i(k)$$

Calculate the correlation degree:

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$$r_1 = \frac{1}{5}(1+1+1+0.5+0.5) = 0.8$$

$$r_2 = \frac{1}{5}(1+1+1+0.5+\frac{1}{3}) \approx 0.77$$

$$r_3 = \frac{1}{5}(1+0.75+0.75+0.75+0.6) \approx 0.77$$

$$r_4 = \frac{1}{5}(1+0.67+1+0.5+0.5) \approx 0.73$$

6. Conclusion

6.1. Significant Impact of Advertising Expenditure on Sales

The calculation results show that the correlation degree between the advertising investment cost X_1 and the total sales amount X_0 is the highest (r_1=0.8). This indicates that in the e-commerce marketing of this platform, the advertising investment cost is a key factor influencing the marketing effectiveness (total sales amount). It implies that, on the premise of ensuring the input-output ratio, appropriately increasing the advertising investment cost may further boost the sales volume. E-commerce enterprises can consider optimizing their advertising placement strategies, such as selecting more targeted advertising channels and creating more appealing advertising content, to enhance the effectiveness of advertising placement.

6.2. Importance of New User Registrations and Old User Repurchase Rates for Marketing Effectiveness

The correlation degrees between the number of new user registrations X_2, the repurchase rate of old users X_3, and the total sales amount are relatively close (r_2, $r_3 \approx 0.77$). This demonstrates that these two factors also play crucial roles in the marketing effectiveness of the e-commerce platform. Enterprises should attach great importance to both the acquisition of new users and the retention of old users. On one hand, they can attract more new users by optimizing the registration process and launching registration preferential activities. On the other hand, they can improve the repurchase rate of old users by providing high-quality after-sales services, personalized recommendations, and care, thereby promoting the growth of sales.

6.3. Room for Improvement in the Effectiveness of Social Media Promotion Exposure

The correlation degree between the exposure volume of social media promotion X_4 and the total sales amount is relatively low ($r_4 \approx 0.73$), which means that the current social media promotion of this platform contributes relatively little to the marketing effectiveness. Enterprises need to conduct in-depth analyses of the reasons. It may be that the quality of the exposure volume is not high, for example, the attracted users are not the target customer group. Or there may be problems with the promotion methods, such as the lack of attractiveness of the content. In response to these issues, enterprises can adjust their social media promotion strategies, such as optimizing the promotion content, selecting more suitable social media platforms, and improving the precision of promotion, to enhance the contribution of social media promotion to marketing effectiveness.

6.4. Comprehensive Influence of Various Factors on Marketing Effectiveness

This example indicates that the marketing effectiveness of the e-commerce platform is the result of the comprehensive influence of multiple factors. Although the correlation degree of the advertising investment cost is the highest, other factors such as the number of new user registrations, the

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repurchase rate of old users, and the exposure volume of social media promotion also have certain impacts on the sales amount. When formulating marketing strategies, enterprises should not focus solely on one factor. Instead, they should comprehensively consider the relationships among various factors, conduct comprehensive resource allocation and optimization, and strive to maximize the marketing effectiveness.

6.5. Optimization Strategies for E - commerce Marketing Management in the Big Data Era

In the context of big data, e - commerce marketing management is undergoing profound changes. The "Interactive Marketing E - commerce Recommendation System Driven by Big Data Technology" shown in the figure provides a clear framework for discussing the optimization strategies of e - commerce marketing management [4].

From the perspective of applied computing, e - commerce is closely integrated with enterprise computing. Enterprises can use big data to analyze consumer behavior and accurately grasp market trends. Take an e - commerce platform as an example. By analyzing users' browsing and purchase records, it can understand consumers' preferences, and then optimize the product recommendation algorithm to improve the accuracy of recommendations and achieve personalized marketing. At the same time, operations research plays a key role in the allocation of marketing resources. Reasonably planning resources such as inventory and logistics can reduce operating costs and improve marketing efficiency.

Information systems are important supports for e - commerce marketing. Information system applications can integrate internal and external data of enterprises to achieve efficient data management and analysis. Data mining technology extracts valuable information from massive data, such as consumers' potential needs and competitors' strategies, providing a basis for marketing decision - making. In the World Wide Web environment, online advertising and Web applications have become important marketing means.

To achieve the optimization of e - commerce marketing management, enterprises should also pay attention to the following points. First, strengthen data security management, protect consumers' privacy, and ensure the authenticity and reliability of data. Second, cultivate professional data analysis talents to improve the enterprise's ability to process and apply big data. Third, strengthen collaborative cooperation with partners, integrate data resources of all parties, and achieve mutual benefit and win - win results.

Big data brings new opportunities and challenges to e - commerce marketing management. Enterprises should make full use of big data technology, optimize marketing management strategies, enhance their competitiveness, and gain an advantage in the fierce market competition.

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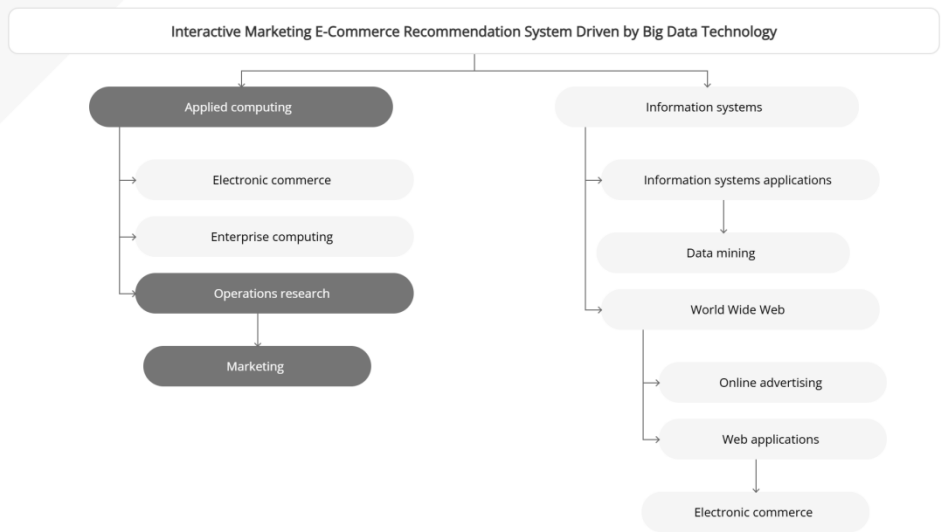

Figure 1.
The Architecture diagram of the interactive - marketing e - commerce recommendation system driven by big data.

7. Optimization Strategies for E - commerce Marketing Management in the Context of Big Data

7.1. Building a Powerful Big Data Information Processing Hub

Enterprises should attach great importance to the construction and improvement of the big data processing center, and comprehensively and deeply promote the collection, collation, and analysis of massive data information. In the specific operation process, advanced big data technologies should be skillfully and reasonably applied. Relying on accurate target user data information, an efficient big data processing center should be established, and the information processing ability of this center should be continuously enhanced during actual operation.

E-commerce enterprises can further optimize their own data information analysis and processing processes with the help of the big data information processing center, and significantly improve the scientific and reliability of the data information analysis results. E-commerce enterprises can use the information results generated by the big data information processing center as an important reference basis, conduct in-depth analysis of market dynamics and consumers' consumption preferences, thus laying a solid foundation, providing necessary support conditions for the smooth implementation of marketing management activities of e-commerce enterprises, and also pointing out a clear development direction for the e-commerce marketing management work. This enables enterprises to accurately formulate relevant product development strategies and specific marketing measures according to their actual development status and marketing needs.

The big data information processing center can not only continuously optimize product improvement plans according to market demands, effectively enhancing the market competitiveness of products, but also provide more accurate and scientific data information for e-commerce marketing management work, effectively preventing enterprises from wasting resources and missing development opportunities due to making wrong judgments or decisions. In this way, the core competitiveness of enterprises can be effectively improved, and the comprehensive strength of enterprises can be further enhanced, helping enterprises to stand out in the fierce market competition [5].

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7.2. Strategies in the Field of Data Management

In the context of the big data era, e-commerce marketing management requires a more in-depth study of relevant aspects of big data. Through comprehensive and meticulous analysis of big data, enterprises can gain a more thorough and comprehensive understanding of the preferences of consumers and the audience. This helps enterprises to precisely control their future development directions and make reasonable and detailed stage divisions of the marketing process. Enterprises should select more appropriate marketing methods and means according to their actual situations, and focus on building a complete marketing mechanism.

Enterprises can introduce modern information systems to conduct in-depth analysis of data and gradually establish their own databases to store information more effectively. At the same time, classify and store the data so that the required content can be quickly found when the information needs to be utilized. In addition, the information in the database should be updated in a timely manner, and regular information backup should be carried out.

Enterprises must fundamentally recognize the great significance of mutual cooperation among enterprises and establish confidence in cooperation. Build an information sharing platform to provide a solid guarantee for communication and interaction among enterprises, so that valuable experience can be truly learned from partners, achieving mutual benefit and win-win results.

7.3. Strategies in the Aspect of Marketing Management

In the field of e-commerce, the final implementation effects of the marketing methods and strategies employed are closely intertwined with the needs of consumers. In other words, consumers' needs will actually influence the specific application of e-commerce marketing methods. In order to obtain more substantial benefits in the fierce market competition, enterprises must accurately analyze the market situation. Through careful analysis, they should identify the differences among different customer groups, so that they can promptly adjust relevant strategies and optimize and upgrade products.

In addition, the powerful capabilities of big data are not only manifested in its ability to accurately predict the consumption capabilities and preferences of consumers and the audience, but also in its capacity to make forward-looking predictions about future market development trends. This undoubtedly significantly increases the success rate of marketing activities. Enterprises should give full play to the advantages of big data, promptly evaluate and judge the analysis results, so as to more precisely meet the diverse needs of consumers and enhance customer satisfaction and loyalty [6].

7.4. Advancing the Reform Process of Marketing Management

The development pace of an enterprise largely depends on its ability to adopt reasonable and effective marketing methods. Marketing strategies must be closely aligned with the actual needs and expectations of users. The behavior patterns and consumption habits of the product audience are often the core elements determining the e-commerce marketing model. In order to gain a foothold and achieve further development and growth in the increasingly fierce market competition, enterprises must delve deep into the market, conduct comprehensive and meticulous research work, and with the strong support of big data technology, significantly improve the accuracy and reliability of the research results.

This requires enterprises to make full and rational use of big data technology and, based on the results obtained from big data analysis, promptly adjust and optimize their own marketing strategies. The analysis and calculation results of big data technology can not only help enterprises accurately predict consumers' consumption behaviors but also make forward-looking predictions about future market consumption trends, enabling enterprises to plan in advance and seize the market opportunities.

7.5. Strengthening the Construction of the Talent Team

E-commerce enterprises should expand their recruitment scale according to their actual situations and development needs to achieve the goal of attracting outstanding talents. Enterprises should change the limitations of the traditional recruitment model that only focuses on the educational background and

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work experience of job seekers, and place more recruitment considerations on aspects such as the reserve of professional knowledge related to big data, practical data processing capabilities, ideological and moral qualities, and work attitudes. For particularly outstanding talents, the requirements for educational background and work experience can be appropriately relaxed.

At the same time, e-commerce enterprises must attach great importance to the cultivation and assessment of relevant internal marketing management staff. Regular training and assessment on modern information technology and the use of big data-related software can be organized for these staff members to improve their professional knowledge levels and practical work abilities. For staff members who perform poorly in the assessment, appropriate disciplinary measures should be taken to fully stimulate the self-improvement awareness of relevant staff members, enhance their work abilities and subjective initiative, so that they can better perform their duties, promote the development of the enterprise's e-commerce marketing management work, improve the enterprise's economic benefits, and help the enterprise achieve more long-term development in the context of the big data era.

8. E-commerce Marketing: Expansion, Optimization and Innovation in the Big Data Era

With the continuous and rapid development of Internet and computer technologies, e-commerce has witnessed unprecedented and significant expansion in both its form and content during its development process. Nowadays, the business scope of e-commerce is no longer limited to traditional online commodity transactions but also widely covers multiple emerging fields such as digital services and virtual product sales. Its transaction forms have also evolved from the single web-based shopping to a diversified pattern integrating mobile shopping, social e-commerce, live streaming e-commerce, and other innovative forms. In this context, in order to stand out and maintain a leading position in the fierce market competition, enterprises must precisely select more suitable marketing methods and means according to their own business characteristics, market positioning, and development goals. At the same time, they should attach great importance to constructing a complete and efficient marketing mechanism, which serves as a solid support for the enterprise's marketing activities. By introducing advanced modern information systems, in-depth analysis is carried out on massive market data, consumer behavior data, and other information to tap valuable insights and potential business opportunities. Through the integration of these data, enterprises can establish their own powerful databases, which can not only ensure the secure and reliable storage of various types of information but also classify and store the data scientifically, enabling quick and accurate retrieval of the required information when needed. This can not only improve the efficiency of information utilization and reduce operating costs, but also better promote sales and enhance brand influence in the process of e-commerce marketing, thereby promoting sustainable economic development [7].

9. Extended Analysis

This article deeply explores the optimization trend of e-commerce marketing management model in the context of the current big data era. It enables enterprises to expand the vast market space and reach potential customer groups, which helps enterprises to utilize diversified market resources. At the same time, enterprises should also actively promote the transformation and innovation of marketing management system and management model, abandon the traditional and relatively rigid management model, and introduce more flexible, efficient and adaptable management concepts and methods in the big data era. More importantly, it is necessary to promote collaboration and communication between personnel in team management and realize data sharing and circulation.

In addition, it is also necessary to increase the importance of e-commerce marketing management. Enterprises should raise the use, analysis and collection of big data to a strategic level, establish a special data analysis team, and increase investment in related technologies and talents. Gradually integrate big data into enterprise management, become the core competitiveness of enterprise innovation and development, obtain a steady stream of development resources and opportunities, and move forward steadily in the wave of the big data era.

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Transparency:

The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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