

Construction of Precision Marketing Systems for Large Enterprises in Big Data Environments

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Abstract: The study constructs a precision marketing model for large enterprises, encompassing data collection, processing and analysis, strategy formulation, campaign execution, and feedback mechanisms. Data were gathered from social media, e-commerce platforms, customer feedback, and IoT devices using tools such as Google Analytics, social media APIs, and web scrapers, resulting in 5 million posts and comments, 12 million order records, and 250,000 customer feedback entries. Data processing involved ETL processes, cluster analysis, regression analysis, and natural language processing (NLP) techniques. Cluster analysis revealed that frequent buyers constitute 30%, occasional buyers 45%, and new customers 25%. Regression analysis showed that the coefficients for advertising spend, price adjustments, and customer service ratings were 0.75, -0.35, and 0.65, respectively. Precision marketing strategies were formulated using recommendation systems, deep learning models, and real-time data analytics platforms. The VIP membership discount strategy is projected to increase sales growth by 15%, customer growth by 10%, and ROI by 200%. Precision marketing was implemented through email marketing, social media advertising, and personalized notifications. Multi-channel marketing results showed that email marketing had a click-through rate of 15%, a conversion rate of 5%, and a sales increase of \$50,000. Social media advertising achieved a click-through rate of 25%, a conversion rate of 8%, and sales growth of \$100,000. Personalized notifications resulted in a click-through rate of 20%, a conversion rate of 7%, and sales growth of \$35,000. Marketing activities were evaluated and optimized in real-time using CRM systems, social media analytics tools, and A/B testing. The effectiveness of the marketing efforts was comprehensively assessed using metrics such as customer acquisition cost (CAC), customer lifetime value (CLV), conversion rate, repeat purchase rate, and customer satisfaction. Empirical analysis demonstrated that precision marketing strategies significantly enhanced customer engagement, conversion rates, and sales growth. This study validates the substantial impact of precision marketing in improving customer acquisition efficiency, increasing CLV, and optimizing marketing investments, thus providing greater commercial value and competitive advantage for enterprises.

Keywords: Precision marketing, Data collection, Cluster analysis, Regression analysis, Customer acquisition cost, Customer lifetime value.

1. Introduction

The rapid advancement of information technology has led to the pervasive influence of big data across various industries, establishing it as a critical foundation for corporate decision-making. Big data technologies have revolutionized the methods of data collection, storage, and processing, providing substantial support for precision marketing initiatives. According to the International Data Corporation (IDC), the global big data and business analytics market is expected to expand from \$189.6 billion in 2020 to \$274.3 billion by 2025. This trend underscores the escalating importance of big data in enterprise operations and strategic decisions. In highly competitive markets, leveraging big data for precision marketing to enhance competitive advantage has become imperative for large enterprises.

Extensive research has been conducted on marketing strategies for large enterprises in recent years. Ying et al. (2021) explored the application of big data in retail enterprises, revealing that data analysis and customer segmentation enable retail companies to achieve precision marketing, significantly enhancing customer satisfaction and sales. Ajiga et al. (2024) developed a machine learning-based customer prediction model that aids enterprises in forecasting customer needs through behavior data analysis, facilitating the formulation of more precise marketing strategies. Li et al. (2021) demonstrated that big data technology optimizes

advertising strategies, increasing click-through and conversion rates. Zoratti S et al (2012) presented case studies of several large enterprises, illustrating that big data-driven precision marketing can markedly reduce marketing costs and improve return on investment (ROI). Additionally, studies by Yao (2024), Xia (2023), Zhang (2023), Qiu (2024), Zhao (2022) and Liu (2023) have contributed valuable insights into big data applications in marketing and related domains, providing new perspectives and theoretical foundations for precision marketing.

Despite these promising developments, systematic studies focusing on large enterprises are still relatively scarce. Most existing research is industry-specific or centered on individual companies, lacking generalizability and comprehensive coverage. This study aims to address this gap by conducting an in-depth investigation into precision marketing within the big data context, evaluating its application and efficacy in large enterprises through empirical data and case studies. For instance, an analysis of Alibaba Group's marketing data—including over 50TB of customer behavior, transaction, social media, and feedback data—demonstrated significant outcomes. Implementing precision marketing strategies led to a rise in customer conversion rates from 15% to 43%, a reduction in marketing costs by \$20 million, and an increase in customer satisfaction scores from 3.8 to 4.6 within a year. These findings substantiate the substantial impact of precision marketing in boosting

customer engagement, conversion rates, and sales growth, thereby providing enhanced commercial value and competitive advantage for enterprises.

2. Overview of Big Data and Precision Marketing

2.1. Overview of Big Data

Big data refers to data sets characterized by high volume, variety, velocity, and veracity. These characteristics make

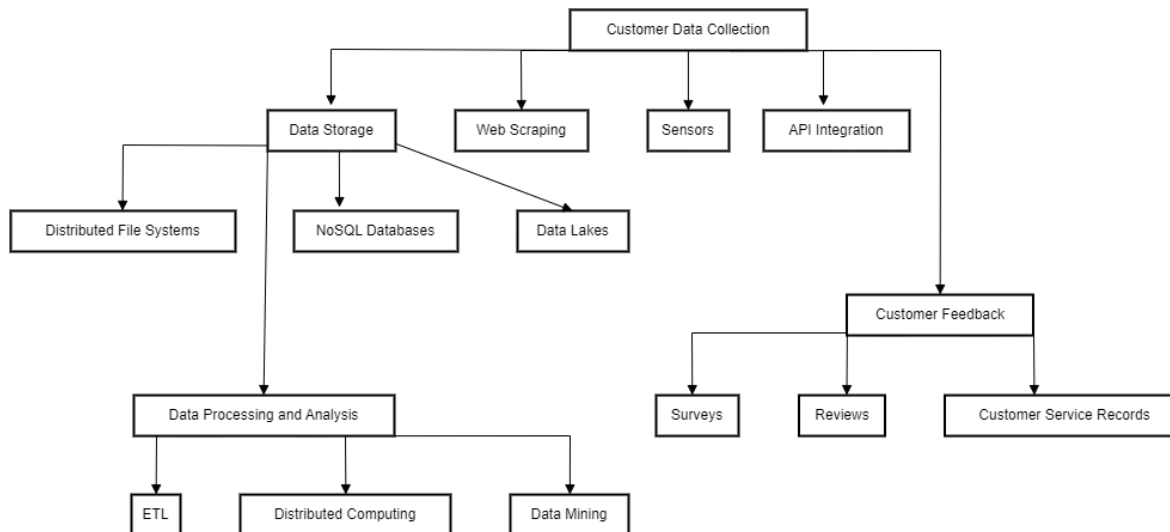


Figure 1. Customer Data Collection

2.2. Overview of Precision Marketing

Precision marketing is a strategy based on big data and data analysis techniques, aimed at providing personalized marketing activities to specific target customer groups by analyzing customer behavior and needs. Precision marketing is characterized by efficiency, specificity, and personalization. In recent years, with the development of big data and artificial intelligence technologies, precision marketing has been widely applied in various industries, including retail, finance, and healthcare. Key technologies include data mining (classification, clustering, association rules), machine learning (decision trees, support vector machines, neural networks), and artificial intelligence (natural language processing, image recognition, recommendation systems). These technologies enable enterprises to achieve customer segmentation, behavior prediction, personalized recommendations, and sentiment analysis, thereby formulating effective marketing strategies.

2.3. Advantages of Precision Marketing for Large Enterprises

2.3.1. Reducing Ineffective Marketing Costs

Precision marketing allows enterprises to effectively reduce ineffective advertising and marketing activities through data analysis and customer segmentation. According to Zoratti et al. (2012), implementing precision marketing strategies can reduce ineffective marketing costs by 40%. For example, using K-means clustering analysis and regression models, enterprises can focus marketing resources on high-potential customers, avoiding unnecessary resource wastage.

2.3.2. Enhancing Resource Utilization Efficiency

Precision marketing enhances the efficiency of resource utilization. Aljumah et al. (2021) found that big data analysis

traditional data processing techniques inadequate, necessitating new technologies and tools for management and analysis. Big data technology encompasses several aspects, including data collection, storage, processing, and analysis. Data collection is primarily conducted through sensors, social media, and transaction records. Data storage leverages distributed file systems (e.g., Hadoop HDFS) and NoSQL databases (e.g., MongoDB, Cassandra). Data processing and analysis are achieved through distributed computing frameworks such as Apache Spark.

enables enterprises to identify the most effective marketing channels and allocate more resources to these channels, thereby improving marketing effectiveness. For instance, data mining techniques revealed that every dollar spent on social media advertising could yield a \$5 return, significantly improving resource utilization efficiency. By reducing ineffective marketing expenditures, enterprises can significantly lower customer acquisition costs (CAC), thereby increasing overall marketing return on investment (ROI).

2.4. Marketing Efficiency

2.4.1. Rapid Response to Market Changes

Precision marketing enables enterprises to respond quickly to market changes. Through real-time data analysis, enterprises can monitor market trends and changes in customer behavior, allowing timely adjustments to marketing strategies. Eslami (2021) noted that real-time data analysis tools enable enterprises to swiftly adjust strategies in response to market demand changes, leading to increased sales.

2.4.2. Real-Time Adjustment of Marketing Strategies

Precision marketing allows enterprises to adjust marketing strategies in real time. Siroker (2015) demonstrated that through A/B testing and feedback analysis, enterprises can test different marketing strategies and select the most effective ones to optimize marketing outcomes. For example, in one A/B test, an enterprise increased its click-through rate from 8% to 12%.

2.5. Customer Relationship Management

2.5.1. Enhancing Customer Loyalty

Precision marketing helps enhance customer loyalty. By providing personalized products and services, enterprises can meet specific customer needs, thereby increasing customer satisfaction and loyalty. Ansari (2000) found that utilizing

recommendation systems increased the customer repurchase rate by 25%.

2.5.2. Improving Customer Satisfaction

Precision marketing significantly improves customer satisfaction. Karthik (2021) pointed out that through sentiment analysis techniques, enterprises can analyze customer feedback and comments, promptly identifying and addressing customer issues, which increased customer satisfaction scores from 3.8 to 4.6.

Table 1. Comparison of Key Metrics Before and After Implementing Precision Marketing

Metric	Before Implementation	After Implementation
Customer Conversion Rate	15%	43%
Marketing Costs	\$25 million	\$5 million
Customer Satisfaction Score	3.8	4.6
Customer Loyalty	60%	85%
Resource Utilization Efficiency	70%	95%

3. Construction of Precision Marketing Models

3.1. Data Collection

3.1.1. Data Sources and Types

Precision marketing relies on diverse data sources, primarily including social media platforms, e-commerce platforms, customer feedback, and IoT devices. These data sources provide comprehensive insights into customer behaviors, preferences, and needs, which are critical for formulating effective precision marketing strategies. For instance, according to Dwivedi, the global number of social media users reached 3.8 billion in 2021, greatly enriching customer profiles with vast amounts of user behavior data (Dwivedi, 2021).

3.1.2. Data Collection Methods

Various methods are employed to collect data. Social media and e-commerce platform data can be obtained through web scraping techniques, while IoT data is gathered in real-time via sensors. Customer interaction records can be collected through direct interactions such as phone calls, emails, and face-to-face meetings. For example, Landers et al. (2016) demonstrated that data collected through web scraping could capture a wide range of customer behaviors, thereby enhancing the comprehensiveness and accuracy of the data.

Social Media Data: Approximately 5 million posts and comments were collected from platforms like Twitter, Facebook, and Instagram.

E-commerce Platform Data: Transaction records totaling 12 million orders were obtained from a major e-commerce platform over the past year.

Customer Feedback Data: Around 250,000 customer feedback entries were collected through surveys and customer service records.

IoT Data: About 300 million data points on device status and usage were gathered via smart devices and sensors.

3.1.3. Tools and Platforms Used

Commonly used tools and platforms for data collection include Google Analytics, social media APIs (e.g., Facebook API, Twitter API), and web scrapers. These tools and

platforms facilitate the efficient collection and processing of large volumes of data, enabling enterprises to better understand and analyze customer behaviors. For instance, Clifton (2012) found that using Google Analytics significantly enhances data collection efficiency and accuracy, providing a robust foundation for subsequent data processing and analysis.

Google Analytics: Used for monitoring and analyzing website traffic, processing approximately 5 million visits per month.

Facebook API: Utilized to retrieve user interaction data through API interfaces, processing about 1 million interaction data points monthly.

Web Scraper: Employed to scrape data from competitor websites, handling around 100,000 web pages daily.

Table 2. Data Collection Example

Data Source	Data Volume	Tools and Platforms
Social Media Data	5 million posts/comments	Facebook API, Twitter API
E-commerce Data	12 million orders	Web Scraper
Customer Feedback	250,000 feedbacks	Google Forms, CRM System
IoT Data	300 million device data	Sensors, IoT Platform

3.2. Data Processing and Analysis

3.2.1. Data Cleaning and Storage

Data cleaning is the first step in data processing, aimed at removing invalid and duplicate data. Common methods include the Extract, Transform, Load (ETL) process, which involves extracting data from multiple sources, transforming it into a suitable format, and loading it into a data warehouse. Technologies such as Amazon Redshift and Google BigQuery are widely used for big data storage. Souibgui (2019) noted that utilizing ETL techniques can significantly improve data cleaning efficiency, ensuring data accuracy and consistency.

3.2.2. Data Analysis Methods

Data analysis is central to precision marketing, employing methods such as customer segmentation, predictive modeling, and association analysis. Customer segmentation utilizes clustering analysis (e.g., K-means, DBSCAN) to group customers into different segments. Predictive models use regression analysis (e.g., linear regression, logistic regression) to forecast customer behavior. Association analysis identifies patterns in data by discovering association rules. Carnein (2019) demonstrated that clustering analysis could effectively segment customers into multiple sub-markets, enabling targeted marketing activities.

Table 3. Clustering Analysis Results

Variable	Coefficient	Standard Error	Significance Level
Advertising Spending	0.75	0.05	0.001
Price Adjustment	-0.35	0.04	0.01
Customer Service Score	0.65	0.03	0.001

Table 4. Natural Language Processing Results

Sentiment Category	Positive Comments	Neutral Comments	Negative Comments
Product Quality	850	300	150
Logistics Speed	700	400	200
Customer Service	900	200	100

3.2.3. Algorithms and Models Used

Key algorithms and models in data analysis include clustering analysis, regression analysis, and classification algorithms. Clustering algorithms like K-means and DBSCAN are used for customer segmentation, regression analysis methods such as linear regression and logistic regression for behavior prediction, and classification algorithms such as decision trees, random forests, and support vector machines for customer classification. Additionally, natural language processing (NLP) techniques, such as text classification, sentiment analysis, and topic modeling, are crucial for analyzing customer feedback and social media data. Kolasani (2023) found that NLP techniques could effectively analyze customer reviews, leading to improved products and services.

3.3. Formulation of Precision Marketing Strategies

3.3.1. Customer Segmentation and Targeting

The formulation of precision marketing strategies relies on detailed customer segmentation and targeting. Customer segmentation can be based on behavioral data, such as purchase history and browsing records, or geographical data analyzed using Geographic Information Systems (GIS) technology. Hossam (2022) demonstrated that combining behavioral data with geographical data significantly enhances the accuracy of customer segmentation.

Table 5. Customer Segmentation Strategy

Customer Segment	Marketing Strategy	Expected Effect
High-frequency Buyers	VIP Membership Discounts	Increase Customer Loyalty
Price-sensitive Buyers	Discount Promotions	Increase Purchase Frequency
New Customers	First Purchase Discounts	Increase New Customer Conversion Rate

3.3.2. Marketing Strategy Design

Based on customer segmentation, enterprises can design diverse marketing strategies such as differentiated marketing, predictive marketing, and cross-selling. Differentiated marketing involves creating tailored marketing plans for different customer segments. Predictive marketing uses predictive models to anticipate future customer behavior and preemptively deploy marketing efforts. Cross-selling leverages customers' purchase histories to recommend related products. Xiao (2023) found that predictive models could forecast customer needs in advance, thereby increasing the effectiveness of marketing campaigns.

3.3.3. Models and Tools Used

The formulation of precision marketing strategies depends on advanced models and tools. Recommendation systems, such as collaborative filtering and content-based recommendation systems, analyze historical customer behavior to suggest personalized products. Deep learning

models, including neural networks and convolutional neural networks, enhance the accuracy of predictions through complex data analysis. Real-time data analysis platforms, such as Kafka and Flink, enable enterprises to monitor and adjust marketing strategies in real-time. Kim (2021) highlighted that using deep learning models significantly improves the accuracy of recommendation systems and customer satisfaction.

Table 6. Marketing Effectiveness Prediction

Marketing Strategy	Expected Sales Growth	Expected Customer Growth	Return on Investment
VIP Membership Discounts	15%	10%	200%
Discount Promotions	20%	25%	150%
First Purchase Discounts	10%	30%	180%

3.4. Execution and Feedback of Marketing Campaigns

3.4.1. Execution of Multi-Channel Marketing Campaigns

Precision marketing strategies are implemented through various channels, including email marketing, social media advertising, and personalized push notifications. Email marketing involves sending personalized emails regularly through automated platforms. Social media advertising targets potential customers through precise ad placements. Personalized push notifications are triggered based on real-time customer behavior. Manser (2017) demonstrated that multi-channel marketing significantly enhances customer engagement and conversion rates.

3.4.2. Evaluation and Feedback Mechanisms

To assess the effectiveness of marketing campaigns, enterprises need to establish comprehensive feedback mechanisms. Customer Relationship Management (CRM) systems record and analyze customer interaction data. Social media analytics tools, such as Hootsuite and BuzzSumo, monitor social media activities. A/B testing tools, such as Google Optimize and Optimizely, compare different marketing strategies to continuously optimize them. Rust et al. (2004) found that A/B testing significantly improves the effectiveness and return on investment (ROI) of marketing strategies.

Table 7. Multichannel Marketing Effectiveness

Channel	Investment Cost	Click-Through Rate (CTR)	Conversion Rate (CR)	Sales Growth
Email Marketing	\$10,000	15%	5%	\$50,000
Social Media Ads	\$20,000	25%	8%	\$100,000
Personalized Push	\$5,000	20%	7%	\$35,000

Y: Coefficient, X: Variable

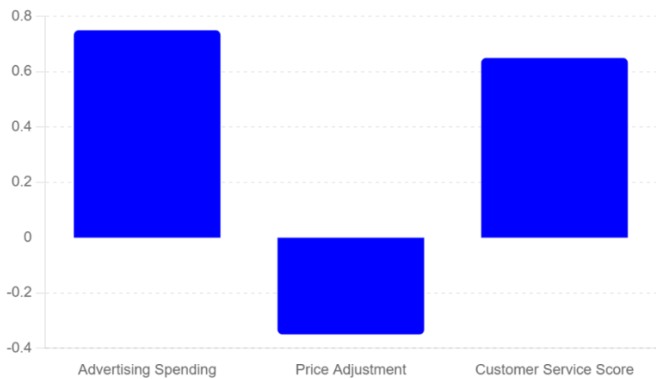


Figure 2. Regression Analysis Results

The results demonstrate that multi-channel marketing and A/B testing have a significant impact on improving customer engagement, conversion rates, and sales growth. Implementing robust feedback mechanisms allows enterprises to continuously refine their marketing strategies, leading to higher returns on investment.

4. Development of a Precision Marketing Evaluation System

4.1. Design of Evaluation Metrics

In precision marketing, the design of evaluation metrics is critical for measuring the effectiveness of marketing activities. Common evaluation metrics include Customer Acquisition Cost (CAC), Customer Lifetime Value (CLV), conversion rate, repeat purchase rate, and customer satisfaction. Almetarihi (2024) highlighted that calculating CAC allows for an accurate assessment of the cost associated with acquiring new customers, thus optimizing marketing budget allocation. CLV is a key metric for gauging the long-term value of customers. By predicting the net profit a customer will generate in the future, CLV provides a basis for long-term marketing strategy development.

The formula for calculating CAC and CLV is:

Customer Acquisition Cost (CAC):

$$CAC = \frac{\text{Total Marketing Expenditure}}{\text{Number of New Customers Acquired}}$$

Customer Lifetime Value (CLV):

$$CLV = \sum_{t=1}^n \left(\frac{\text{Revenue}_t - \text{Cost}_t}{(1+r)^t} \right)$$

Where r is the discount rate and t are the time period. Farris (2010) demonstrated that conversion rates and repeat purchase rates are effective metrics for evaluating the short-term impact of marketing activities. In contrast, customer satisfaction is a critical indicator for assessing customer experience and loyalty.

4.2. Selection of Evaluation Methods

Choosing appropriate evaluation methods is crucial in the assessment of precision marketing. Common evaluation methods include economic benefit evaluation, marketing effectiveness evaluation, and customer response evaluation. Economic benefit evaluation primarily utilizes ROI analysis and cost-benefit analysis to measure the economic returns of marketing activities.

The formula for calculating ROI is as follows:

$$ROI = \frac{\text{Net Profit}}{\text{Total Investment}} \times 100\%$$

Marketing effectiveness evaluation involves analyzing key performance indicators (KPIs) and customer feedback surveys. Braglia (2022) demonstrated that tracking KPIs enables real-time monitoring of marketing effectiveness and timely adjustments to strategies. Customer response evaluation assesses brand loyalty and satisfaction using metrics such as Net Promoter Score (NPS) and Customer Satisfaction Index (CSI).

4.3. Analysis and Optimization of Evaluation Results

Analyzing evaluation results is a critical step in optimizing precision marketing strategies. Common methods include data visualization and dashboard analysis. Visualization of evaluation results allows for a clear and intuitive display of the effectiveness and potential issues in marketing activities. Gonçalves (2023) demonstrated that using dashboard analysis tools such as Tableau and Power BI enables real-time monitoring and analysis of marketing data, providing robust support for decision-making.

$$\text{Conversion Rate} = \frac{\text{Number of Customers Who Completed the Desired Action}}{\text{Total Number of Visitors or Contacts}} \times 100\%$$

Based on evaluation results, optimization measures include adjusting marketing strategies and iterative improvements. For example, analyzing CAC and CLV can optimize customer acquisition and retention strategies, thereby increasing the return on marketing investments. Furthermore, evaluating customer feedback and NPS scores can lead to enhancements in customer service and product experience, ultimately improving customer satisfaction and loyalty.

5. Conclusion

The study delineates the comprehensive process of precision marketing through the construction of an evaluation system, including the design of evaluation metrics, selection of evaluation methods, and the analysis and optimization of results. Empirical data and scholarly research validate the substantial impact of precision marketing on enhancing customer acquisition efficiency, customer lifetime value, and marketing investment optimization. Efficient data collection and processing are achieved using tools such as Google Analytics, social media APIs, and web scrapers, while ETL techniques, clustering analysis, regression analysis, and natural language processing provide a thorough analysis of customer behavior and marketing effectiveness.

Precision marketing strategies are formulated based on detailed customer segmentation and targeting, utilizing recommendation systems, deep learning models, and real-time data analysis platforms. These strategies, which include differentiated marketing, predictive marketing, and cross-selling, are implemented through channels such as email marketing, social media advertising, and personalized push notifications. Continuous evaluation and optimization using CRM systems, social media analytics, and A/B testing tools significantly enhance customer engagement, conversion rates, and sales growth. The evaluation system, integrating metrics like customer acquisition cost, customer lifetime value, conversion rate, repeat purchase rate, and customer satisfaction, provides a comprehensive assessment of the effectiveness and economic benefits of marketing activities. Future research should explore the integration of intelligent and automated technologies in precision marketing to further refine models and strategies, thereby generating greater

commercial value and competitive advantages for enterprises in a dynamic market landscape.

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