Research on AI-driven Green Marketing Communication Effectiveness Evaluation and Optimization Strategy

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Abstract: With the rapid development of artificial intelligence technology and the widespread adoption of the concept of green development, the integration of AI and green marketing communication has become a significant trend in enterprise development. This paper focuses on AI-driven green marketing communication, aiming to evaluate its communication effect and propose optimization strategies. By adopting literature research, case analysis, and a combination of quantitative and qualitative research methods, the theoretical basis, current status model, effect evaluation system, and optimization strategy of AI-driven green marketing communication are deeply discussed. The study identified the relevant theories and research status, analyzed their development, typical characteristics, and main models, and constructed an evaluation system for their effects. Ultimately, this paper proposes targeted optimization strategies to serve as a reference for enterprises to enhance the effectiveness of green marketing communication and promote the sustainable development of the industry.

1. Introduction

In the digital age, artificial intelligence (AI) has rapidly transformed various industries, and marketing is no exception. AI has significantly changed marketing communication through its powerful data processing, machine learning, and intelligent analysis capabilities. At the same time, as global environmental issues become more severe, green development has emerged as the central theme of our time. Green marketing communication is a crucial means for enterprises to implement green concepts and establish a positive social image. It has been receiving increasing attention from enterprises. In this context, the combination of AI and green marketing communication has become an inevitable trend. It will not only improve the accuracy and efficiency of marketing communication, but also better convey the value of green products and meet consumers' demand for green services. The purpose of this study is to evaluate the effect of AI-driven green marketing communication, find out the problems, and provide practical optimization strategies. For enterprises, it enables them to conduct green marketing activities more effectively and enhance their market competitiveness. For the industry, it promotes the standardization and efficiency of green marketing communication, ultimately fostering the development of a green and sustainable society. To achieve the research objectives, this paper will comprehensively employ the literature research method to summarize relevant domestic and foreign theories and research results, thereby laying the theoretical foundation for the research. It will also adopt the case analysis method, selecting practical cases of typical enterprises for in-depth analysis, and summarizing the experiences and shortcomings. From a research perspective, this study will focus on the deep integration of AI and green marketing communication, thereby breaking through the limitations of previous research on the application of AI in marketing or green marketing communication. In terms of method application, this study attempts to combine AI algorithms with traditional evaluation methods to enhance the accuracy of

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effect evaluation, which constitutes its innovation.

2. An Overview of Theoretical Basis

2.1 Application of AI in Marketing and Green Marketing Communication

AI refers to a complex set of technologies that enable machines to perceive, learn, reason, and make decisions by simulating the thinking process and behavior of human intelligence. Its core principles include data mining, machine learning, natural language processing, and computer vision. In the field of marketing, AI is widely used. Data mining technology can extract valuable information from massive amounts of consumer data, helping companies understand consumer needs, preferences, and behavioral characteristics, and providing data support for precision marketing. For example, companies can predict consumers' potential purchasing intentions by analyzing data such as consumer purchase records and browsing history, and thus make targeted product recommendations [1]. Machine learning algorithms can continuously optimize marketing models, improving the accuracy and efficiency of marketing decisions. For example, in advertising, machine learning algorithms can adjust strategies in real-time according to the effectiveness of the advertising and improve the conversion rate of the advertising.

Green marketing communication involves businesses committed to sustainable practices, offering eco-friendly products, services, and values to consumers through various communication channels. This approach aims to meet consumer needs while promoting the harmonious development of businesses, society, and the environment. Its connotation encompasses the research, development, and promotion of green products, the creation of green brands, and the dissemination of green consumption concepts. Figure 1 illustrates the principal of green marketing. Green marketing communication has the following characteristics: First, it emphasizes environmental responsibility. Enterprises pay attention to environmental protection in the marketing process to avoid negative impacts on the environment [2]. Second, it focuses on the green needs of consumers and conducts marketing activities tailored to meet these needs. Third, it is long-term and systematic, because green marketing communication is a long-term systematic project that requires enterprises to plan and implement at the strategic level. The development of green marketing communication can be traced back to the 1970s. Due to the increasing prominence of environmental problems, the concept of green marketing has emerged, and green marketing communication has undergone a gradual development process from initial exploration to maturity. Today, green marketing communication has become an integral part of an enterprise's sustainable development, playing a significant role in enhancing its social image and market competitiveness.

Fig. 1 The principal of green marketing

2.2 Research Status of AI-Driven Green Marketing Communication

In recent years, research on AI-driven green marketing communication has garnered the attention of both academia and the business community. Existing research mainly focuses on the following

aspects: First, the specific application scenarios of AI in green marketing communication include the use of intelligent customer service to answer consumers' inquiries about green products and the creation of AI-generated green marketing content. Second, the impact of AI on the efficiency of green marketing communication. Most studies suggest that AI can enhance the accuracy and efficiency of marketing communication, while also reducing marketing costs. Third, the consumer response mechanism in green marketing communication involves exploring consumers' acceptance and trust in AI-driven green marketing information [3].

Despite recent advancements in research, notable shortcomings persist. Specifically, there is a lack of systematic evaluation studies on the effectiveness of AI-driven green marketing communication, and no comprehensive evaluation system exists. In terms of research methods, qualitative research is the primary focus, while quantitative research is relatively underutilized, resulting in a need to enhance the credibility of research conclusions. From a research perspective, researchers often overlook the problems and coping strategies that arise during the integration of AI and green marketing communication. Based on this, this paper will focus on developing an AI-driven system for evaluating the effectiveness of green marketing communication, analyzing its optimization strategy in depth, and addressing the shortcomings of existing research.

3. Current Status and Model of AI-Driven Green Marketing Communication

3.1 Development Status and Typical Characteristics

Currently, the application of AI in green marketing communication has made significant progress and exhibits a diverse range of development statuses. In terms of intelligent advertising, companies utilize AI to analyze consumer data, accurately identify target audiences, and achieve effective green advertising. For example, some new energy vehicle companies analyze consumers' travel habits and environmental awareness to push new energy vehicle advertisements to potential consumers, thereby improving the conversion rate of advertisements. Personalized recommendations are also an important application of AI in green marketing communication. Companies recommend products and services that meet consumers' green needs based on their purchase history, browsing history, etc. For example, e-commerce platforms utilize AI algorithms to recommend green and environmentally friendly household products, as well as organic foods, to consumers [4].

AI-driven green marketing communication also has some typical characteristics. First, AI-driven green marketing communication is precise. AI can conduct in-depth analysis of massive consumer data, accurately grasp consumer needs and preferences, and create more targeted marketing communications. Second, it is intelligent. AI can automate and enhance the intelligence of marketing communication. For example, intelligent customer service can offer consumers 24-hour green product consulting services, enhancing service efficiency. Third, it is interactive. Interactive marketing tools developed by AI, such as virtual fitting rooms and green knowledge question-and-answer robots, enhance the interactivity between consumers and enterprises, thereby increasing consumer participation. Fourth, AI-driven green marketing communication is focused on data. It relies on data to target and effectively engage audiences. Through the analysis and mining of data, it continuously optimizes marketing communication strategies and improves communication effects [5].

3.2 Primary Models and Case Analysis

The primary models of AI-driven green marketing communication include content generation mode, user interaction mode, and precise positioning mode. Content generation mode refers to the use of AI to automatically generate green marketing content, such as introductions to green products, popular science articles on environmental protection knowledge. AI quickly generates high-quality marketing content tailored to the needs of the enterprise and the characteristics of the target audience, thereby enhancing the efficiency of content creation. The user interaction mode aims to enhance communication between consumers and businesses through AI, including the development of AI chatbots that engage with consumers in real-time, respond to their inquiries, and gather feedback. The precise positioning mode utilizes AI to accurately portray consumers, thereby ensuring the accurate

delivery of green marketing information [6].

Take Tesla as an example. It has widely used AI in green marketing communication. Tesla utilizes AI algorithms to analyze consumers' car purchase data, usage data, and other relevant information, accurately identifying potential consumers and delivering personalized new energy vehicle information to them. Furthermore, Tesla has developed an intelligent customer service system to provide consumers with 24-hour consulting services, answering questions about charging and maintenance of new energy vehicles, and enhancing interaction with consumers.

Additionally, Apple is a typical representative of AI-driven green marketing communication. Apple pays attention to the environmental attributes of its products and disseminates environmental information about its products through AI. Apple utilizes AI to generate environmental promotional content, conveying its efforts to protect the environment through product materials and production processes to consumers on its official websites, social media, and other channels, thereby creating a positive green brand image.

4. Construction of an AI-driven Green Marketing Communication Effectiveness Evaluation System

4.1 Evaluation Indicator Selection Principles and Specific Indicators

When constructing an AI-driven system for evaluating the effectiveness of green marketing communications, certain principles for selecting evaluation indicators must be followed. The comprehensiveness principle requires that the evaluation indicators cover all aspects of marketing communication, including the communication process, communication results, etc., to ensure the integrity of the evaluation; the measurability principle means that the evaluation indicators should have clear definitions and calculation methods, and can be quantitatively measured through data; the relevance principle emphasizes that the evaluation indicators should be related to the goals of AI-driven green marketing communication and can truly reflect the communication effect; the timeliness principle requires that the evaluation indicators can reflect the effect of marketing communication promptly so that companies can adjust their marketing strategies in a timely manner.

Based on the above principles, the specific evaluation index system constructed covers multiple dimensions. Communication coverage includes indicators such as the number of people reached by green marketing information and the geographical scope covered, reflecting the breadth of marketing communication. Brand awareness is measured by indicators such as consumers' awareness and memory of corporate green brands, reflecting the role of marketing communication in shaping brand image [7]. Consumer participation includes the number of consumers participating in green marketing activities and the number of interactions, reflecting consumers' interest in and participation in marketing communication; sales conversion rate refers to the ratio of product sales achieved through green marketing communication to the number of people reached by marketing, which directly reflects the economic benefits of marketing communication; environmental impact is evaluated through indicators such as the degree to which corporate green marketing communication improves consumers' environmental awareness and promotes social environmental protection behavior, reflecting the social benefits of marketing communication.

4.2 Evaluation Methods and Model Selection

To ensure the scientificity and accuracy of AI-driven green marketing communication effect evaluation, we will employ methods such as the hierarchical analysis method and the fuzzy comprehensive evaluation method, combined with AI algorithms for evaluation. The hierarchical analysis method is a technique that decomposes complex problems into multiple levels and determines the weight of each factor through pairwise comparisons. In the evaluation process, the first step is to divide the evaluation indicators into goals, criteria, and indicators, and then determine the weight of each indicator through expert scoring, which provides a basis for subsequent comprehensive evaluation.

The fuzzy comprehensive evaluation method is suitable for situations where the evaluation

indicators are ambiguous and can comprehensively evaluate multiple fuzzy factors. In evaluating the effectiveness of AI-driven green marketing communication, several indicators, such as brand awareness and consumer satisfaction, are ambiguous. The fuzzy comprehensive evaluation method provides a more objective reflection of the situation regarding these indicators.

At the same time, combining AI algorithms for evaluation is conducive to improving the efficiency and accuracy of evaluation. For example, using machine learning algorithms to train historical marketing data and establish a marketing effect prediction model can predict future marketing communication effects and provide a reference for companies to adjust their marketing strategies. By combining traditional evaluation methods with AI algorithms, a comprehensive evaluation method system has been formed, which can objectively and thoroughly assess the effects of AI-driven green marketing communication.

5. AI-Driven Optimization Strategy for Green Marketing Communication

5.1 Optimization of Communication Content and Channels

In terms of content optimization, companies can utilize AI technology to create personalized and visually appealing green marketing content. AI can generate marketing content that suits the interests of different consumers based on their characteristics and needs. For example, for consumers with a strong sense of environmental protection, more comprehensive content about environmental protection knowledge and corporate environmental protection initiatives can be developed. For young consumers, it is recommended to use more engaging and interactive marketing forms, such as short videos and comics. At the same time, AI can also monitor and analyze marketing content in real-time, adjust content promptly based on consumer feedback, and enhance the quality and attractiveness of content.

In terms of communication channel optimization, AI technology can be utilized to accurately identify the target audience and select the most suitable communication channels for them. AI can analyze data, such as consumers' media usage habits and social network behaviors, to determine the channels where the target audience is most active, including social media platforms, industry websites, and short video platforms. Moreover, it is recommended that companies conduct targeted marketing communications on these channels to improve communication efficiency. For example, for young target audiences, companies can opt to conduct green marketing communications on social media platforms such as Douyin and Xiaohongshu. For professionals, companies can choose to publish green marketing information on channels like industry forums and professional journals.

5.2 Interactive Experience and Brand Image Optimization

Utilizing AI technology to enhance the interactivity and experience of marketing activities is a crucial way to improve consumer engagement and satisfaction. Companies can develop AI interactive tools, such as virtual showrooms and green games, to allow consumers to learn about green products and environmental protection knowledge during the interaction. For example, some home furnishing companies have developed virtual home design tools that allow consumers to use AI technology to design their homes, selecting green and environmentally friendly materials and furniture, which enhances the consumer experience. Moreover, AI chatbots can interact with consumers in real-time, answer their questions promptly, collect their feedback, and enhance their satisfaction.

In the process of AI-driven green marketing and communication to shape and strengthen the green brand image of enterprises, enterprises need to integrate green concepts into their entire marketing and communication process. AI technology can be used to comprehensively and accurately communicate the green behavior and environmental protection achievements of enterprises, such as generating corporate environmental protection reports and green product certification information through AI, to convey to consumers the determination and responsibility of enterprises to protect the environment. Additionally, AI can analyze consumer feedback, understand consumers' cognitive expectations of corporate green brands, and tailor brand image-building strategies accordingly. For example, based on consumer feedback, the company can strengthen its publicity in a specific

environmental protection field, enhance the brand's professionalism and credibility, and thereby increase brand value.

6. Conclusion

This paper conducts an in-depth study on the evaluation and optimization strategies of AI-driven green marketing communication. By examining the relevant theoretical foundations and current research status, this study clarifies the application of AI technology in the marketing field and the connotations of green marketing communication, highlighting the shortcomings of existing research. It analyzes the development status, typical characteristics, and main models of AI-driven green marketing communication, examining them in conjunction with specific cases. In addition, this paper constructs an effect evaluation system that includes dimensions such as communication coverage, brand awareness, consumer participation, sales conversion rate, and environmental impact, and introduces evaluation methods and model selection. Finally, optimization strategies are proposed from the aspects of communication content and channels, interactive experience, and brand image.

This study suggests that AI-driven green marketing communication offers significant advantages in enhancing communication efficiency and accurately targeting the audience. However, it also identifies some problems, including an imperfect evaluation system and the need for further improvement in interactive experience. In the future, we should explore innovative models to continuously improve the effectiveness of green marketing communication. The research results presented in this paper provide a theoretical foundation and practical guidance for enterprises to implement AI-driven green marketing communication, thereby promoting the sustainable development of enterprises.

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