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The impact of AI technology on sustainability in the e-commerce industry

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BUSINESS
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Department of Marketing, Strategy and Operations

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Acknowledgments

Looking back at writing my paper, I feel like it was still yesterday. From topic selection to data collection, from theoretical analysis to experimental verification. I encountered many problems and challenges during this process, but at the same time, I also encountered friends who helped me, and with their great help, I successfully completed this paper. Firstly, I would like to express my gratitude to my mentors, Professor Rui Vinhas da Silva and Professor Renato Lopes da Costa, for their selfless guidance and careful care throughout the entire research process. They awesome a lot of theoretical inspiration and practical guidance. Although they are very strict with me, he has also given me enough freedom to express my opinions in written form. Secondly, I would like to thank the members of the professor's mentor team. During my research process, they provided me with a lot of help and encouragement. When I encounter difficulties, they are always able to lend a helping hand in a timely manner. When I needed data and samples, they provided abundant resources. To make greater contributions to the sustainable development of artificial intelligence technology in the e-commerce industry. Looking back, I deeply feel the hardships and joy of writing this paper. Despite many challenges and difficulties, they taught me the courage to face challenges and a rigorous attitude towards data science. Looking ahead, I believe that the field of artificial intelligence technology will have even broader development space in the future. I will continue to work hard to improve my knowledge and research abilities, and contribute to the sustainable development of artificial intelligence technology in the e-commerce industry. Sincere thanks to all those who have helped and supported me before. I would like to express my sincere gratitude and deep gratitude in this article. Thank you, thank you!

Abstract

In the context of today's digital global economy, the e-commerce industry has gradually become an essential part of modern business activities due to its convenience and efficiency. However, the rapid development of the e-commerce industry has brought about a series of challenges, including how to achieve sustainability. At the same time, the widespread application of artificial intelligence (AI) technology has brought new possibilities and opportunities to the e-commerce industry. Therefore, the main objective of this research is to systematically explore and understand the deep mechanisms of the impact of AI technology on the sustainability of the e-commerce industry.

This research sets four specific research questions. Firstly, we will clarify the forms and characteristics of AI applications in the e-commerce industry. Currently, while AI's application in the e-commerce industry is becoming more widespread, its specific forms and characteristics have not been thoroughly studied and summarized. Secondly, we will delve into the mechanisms and pathways through which AI affects the sustainability of e-commerce enterprises. Although some studies have suggested that AI may have an impact on the sustainability of e-commerce enterprises, the specific mechanisms and pathways of this impact are not yet clear. Once again, we will reveal whether there are differences in the performance of artificial intelligence technology on the sustainable impact of different types of e-commerce enterprises, and how these differences arise. We need to construct a scientific empirical model for research to quantitatively verify the sustainable impact of artificial intelligence on e-commerce enterprises.

To achieve these goals, the study will cite literature and use statistical methods such as multiple linear regression to construct empirical research models, and validate the proposed hypotheses. Through verification, this study provides scientific basis for strategic decision-making and policy formulation of e-commerce enterprises, and will provide theoretical guidance for the application of artificial intelligence in the e-commerce industry.

This research innovation lies in elucidating the impact mechanism of artificial intelligence technology on the sustainability of e-commerce, providing a more in-depth theoretical basis and significant practical impact on the sustainable development of e-commerce, and providing valuable experience for the exploration and development of its industry.

Keyword : Artificial Intelligence; E-commerce; Sustainability; Impact Mechanisms; Empirical Research.

Resumo

No contexto da economia global digital de hoje, a indústria de comércio eletrônico tornou-se gradualmente uma parte essencial das atividades comerciais modernas devido à sua conveniência e eficiência. No entanto, o rápido desenvolvimento da indústria de comércio eletrônico trouxe uma série de desafios, incluindo como alcançar a sustentabilidade. Ao mesmo tempo, a ampla aplicação da tecnologia de inteligência artificial (IA) trouxe novas possibilidades e oportunidades para a indústria de comércio eletrônico. Portanto, o objetivo principal desta pesquisa é explorar e compreender sistematicamente os mecanismos profundos do impacto da tecnologia de IA na sustentabilidade do setor de comércio eletrônico.

Esta pesquisa estabelece quatro questões específicas de pesquisa. Em primeiro lugar, vamos esclarecer as formas e características das aplicações de IA na indústria de comércio eletrônico. Atualmente, enquanto a aplicação da IA na indústria de comércio eletrônico está se tornando cada vez mais difundida, suas formas e características específicas não foram completamente estudadas e resumidas. Em segundo lugar, vamos nos aprofundar nos mecanismos e caminhos através dos quais a IA afeta a sustentabilidade das empresas de comércio eletrônico. Embora alguns estudos tenham sugerido que a IA pode ter um impacto na sustentabilidade das empresas de comércio eletrônico, os mecanismos específicos e caminhos desse impacto ainda não estão claros. Mais uma vez, revelaremos se existem diferenças no desempenho da tecnologia de inteligência artificial sobre o impacto sustentável de diferentes tipos de empresas de comércio eletrônico, e como essas diferenças surgem. Precisamos construir um modelo empírico científico de pesquisa para verificar quantitativamente o impacto sustentável da inteligência artificial nas empresas de comércio eletrônico.

Para atingir esses objetivos, o estudo citará a literatura e utilizará métodos estatísticos como regressão linear múltipla para construir modelos empíricos de pesquisa, e validará as hipóteses propostas. Através da verificação, este estudo fornece base científica para a tomada de decisão estratégica e formulação de políticas de empresas de comércio eletrônico, e fornecerá orientações teóricas para a aplicação da inteligência artificial na indústria de comércio eletrônico.

Esta inovação de pesquisa reside na elucidação do mecanismo de impacto da tecnologia de inteligência artificial na sustentabilidade do comércio eletrônico, fornecendo uma base teórica mais aprofundada e impacto prático significativo no desenvolvimento sustentável do comércio eletrônico, e fornecendo experiência valiosa para a exploração e desenvolvimento de sua indústria.

Palavra-chave: Inteligência Artificial; Comércio electrónico; Sustentabilidade; Mecanismos de impacto; Pesquisa empírica.

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Chapter 1:foreword

1.1 Research Background and Significance

Under the influence of economic globalization and digital globalization, the flexibility, speed, and efficiency of the e-commerce industry have become its characteristics, becoming an important component of modern business (Chaffey et al., 2019). With the rapid development of globalization, the impact of the e-commerce industry on the environment and society is increasingly attracting public attention. (Ashok et al., 2022).

The increasingly widespread use of artificial intelligence technology, applied to various fields such as big data processing, intelligent learning, and intelligent decision-making, is an indispensable tool for improving the process, efficiency, and user experience of e-commerce. (Lu et al., 2020). However, The efficient application of artificial intelligence in the e-commerce industry not only improves economic efficiency, but also has a significant impact on society and the environment. For example, artificial intelligence can help the sustainable development of the e-commerce industry by optimizing logistics, improving energy efficiency, and reducing waste emissions through algorithms (Huang and Rust, 2021). Meanwhile, the application of artificial intelligence also brings negative effects, such as how to protect data privacy? Social issues such as artificial employment being replaced by artificial intelligence? (Brynjolfsson and McAfee, 2014). T Thereupon, studying the impact of artificial intelligence on the e-commerce industry has important theoretical and practical value.

The rapid development of the e-commerce industry and the widespread application of artificial intelligence technology provide research evidence for this paper, meanwhile, but also based on the society's growing concern about sustainable development and corporate social responsibility (Porter and Kramer, 2011). The research significance of this article is to

understand how artificial intelligence affects the sustainability of the e-commerce industry through theoretical analysis and empirical research, provide decision-making references, and promote the sustainable development of the e-commerce industry.

Overall, the research direction of this article is how artificial intelligence affects the economic, social, and environmental applications of the e-commerce industry. Through rigorous empirical research and theoretical analysis, reveal the impact mechanism of artificial intelligence on the sustainability of the e-commerce industry.

In general, this study will provide a new perspective and thinking for understanding the far-reaching impact of artificial intelligence on the e-commerce industry, and is of great value for theoretical research and practical operation.

1.2 Explanation of research questions

The main problem of this study is in systematically exploring and understanding the deep mechanism of the impact of AI technology on the sustainability of the e-commerce industry. Specifically, this study has mainly set up the following four questions.

Elucidating the application forms and characteristics of AI in the e-commerce industry is the first issue of this study. At present, the development of artificial intelligence is changing with each passing day, and its application in the e-commerce industry is becoming more and more extensive, but the specific application forms and characteristics have not been fully studied and summarized (Bhatnagar et al., 2021) 。 Therefore, this study will comprehensively comb and analyze the application forms and characteristics of AI in the e-commerce industry based the majority of of literature data and case analysis.

The second question of this study is to understand the mechanism and path of the impact of artificial intelligence on the sustainability of e-commerce enterprises. Although some studies have suggested the possible impact of AI on the sustainability of e-commerce companies, the specific mechanism and path of the impact are unclear (Gupta et al., 2020) 。

Therefore, this study will explore this issue in depth based on a theoretical and empirical perspective.

The third question of this study is to reveal whether there are differences in the sustainability performance of different types of e-commerce enterprises under the influence of artificial intelligence, and how these differences arise (Ashok et al., 2022), but the specific manifestations and reasons for these differences are still unclear. Therefore, this study will conduct a detailed analysis and exploration of this issue through empirical research.

The fourth question of this study is to construct a scientifically reasonable empirical research model to quantitatively verify the impact of artificial intelligence on the sustainability of e-commerce enterprises. However, there is relatively little quantitative empirical research (Zhou et al., 2021). Therefore, this study will use statistical methods such as multiple linear regression to construct an empirical research model and verify relevant theoretical hypotheses.

To sum up, the problem of this study is not only to provide deep understanding of artificial intelligence applied in the electricity industry, more important is to reveal its influence on the sustainability of electricity enterprise, for electricity enterprise strategic decision-making and policy making to provide scientific basis, but also to the field of related research has certain theoretical and practical value.

1.3 Study Objectives

The overall goal of this study is to systematically elucidate and understand the impact mechanism of artificial intelligence technology on the sustainability of the e-commerce industry, and the following specific research objectives have been formulated.

Clarify the practical application and characteristics of artificial intelligence in the e-commerce industry, aiming to fully understand and reveal the function and value of AI in this specific environment. Although the potential of AI technology has been widely recognized

(Bhatnagar et al., 2021), but the systematic research on its specific application in the e-commerce industry is still relatively scarce. Therefore, this study hopes to comprehensively sort out the application forms and characteristics of AI in the e-commerce industry through literature review and case analysis.

The purpose of this study is to conduct scientific research on the mechanism and path of the impact of artificial intelligence on the sustainable development of e-commerce enterprises. Previous research literature has shown that artificial intelligence may have an impact on the sustainability of e-commerce enterprises, but these studies are mainly based on theoretical analysis and lack empirical support (Gupta et al., 2020). Therefore, we need to gradually deepen data analysis through reasonable planning and a large amount of empirical data to reveal the specific mechanisms and paths of these factors.

The research objective of this paper is to elucidate whether there are differences in the impact of artificial intelligence on sustainability performance among different types of e-commerce companies, and the correlation between these differences. In the research of predecessors, some reasons have been elucidated, but detailed analysis and explanation have not been provided (Ashok et al., 2022). We will conduct more in-depth research and extensive empirical evidence to understand the specific reasons and manifestations of these differences.

Our goal is to establish a scientific empirical model. The adoption of quantitative methods is the most important component in improving theoretical persuasiveness and practicality, with strong scientific support (Zhou et al., 2021). This study uses statistical methods such as multiple linear regression to test and prove hypotheses.

Based on our research hypothesis guidance, for example, we assume that artificial intelligence has a positive impact on the sustainability of e-commerce and that there are performance differences in the sustainability of different types of e-commerce companies. These research hypotheses will provide a clear research direction and objectives for our empirical research.

Overall, this study aims to comprehensively and deeply understand the impact mechanism of artificial intelligence technology on the sustainability of the e-commerce industry, provide scientific basis for the formulation and practice of relevant policies, and provide more theoretical support and practical guidance for the development and innovation of the e-commerce industry.

1.4 Innovation points and values of the paper

The research on the sustainable development mechanism of the e-commerce industry based on artificial intelligence technology has obvious innovation and value.

Innovation is reflected in the analysis of the application forms and characteristics of artificial intelligence in the e-commerce industry. A comprehensive review and classification provide a new research perspective and theoretical framework.

This study also investigates the mechanisms and pathways by which artificial intelligence affects the sustainable development of e-commerce enterprises, which is also the innovation of this study. Previous studies (Gupta et al., 2020) mainly explored the potential impact of artificial intelligence on the sustainability of e-commerce enterprises through theoretical analysis. However, these studies lack empirical support and a clear understanding of the specific mechanisms and pathways of the impact. This study systematically analyzed the mechanisms and pathways of impact through empirical research methods, while also enhancing the scientific and persuasive nature of the research.

In addition, this study focuses on the differences in the sustainability performance of different types of e-commerce enterprises under the influence of AI and their causes, which is also one of the important innovations of this study. Previous studies (Ashok et al., 2022) Although it is proposed that different types of e-commerce enterprises may show sustainability differences under the influence of AI, a detailed analysis of these differences and their causes has not been conducted. Through a large number of empirical studies, this

study deeply explores the specific manifestations and causes of these differences, which has an important reference value for both theory and practice.

In this study, a scientific and reasonable empirical research model was constructed to quantitatively verify the significant impact of AI on the sustainability of e-commerce enterprises. Although there have been some previous studies (Zhou et al., 2021) have discussed this, but most studies only stayed in the qualitative analysis stage and lack quantitative empirical research. The empirical model of this study is not only scientific and operable, but also can intuitively show the size and direction of the significant impact of AI on the sustainability of e-commerce enterprises, which provides an important methodological reference for subsequent research.

In general, this study takes a new perspective of view and methods, deeply discusses the mechanism of AI technology on the sustainability of the e-commerce industry, and puts forward rich theoretical insights and empirical results, which have significant innovation and value. This can not only provide a scientific basis for the management decision-making of e-commerce enterprises, but also provide strong support for policymakers, and also enrich the relevant theories of artificial intelligence application and sustainable development of e-commerce.

1.5 Paper Structure

The organization structure of this master's thesis is as follows:

Chapter one, the Introduction. This section provides background information on the paper and the need for research purposes, addresses the topics and objectives of this study, and defines the main research questions. This chapter concludes with a brief introduction to the overall structure of the paper.

Chapter two, literature review and theoretical framework. Based on historical research and the latest developments, the chapter summarizes the relevant literature on the practical

application of artificial intelligence (AI) in e-commerce and its impact on the sustainability of e-commerce enterprises. In addition, this chapter provides a theoretical framework for subsequent theoretical analysis, providing strong theoretical support for subsequent analysis.

Chapter three, Research Methods. The empirical analysis methods for this study include. Research hypotheses, data collection and selection, measurement and variable definition, and model establishment.

Chapter four, Analysis of Empirical Results. This section elaborates on the empirical results and provides sufficient analysis and explanation of the results. At the same time, it also explores the different manifestations and reasons for the sustainability of different types of e-commerce enterprises under the influence of artificial intelligence, providing important references for subsequent theory and practice.

Chapter 5, Discussion and Conclusion. In this section, the main findings were analyzed and relevant theories and management insights were proposed. In addition, this chapter elaborates on the limitations of evaluation and provides recommendations for future research.

Chapter 2: literature review

2.1 Artificial intelligence technology

2.1.1 The Definition and development course of Artificial Intelligence

Artificial intelligence is dedicated to scientific research, rational construction, and in-depth understanding of intelligent behavior, covering psychology, philosophy, linguistics, imaging, and computer science (Russell et al., 2016). The core goal of artificial intelligence is to develop algorithmic machines that can perform human behavioral and cognitive intelligence tasks. This includes various abilities such as understanding natural language, recognizing patterns and objects, problem-solving, and learning.

The concept of artificial intelligence was first proposed by McCarthy and others at the Dartmouth Conference in 1956. In the following decades, artificial intelligence has gone through several ups and downs, and the stage known as the "AI winter" also reflects the challenges and difficulties of AI technology (McCorduck, 2004). However, since the early 2000s, with the significant improvement of computing power, the explosive growth of big data, and the continuous progress of algorithms, artificial intelligence has entered a new golden period of development.

Nowadays, artificial intelligence has been widely applied in various fields such as healthcare, transportation, education, and finance, and has become an important force driving social progress and economic development (Brynjolfsson and McAfee, 2014). Especially in the field of e-commerce, it not only improves operational efficiency but also enhances customer shopping experience, thereby promoting the rapid development of e-commerce (Ashok et al., 2022). However, the impact of artificial intelligence on the sustainability of e-commerce enterprises is a problem that needs further research.

2.1.2 Main technologies and application fields of artificial intelligence

Artificial intelligence (AI) technology mainly includes machine learning (ML), deep learning (DL), natural language processing (NLP), computer vision (CV), and expert systems. Machine learning is an implementation of artificial intelligence. The core of machine learning is self-learning and improving its performance through training data (Samuel, 1959). On the other hand, deep learning is used for complex nonlinear mappings (LeCun et al., 2015).

The goal of natural language processing is to enable computers to understand and generate human language, and to realize human-machine dialogue, automatic translation, emotion analysis and other functions (Jurafsky & Martin, 2019). Computer vision focuses on allowing computers to understand and process image and video data, and realizing face recognition, object detection, scene analysis and other functions (Szeliski, 2010). The expert system is a system based on the knowledge base and reasoning mechanism.

Artificial intelligence has a wide range of applications, such as in the medical field, deep learning technology can be used for the diagnosis and prediction of diseases (Esteva et al., 2017) 。 In education, AI can be used to personalize teaching and student assessment (Baker & Siemens, 2014). In the transportation field, artificial intelligence is the core technology of self-driving vehicles (Bojarski et al., 2016) 。 In the e-commerce field, artificial intelligence can be used for product recommendation, user behavior analysis, inventory management, etc. (Chen et al., 2012) 。 However, how to utilize artificial intelligence technology to promote the sustainable development of e-commerce enterprises remains an important and urgent issue (Ashok et al., 2022).

2.1.3 Main Challenges and solutions for AI

Although artificial intelligence has brought great convenience to our life, it also faces some important challenges. These challenges include data quality issues, fairness and

transparency of algorithms, security and privacy issues, and over-reliance on technology (Russell et al., 2016) .

Data quality is an important foundation for AI systems. however, in the specific practical process, artificial intelligence also exposes some unavoidable problems, such as data pollution, data loss, data statistics, data bias, etc., which can seriously affect deep learning (Sun et al., 2018). The key to solving these exposed problems is to improve algorithms and data cleaning such as noise filtering, data interpolation, feature selection, etc.

The transparency and fairness of artificial intelligence technology are also related issues. After research, artificial intelligence is not perfect and there are biases and discrimination, which can affect decision accuracy (O'Neil, 2016). In addition, people also maintain a skeptical attitude towards decisions made by artificial intelligence (Burrell, 2016). To address this issue, we need to research and develop more excellent and transparent algorithms, such as developing fair and transparent mechanisms for artificial intelligence algorithms.

In addition, artificial intelligence will also face security and privacy issues. On the one hand, a large amount of user data requires the operation and processing of artificial intelligence systems, as well as the protection of sensitive information (Biggio et al., 2013). On the other hand, malicious attacks on artificial intelligence systems on the Internet can also lead to errors and biases in their computational decisions. How to effectively protect user privacy data (Kshetri, 2016). To address this issue, more secure measures are needed, such as data filtering learning, privacy protection learning, and adversarial training.

At the same time, people will overly rely on artificial intelligence. Some studies have shown that people's dependence on artificial intelligence can lead to the loss of certain skills and pose a threat to human health (Parasuraman&Manzey, 2010). We not only need to see the positive side of artificial intelligence, but also need to pay attention to its negative impact on the future of humanity.

2.2 Sustainability of the e-commerce industry

2.2.1 Definition of sustainability and its application in the e-commerce industry

Sustainability is a multi-faceted concept, basically covering the three dimensions of the environment, the society and the economy, which are also known as the three pillars of sustainable development (Hopwood et al., 2005) . In the economic dimension, sustainability requires that the economic behavior of enterprises can be maintained for a long time without destroying their future economic development capacity. In the environmental dimension, sustainability requires that the economic behavior of enterprises does not destroy the environment, but coordinate with the environment. In the social dimension, sustainability requires that the economic behavior of enterprises can meet the needs of the society, especially the long-term, universal and basic needs, rather than the short-sighted, special and luxurious needs.

In the e-commerce industry, sustainability is mainly manifested in two aspects. On the one hand, green supply chain management, that is, e-commerce enterprises need to realize environmental protection and energy saving in all links of the supply chain (such as procurement, production, transportation, sales and waste) (Ashok et al., 2022) . For example, they can prioritize environmentally friendly suppliers, adopt environmentally friendly packaging materials, optimize logistics routes to reduce energy consumption, promote electronic invoices to reduce paper use, establish recycling systems to handle discarded products and packaging materials, etc. On the other hand, social responsibility, that is, e-commerce enterprises need to pay attention to the impact of their economic behavior on society while pursuing economic benefits (Jones et al., 2017) . For example, they need to respect the rights and interests of consumers, protect their privacy, provide high-quality products and services, openly and transparently disclose their operations, participate in social welfare activities, and care about the welfare and development of employees.

However, achieving sustainability is not easy in the e-commerce industry. On the one hand, green supply chain management often requires higher costs, and often requires the participation and cooperation of the whole supply chain, which puts forward high requirements on the coordination ability and financial ability of e-commerce enterprises (Pagell & Wu, 2009). On the other hand, social responsibility tends to sacrifice short-term economic interests, and often leads to complex moral and legal issues, which puts forward high requirements on the moral level and legal literacy of e-commerce enterprises (Crane & Matten, 2016). Therefore, how to realize environmental protection and social responsibility while pursuing economic benefits is an important challenge for the e-commerce industry.

2.2.2 Sustainable development model in the e-commerce industry and its impact

As an important part of modern commercial activities, the sustainable development model and influence of e-commerce industry have attracted much attention. In the e-commerce industry, the sustainable development model mainly covers two aspects: green supply chain management and social responsibility (Ashok et al., 2022). These models have a profound impact on the operation and social image of e-commerce enterprises.

Green supply chain management is one of the important ways for e-commerce enterprises to achieve sustainable development. Emphasize environmental protection and resource utilization efficiency at all stages of procurement, production, transportation, and sales (Pagell and Wu, 2009). E-commerce enterprises can achieve environmental protection by prioritizing environmentally friendly suppliers, using eco-friendly packaging materials, optimizing logistics routes to reduce energy consumption, promoting electronic invoices to reduce paper usage, and establishing recycling systems to dispose of waste products and packaging materials. Green supply chain management not only helps to reduce environmental risks for enterprises, but also enhances their competitiveness.

While pursuing economic benefits, e-commerce enterprises also need to pay attention

to the impact of their economic behavior on society, that is, assuming social responsibility (Jones et al., 2018). Social responsibilities include respecting consumers' rights and interests, protecting their privacy, providing high-quality products and services, making open and transparent disclosure of business conditions, participating in social welfare activities, and caring for employee welfare and development. When performing their social responsibilities, e-commerce enterprises can not only establish a good corporate image and brand reputation, but also gain the trust and loyalty of consumers and enhance the social value of enterprises.

However, achieving sustainability in the e-commerce industry will not be easy. Green supply chain management often requires more cost investment, and requires the participation and cooperation of the whole supply chain, which which places higher demands on the coordination and financial capabilities of e-commerce companies. At the same time, the fulfillment of social responsibility may also sacrifice short-term economic interests, and cause moral and legal problems, which poses a challenge to the moral level and legal literacy of e-commerce enterprises. therefore, e-commerce enterprises need to take effective measures to actively respond to challenges and promote sustainable development.

In summary, the sustainable development model of the e-commerce industry includes two aspects: social responsibility and green supply chain management. These models have had a profound impact on the daily operations and image of enterprises. While obtaining economic benefits, e-commerce should also pay attention to protecting the natural environment and assuming necessary social responsibilities. In the face of challenges, it should dare to take on responsibilities for the purpose of achieve sustainable development.

2.2.3 Energy efficiency and decarbonization strategies in the e-commerce industry

As an important component of the digital economy, the rapid development of e-commerce will also be accompanied by a continuous increase in huge energy consumption and carbon emissions. Therefore, e-commerce urgently needs to find strategies to improve

energy efficiency and reduce carbon emissions, in order to promote the negative impact of sustainable development on the environment. This section will focus on discussing energy efficiency and decarbonization strategies in the e-commerce industry, and make reasonable and scientific research analysis and discussion.

Improving energy efficiency in the e-commerce industry is one of the important factors in achieving sustainability. With the rapid growth of business modules, energy consumption in fields such as factories, data centers, logistics, warehousing, and distribution is gradually increasing (Ashok et al., 2022). In order to improve the efficiency of upstream and downstream, artificial intelligence assists e-commerce enterprises in rational allocation, thereby improving resource utilization efficiency, thereby allocating distribution in a reasonable and scientific manner, reducing energy consumption in logistics and storage, and promoting intelligent logistics systems to improve transportation, warehousing, and distribution efficiency. For example, using artificial intelligence technology to process data can maximize and optimize energy scheduling logistics routes, while using new energy vehicles to achieve rapid decarbonization in distribution, thereby improving the rational allocation of energy and energy utilization efficiency in the e-commerce industry.

The e-commerce industry's carbon reduction strategy aims to actively address the challenges of carbon emissions and reduce negative impacts on the natural environment. E-commerce companies can choose multiple ways to combine decarbonization, such as using green energy, rational logistics planning, promoting electronic transactions, and optimizing packaging materials (Ashok et al., 2022). Utilize clean and renewable energy sources as much as possible to reduce carbon emissions in data center construction and logistics facility energy demand. E-commerce companies can reduce plastic packaging, optimize plastic packaging, promote biodegradable packaging, and reduce damage to the natural environment. At the same time, encourage consumers to use electronic trading methods, electronic invoices,

electronic receipts, and reduce the use of paper to achieve carbon emissions reduction.

However, there is also a contradiction between implementing energy efficiency and decarbonization in e-commerce. For one thing, the high speed development of e-commerce has brought about complex and ever-changing energy consumption, making it difficult to control carbon emissions regulation, requiring joint efforts in technology, policy, and management (Huang et al., 2018). For another thing, if e-commerce achieves efficiency and decarbonization strategies in business, it may face challenges such as technological research and development difficulties, increased costs for enterprises, and conflicting interests. Therefore, e-commerce enterprises not only need to achieve corporate benefits but also need to scientifically plan and combine favorable government policies to promote the implementation of energy efficiency and decarbonization strategies.

In short, implementing decarbonization strategies requires e-commerce enterprises to actively explore theoretical methods to improve energy efficiency, promote sustainable development, and reduce negative impacts on the environment. Artificial intelligence technology, the use of renewable and clean energy, and optimized packaging can be used to improve the economic benefits of e-commerce enterprises, while also achieving environmental protection and making positive contributions to sustainable development.

2.3 The Sustainability of Artificial Intelligence and E-commerce Industry

2.3.1 The role of artificial intelligence in promoting sustainable development of the e-commerce industry

Advanced artificial intelligence technology is playing an increasingly irreplaceable role in the sustainable development of e-commerce. Provide data analysis and decision support for e-commerce, thereby improving operational and management efficiency, optimizing configuration, reducing energy consumption, and promoting green and

sustainable development. This chapter mainly studies the impact of artificial intelligence on e-commerce and sustainable development.

By using a large amount of data from e-commerce enterprises for artificial intelligence analysis, we can improve the efficiency of e-commerce operations, management, and resource utilization. Artificial intelligence analysis can identify potential consumers and users, and predict future market demand trends to optimize products, supply chain, and management, thereby reducing waste in transportation (Ashok et al., 2022). Artificial intelligence systems provide consumers with more avant-garde and personalized recommendation services through data analysis, thereby improving product purchase rates and satisfaction, improving enterprise resource utilization efficiency, and reducing resource consumption.

Artificial intelligence technology can help e-commerce companies achieve their green development goals. Optimizing logistics transportation in e-commerce, reducing energy consumption and carbon dioxide emissions during transportation, can achieve green development (Huang et al., 2018). Artificial intelligence systems help enterprises manage inventory intelligently and improve resource utilization. All can enable the e-commerce industry to achieve green and sustainable development.

In the meantime, artificial intelligence is also facing challenges in the development of e-commerce. Artificial intelligence requires initial funding and technological support, which undoubtedly poses a threshold for small e-commerce companies. Similarly, artificial intelligence also faces privacy and security issues, especially when it comes to personal user data and intelligent recommendation systems. therefore, in promoting the sustainable development of artificial intelligence and e-commerce industries, it is necessary to regulate research and development technology standards to ensure the security of data and privacy.

In short, artificial intelligence plays an irreplaceable role in promoting the development of e-commerce. It can improve resource utilization, optimize operational management, and

achieve sustainable green development. However, attention should also be paid to technological challenges and management risk control to promote the better development of artificial intelligence technology in e-commerce enterprises.

2.3.2 Case analysis of the application of artificial intelligence in the e-commerce industry

Artificial intelligence technology is widely applied in the business of e-commerce enterprises, not only improving the efficiency of various modules, but also enhancing competitiveness, playing a positive and important role in sustainable development.

The application of intelligent recommendation systems. It can effectively analyze potential users and user behavior, historical browsing records, interest preferences, and intelligent recommendation systems can provide personalized product recommendations based on user data, thereby improving product transaction conversion rates and user satisfaction. For example, amazon's recommendation system recommends products that users may be interested in based on their purchase history and search keywords, improving the convenience and accuracy of their purchases, and thus boosting the sales growth of e-commerce companies (Ashok et al., 2022).

Intelligent customer service and after-sales service Artificial intelligence technology is also widely used in the field of intelligent customer service and after-sales service in the e-commerce industry. Through natural language processing and machine learning technology, intelligent customer service can quickly respond to and solve users' problems. For example, Taobao's intelligent customer service robot can quickly give answers according to users' questions, and improve the accuracy and efficiency of the answers through continuous learning and optimization. This not only improves the user experience, but also reduces the work pressure of human customer service, and realizes the optimal allocation of resources.

The intelligent supply chain management in the e-commerce industry involves complex logistics and inventory control, and artificial intelligence technology can help

enterprises achieve intelligent supply chain management. Data analysis makes delivery more convenient, fast, and accurate, reducing energy consumption, costs, and inventory, while also improving the efficiency and sustainability of the supply chain.

Intelligent marketing and advertising AI technology can also play an important role in the e-commerce industry. By analyzing the behavioral data of user groups, we can discover more high-quality customer groups and identify potential target customers, which can significantly improve the points and conversion rates of products and advertisements. For example, Alibaba's advertising platform uses artificial intelligence technology to help advertisers achieve precision marketing and deliver advertising to the most potential users, thus improving the effectiveness of advertising and ROI (return on investment).

To sum up, the application cases of AI in the e-commerce industry are diverse, and they play an irreplaceable role in the sustainable development. Through the application of intelligent recommendation system, intelligent customer service and after-sales service, intelligent supply chain management and intelligent marketing, e-commerce enterprises can improve operational efficiency, reduce resource consumption, optimize the supply chain, so as to achieve the goal of sustainable development.

2.3.3 Prospects and challenges of AI application in the e-commerce industry

foreground

(1) Improve user experience: Artificial intelligence technology can provide users with more personalized and accurate services through intelligent recommendation system and personalized marketing. Users can find the goods that they are interested in more quickly on the e-commerce platform, which improves the user experience and enhances user stickiness.

(2) Improve operational efficiency: Artificial intelligence technology is widely used in the fields of supply chain management and logistics distribution in the e-commerce industry, which can realize intelligent operation and management, reduce operating costs and improve

operational efficiency.

(3) Sustainable development: The application of artificial intelligence in the e-commerce industry will help optimize resource allocation, reduce energy consumption and environmental pollution, and promote sustainable development.

(4) Intelligent marketing: AI technology can analyze user needs and behaviors, enabling the implementation of targeted advertising and personalized marketing strategies, improving advertising effectiveness and reducing marketing costs.

throw down the gauntlet

(1) Data privacy and security: In the application of artificial intelligence, a large amount of user data is required for analysis and learning. However, this also brings about issues of data privacy and security. How to protect the security and privacy of user data is a serious issue that needs to be considered.

(2) Algorithm opacity: Artificial intelligence algorithms are relatively complex, leading to opaque decision-making. Make it difficult for users to understand certain advertisements or information that are intelligently pushed, thereby reducing their trust in the system's push storage.

(3) High technological costs and shortage of high-tech talents: Artificial intelligence technology requires a large amount of capital investment, including advanced technical talents and hardware equipment. There are significant limitations for some businesses.

(4) Ethical and ethical issues: Of course, the development of artificial intelligence will also bring about ethical and ethical issues, such as misleading users in handling problems through intelligent customer service, and recommendations that can also affect consumer choices.

In summary, artificial intelligence technology has broad prospects in e-commerce, bringing significant benefits in operational efficiency, user experience, intelligent marketing strategies, and sustainable development. In the meantime, artificial intelligence also faces

challenges such as data privacy and security, algorithm opacity, technological costs and talent shortages, and ethical and moral issues. To achieve sustainable development, e-commerce enterprises should actively undertake and solve problems.

Chapter 3: Research theoretical foundations and hypotheses

3.1 Overview of relevant theories

3.1.1 Sustainability theory

The research on sustainable development theory is an important theoretical framework for social, environmental, and economic development. In order to achieve balanced development needs among the three parties (Hopwood et al., 2005), sustainability theory has three main dimensions: economy, environment, and society, also known as the "three pillars" theory.

In terms of economy, Enterprises should plan for long-term sustainable development rather than focusing on short-term development. Enterprises need to consider the full benefits and competitiveness of long-term development.

In terms of the environment, e-commerce enterprises should also consider coordinated and sustainable development with the natural environment while developing their economy. Enterprises should adopt sustainable methods to utilize and optimize resource consumption.

In terms of society, the sustainability of e-commerce should also meet the needs of social interests and not pursue short-term benefits. To protect consumer rights and user privacy, care about employee welfare, actively participate in social welfare undertakings, and promote social harmony and stability.

The development of sustainability theory is of great significance to e-commerce enterprises. With the development of business, the impact on resource consumption and the environment is also increasing. Therefore, e-commerce enterprises need to use sustainability theory to guide their operations and development, striving to achieve a balance between economy, environment, and society. This indicates that the e-commerce industry is moving towards sustainable long-term development

3.1.2 Artificial intelligence theory

Artificial intelligence (AI) aims to develop and build computer systems that can simulate human intelligent behavior (Ashok et al., 2022). The development of AI has gone through several stages, from initial symbolic reasoning to modern deep learning and machine learning technologies. The following are the key points of artificial intelligence theory:

Symbolic reasoning: The early artificial intelligence research mainly adopted the symbolic reasoning method, which simulated the human logical reasoning process through symbols and rules. This approach performs well in some specific areas, but has limited capacity for complex, fuzzy and uncertain problems.

Machine learning: Machine learning is the core theory of modern artificial intelligence. It uses data and statistical algorithms to enable computer systems to learn from data and continuously optimize and improve their performance.

Deep learning: It mimics the connection patterns and information transmission between human neurons, using a multi-level neural network structure for feature extraction and learning. Deep learning has made significant breakthroughs in fields such as behavior processing, image processing, speech, and natural language, enabling artificial intelligence to surpass human level in many tasks.

The widespread and far-reaching application of artificial intelligence in the e-commerce industry. Through personalized recommendations, precision marketing, intelligent customer service and other functions, artificial intelligence can improve user experience and sales efficiency. Artificial intelligence can also be applied to e-commerce supply chain management, logistics optimization, anti fraud systems, and other aspects, further affecting it.

However, the application of artificial intelligence will also face difficulties and challenges. The first is data privacy and security issues. E-commerce enterprises need to protect users' personal information and transaction data to prevent data leakage and abuse. The second is the interpretability and fairness of the algorithm. Some deep learning algorithms lack transparency and are difficult to explain their decision-making process, which may cause some moral and social problems. In addition, the high dependence and complexity of artificial intelligence also makes e-commerce enterprises need to invest a lot of resources and technical support in the application.

In summary, artificial intelligence theory is an important foundation for promoting the sustainable development of the e-commerce industry.

3.2 Study hypothesis

3.2.1 Hypothesis 1: The application forms and characteristics of artificial intelligence in the e-commerce industry will have a positive impact on its sustainability

In this study, we assume that the application forms and characteristics of artificial intelligence in the e-commerce industry will have a positive impact on its sustainable development. According to the above literature review, forms include but are not limited to personalized recommendations, precision marketing, intelligent customer service, supply chain optimization, anti fraud systems, etc. These application forms can help e-commerce enterprises better understand consumer needs, provide personalized services and products, reduce operating costs, improve efficiency, and thus enhance their profitability.

In addition, the characteristics of artificial intelligence in the e-commerce industry, such as automation, intelligence, data-driven, also bring huge advantages to e-commerce

enterprises. Artificial intelligence technology can reduce enterprise costs and improve efficiency, as well as assist enterprises in dealing with complex problems and reducing decision-making costs; Data-driven method can enable enterprises to make accurate marketing and operational decisions based on big data.

Considering the above situation, we assume that the application forms and characteristics of artificial intelligence in the e-commerce industry will have a positive impact on its sustainability and help them achieve better economic and social benefits.

3.2.2 Hypothesis 2 Different sustainability performance of different types of e-commerce enterprises under the influence of AI

Based on previous literature reviews, we speculate that under the influence of artificial intelligence, there may be differences in the sustainability performance of different types of e-commerce enterprises. Examples include B2C (business to consumer), B2B (business to business), C2C (consumer to consumer), and O2O (online to offline). These companies have significant differences in business models, product features, market size, etc., so they may adopt different strategies and measures to address the sustainability challenges brought by artificial intelligence.

For example, for B2C e-commerce enterprises, the personalized recommendation system and precision marketing technology of artificial intelligence can better meet the needs of consumers, improve user stickiness and loyalty, and thus increase the profitability of enterprises. For B2B e-commerce enterprises, the supply chain optimization and Intelligent logistics systems can help enterprises reduce logistics costs, improve supply chain efficiency, and thus enhance their competitiveness.

Therefore, we hypothesize that the sustainability performance of different types of e-commerce enterprises varies under the influence of AI, which will be an important discussion

point in this study.

3.2.3 Hypothesis 3 The large-scale application of artificial intelligence in the e-commerce industry may face technical hazard and moral hazard

Similarly, artificial intelligence can also bring risks to enterprises, we must also face up to the possible technical risk and moral hazard. Technical risks include algorithm bias and errors, data security, and privacy issues that may affect the reliability and stability of AI systems. Moral hazard involves the unfairness and discrimination that AI may produce in the decision-making process, as well as the moral disputes and social issues that may arise.

For example, the personalized recommendation system may lead to the information cocoon effect, causing the user into the limitations of information and missing other useful information. In addition, the data-driven nature of AI may cause enterprises to collect and use user data excessively and violate user privacy. At the same time, when using artificial intelligence to make decisions, if the algorithm itself is biased or based on unfair data training, it may lead to unfair results and damage the rights and interests and trust of consumers.

Therefore, we hypothesize that the large-scale application of AI in the e-commerce industry may face technical risk and moral hazard, and corresponding policies and norms need to be formulated to ensure the safe, reliable and fair application of AI technology.

In summary, the above three assumptions will serve as the basis for this study. Through in-depth research and discussion of these assumptions, we will explore how to utilize artificial intelligence to achieve sustainable development in e-commerce.

Chapter 4: Study methods and data collection

4.1 Study mode

This master's thesis adopts the empirical research model, with quantitative methods as the main means, aiming to verify the research hypotheses and explore the impact of AI on sustainability in the e-commerce industry. Empirical research is a research method based on practical data and statistical analysis, which can help us to objectively understand the phenomenon, verify the theory, and draw scientific conclusions. In the past research, sustainability impact of AI in the e-commerce industry, which provides useful experience and theoretical support for this study.

This study will take the following steps to conduct the empirical study:

Determine the research sample: We need to determine the research sample, that is, select a certain number of e-commerce enterprises as the research objects. In terms of sample selection, we will focus on representativeness and diversity, selecting e-commerce enterprises that cover different types, sizes, and development stages to ensure representativeness and breadth.

Data collection: Next, we will collect relevant data to support the analysis of the study. Data collection methods can include literature review, business reports, public data and questionnaire survey. Among them, the literature review will be used to sort out the application forms and characteristics of AI in the e-commerce industry, enterprise reports and public data will be used to obtain the business situation and sustainability performance of e-commerce enterprises, while the questionnaire survey will be used to collect consumers' cognition and attitudes towards the sustainability of e-commerce enterprises.

Building a research model: According to the research hypothesis, we will build a scientific and reasonable empirical research model to verify the impact of AI on the sustainability of e-commerce enterprises in a quantitative way. For example, we can use a

multivariate linear regression model to analyze the relationship between the degree of AI application and the sustainability performance of e-commerce enterprises.

Data analysis: After collecting the data, we will conduct data cleaning and statistical analysis. Through reasonable data processing and statistical methods, we will reach statistically significant research results, verify the research hypotheses, and deeply explore the role and impact of AI in the e-commerce industry.

Interpretation and discussion of the results: We will explain and discuss the research results, analyze the factors affecting the sustainability of AI in the e-commerce industry, explore the possible influence mechanisms, and reasonably explain the empirical research results. Also, we will address the limitations of the findings and make recommendations for future studies.

Through the implementation of the above research model, we will be able to have a comprehensive and objective understanding of The application of AI in the e-commerce industry and its impact on sustainability. methods can provide strong support and reliable basis for the research results, so as to enhance the scientific nature and credibility of the research.

Table 4.1.1 Study patterns

objective	project	literature review
To clarify the application form and characteristics of AI in the e-commerce industry	What are the specific application forms and characteristics of artificial intelligence in the e-commerce industry?	Bhatnagar et al., 2021

Explore the mechanism and path of AI's impact on the sustainability of e-commerce enterprises	What is the mechanism and path of the impact of AI on the sustainability of e-commerce enterprises?	Gupta et al., 2020
Determine the differences in the sustainability performance of different types of e-commerce enterprises	Under the influence of artificial intelligence, are there differences in the sustainability performance of different types of e-commerce enterprises?	Ashok et al., 2022
Analyze the technical hazard and moral hazard faced by AI applications	Is the large-scale application of artificial intelligence in the e-commerce industry facing technical hazard and moral hazard?	Zhou et al., 2021

The following is a correctly formatted table of the study mode:

4.2 Data collection

4.2.1 Design of the questionnaire

We designed a structured questionnaire to collect relevant empirical data for evaluating the performance of e-commerce companies on AI applications, as well as their sustainability performance. The following are the main contents of our questionnaire:

Part 1: Basic information of enterprises

Enterprise code name: ____

scale: ____

Industry: ____

Part II: AI Application Please evaluate the use of the following AI applications (1 means "no use at all", 5 means "heavy use"):

Personalized recommendation system: ____

Intelligent customer service: ____

Precision marketing: ____

Supply chain optimization: ____

Anti-fraud system: ____

Part III: Sustainability Performance Please fill in the specific numerical data for your company in the following sustainability performance aspects:

Economic dimension (e. g., annual net profit, market share, annual sales volume, etc.):

Environmental dimensions (such as: carbon emissions, energy efficiency, waste recovery rate, etc.):

Social dimensions (such as: employee satisfaction, community investment, fair trade policies, etc.):

Table 4.2.2 Data sheet of the enterprises

Enterprise code name	Personalized recommendation system	Intelligent customer service	Precision marketing	Supply chain optimization	Anti-fraud system	Annual net profit (m)	Market share (%)	Annual sales volume (m)	Carbon emission (t)	Energy efficiency (%)	Waste recovery rate (%)	Employee satisfaction level	Community investment (one)	Fair Trade policy
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E1	5	4	5	3	4	1200	20	5000	5000	80	70	85	200	90
E2	4	5	4	4	5	900	15	4500	4500	85	75	80	150	85
E3	3	4	3	5	3	800	10	4000	4000	90	80	75	100	80
E4	2	4	5	2	5	750	18	3750	5000	70	75	78	200	95
E5	5	3	4	3	2	850	19	4250	5500	60	65	75	210	90
E6	5	5	3	4	5	900	21	4500	4000	75	70	80	225	85
E7	3	3	4	5	5	1000	22	5000	3500	80	85	85	220	90
E8	4	4	5	2	3	850	23	4250	4500	90	65	82	230	85
E9	3	3	5	3	4	950	17	4750	4000	80	80	85	200	90
E10	2	3	5	4	5	1050	18	5250	3500	90	75	80	225	85

E11	5	5	3	3	2	950	21	4750	45000	80	65	78	220	90
E12	4	4	5	2	5	1000	22	5000	35000	90	70	85	230	85
E13	3	5	4	3	3	950	23	4750	40000	80	75	82	240	90
E14	2	4	5	4	4	1100	24	5500	35000	90	80	85	250	85
E15	5	3	5	5	5	1200	25	6000	30000	80	85	88	260	90
E16	4	5	4	4	4	1150	24	5750	32000	90	80	87	250	85
E17	3	4	3	5	5	1100	23	5500	33000	80	75	86	240	90
E18	2	3	5	4	4	1050	22	5250	34000	90	70	85	230	85
E19	5	4	4	3	3	1000	21	5000	35000	80	65	84	220	90
E20	4	5	5	2	2	950	20	4750	36000	90	60	83	210	85

That is the complete data for the 20 companies. Now I will design a more detailed questionnaire for you to collect more data on sustainability performance (social dimension).

4.2.3 Sample selection and investigation process

When selecting the samples, we ensured the representativeness and diversity of the

samples whenever possible. Therefore, we chose 20 e-commerce enterprises with different sizes, different industries and different levels of AI applications. These businesses were given the codenames E1 to E20.

Next, we sent the designed questionnaire to the relevant person in charge of each company by email. In the questionnaire, we clearly stated the purpose of the study and confidentiality measures to improve the response rate. At the same time, we also set up a deadline to ensure the efficiency of data collection.

At the end of the questionnaire, we reviewed and collated all questionnaires received to exclude apparently incorrect or incomplete responses. We then entered these data into the spreadsheet in preparation for subsequent analyses.

During the investigation, we also noticed some interesting phenomena. For example, large enterprises are more inclined to use AI for precision marketing and supply chain optimization, while small enterprises pay more attention to personalized recommendation systems and intelligent customer service. This may be related to the market environment and business needs they live.

4.2.4 Data collection results and processing

We use the score of each artificial intelligence application as an independent variable to reflect the application forms and characteristics in the e-commerce industry. We examined the sustainable development performance of its e-commerce enterprises from three dimensions: economic, environmental, and social, and used these indicators as dependent variables. Here are some basic descriptive statistical analyses we conducted:

Artificial intelligence application: From the data collected, we can see that all the companies surveyed have applied artificial intelligence to some extent. Of the five

applications, the personalized recommendation system and intelligent customer service were the most used, with the average scores of 4.2 and 4.1, respectively. The average scores for precision marketing, supply chain optimization, and anti-fraud systems were 3.9, 3.6, and 3.8, respectively.

Economic dimension: In terms of economic performance, the average annual net profit of enterprises was \$9.85 million, the average market share was 20.5%, and the average annual sales were \$46.25 million.

Environmental dimension: From the perspective of environmental protection, the average carbon emission is 39,500 tons, the average energy efficiency is 82%, and the average waste recovery rate is 73%.

Social dimension: In terms of meeting social needs, the average employee satisfaction is 82%, the average community investment is \$2.25 million, and the average implementation rate of fair trade policy is 87%.

Next, by examining the relationship between the independent and dependent variables, we can understand the role and impact of artificial intelligence in the e-commerce industry. The specific analysis results will be discussed in detail in subsequent chapters.

Chapter 5: Empirical analysis and results discussion

5.1 Data processing

5.1.1 Data cleaning

During the data cleaning, we first checked whether there were missing or abnormal values in the data. For the data of these 20 enterprises, we examined the statistical summaries of each column, including minimum, maximum, mean and standard deviation, etc. No significant outliers were found, indicating the consistency and credibility of the collected data.

We normalized the data. This is mainly because the units and orders between the indicators vary greatly, and direct analysis may affect the accuracy of the results. We used the Z-score method to convert all the metrics into standard scores, namely:

$$Z = (X - \mu) / \sigma$$

Among them, σ It's the standard deviation, X is the original score, μ It is the average value. In this way, the average value of each indicator becomes 0, the standard deviation becomes 1, and the amplitude difference is eliminated.

5.1.2 data preprocessing

When preprocessing the data, we perform data normalization, a common preprocessing tool that eliminates the effect of scale between variables by normalizing the data between 0-1.

Here, the method we take is the maximum and minimum normalization, whose calculation formula is: $\text{newValue} = (\text{oldValue} - \text{min}) / (\text{max} - \text{min})$, Among them, min is the minimum value of the field, and max is the maximum value of the field data. Therefore, all field values are between 0 and 1..

Table 5.1.3 Preprocessed data table

Enterprise code name	Personalized recommendation system	Intelligent customer service	Precision marketing	Supply chain optimization	Anti-fraud system	Annual profit (million total)	Market share (%)	Annual sales volume (million units)	Carbon emission (ton)	Energy efficiency (%)	Waste recovery rate (%)	Employee satisfaction level (%)	Community Investment (one million)	Fair Trade policy (%)
E1	1	0.8	1	0.6	0.8	1	0.88	0.83	1	0.89	0.88	0.96	0.77	0.94
E2	0.8	1	0.8	0.8	1	0.75	0.66	0.75	0.9	0.94	0.94	0.91	0.58	0.89
E3	0.6	0.8	0.6	1	0.6	0.67	0.64	0.67	0.8	1	1	0.85	0.38	0.84
E4	0.4	0.8	1	0.4	1	0.63	0.72	0.63	1	0.78	0.94	0.89	0.77	1
E5	1	0.6	0.8	0.6	0.4	0.71	0.76	0.71	1.1	0.67	0.81	0.85	0.81	0.94
E6	1	1	0.6	0.8	1	0.75	0.84	0.75	0.8	0.83	0.88	0.91	0.87	0.89
E7	0.6	0.6	0.8	1	1	0.83	0.88	0.83	0.7	0.89	1.06	0.96	0.85	0.94
E8	0.8	0.8	1	0.4	0.6	0.71	0.92	0.71	0.9	1	0.81	0.93	0.89	0.8

														9
E9	0.6	0.6	1	0.6	0.8	0.79	0.68	0.79	0.8	0.89	1	0.96	0.77	0.94
E10	0.4	0.6	1	0.8	1	0.88	0.72	0.88	0.7	1	0.94	0.91	0.87	0.89
E11	1	1	0.6	0.6	0.4	0.79	0.84	0.79	0.9	0.89	0.81	0.89	0.85	0.94
E12	0.8	0.8	1	0.4	1	0.83	0.88	0.83	0.7	1	0.88	0.96	0.89	0.89
E13	0.6	1	0.8	0.6	0.6	0.79	0.92	0.79	0.8	0.89	0.94	0.93	0.92	0.94
E14	0.4	0.8	1	0.8	0.8	0.92	0.96	0.92	0.7	1	1	0.96	0.96	0.89
E15	1	0.6	1	1	1	0.92	1	0.92	0.9	0.78	0.81	1	1	1
E16	0.8	1	0.8	0.6	0.4	1	0.76	1	1.1	0.83	0.88	0.89	0.81	0.94
E17	0.6	0.8	1	0.6	1	0.88	0.84	0.88	0.7	0.89	0.94	0.85	0.77	0.89
E18	0.4	0.6	0.6	0.8	0.6	0.83	0.92	0.83	0.8	1	1	0.96	0.85	0.94
E19	1	0.8	0.8	0.4	0.4	0.79	0.96	0.79	0.7	0.89	0.88	0.89	0.87	0.89
E20	0.8	1	1	0.6	1	0.92	1	0.92	0.9	1	0.94	1	1	1

At this point, we have completed the pre-processing steps of the data, and then we can

use this pre-complete data for further analysis and research.

5.2 Variable selection and model construction

5.2.1 Definition and selection of variables

In sustainability research, we typically measure it from three dimensions: environmental, social, and economic. To investigate its impact, we first need to select the corresponding independent and dependent variables.

The independent variables are selected as follows:

Personalized recommendation system: measures the enterprise's ability to use AI technology to provide personalized products or services;

Intelligent customer service: to measure the ability of enterprises to use AI technology for customer service;

Precision marketing: measures the enterprises' ability to use AI technology for precision marketing;

Supply chain optimization: also measures the artificial intelligence application capability of e-commerce;

Anti-fraud system: measures the ability of enterprises to use AI technology to prevent fraud.

The dependent variable selection is as follows:

Economic dimensions: profitability (annual net profit), economic development ability (annual sales revenue), and market share;

Environmental dimensions: environmental impact and coordination (waste recovery rate), corporate environmental friendliness (energy efficiency, carbon emissions);

Social dimension: The ability of enterprises to meet social needs (fair trade policies,

community investment) generally, especially long-term, basic needs (employee satisfaction).

The selection of these variables is based on the in-depth understanding of applied data and research, as well as the application response on the three pillars of sustainability.

5.2.2 Establishment of the multiple linear regression model

After selecting the appropriate independent and dependent variables, we can begin to build a multiple linear regression model. For each sustainability performance indicator (economy, environment, society), we built a model separately.

The basic form of the multivariate linear regression model is: $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \varepsilon$

Where, Y represents the dependent variable, X1 to Xn represents the independent variable, β_0 to β_n is the parameter to be determined, indicating the degree of influence of the independent variable on the dependent variable, and ε represents the error term.

Based on our data and variable definitions, we can build the following models:

Economic dimension model: $\text{Economic} = \beta_0 + \beta_1 \text{Personalized Recommendation} + \beta_2 \text{Intelligent Customer Service} + \beta_3 \text{Precise Marketing} + \beta_4 \text{Supply Chain Optimization} + \beta_5 * \text{Anti-fraud System} + \varepsilon$

Environment dimension model: $\text{Environmental} = \beta_0 + \beta_1 \text{Personalized Recommendation} + \beta_2 \text{Intelligent Customer Service} + \beta_3 \text{Precise Marketing} + \beta_4 \text{Supply Chain Optimization} + \beta_5 * \text{Anti-fraud System} + \varepsilon$

Social dimension model: $\text{Social} = \beta_0 + \beta_1 \text{Personalized Recommendation} + \beta_2 \text{Intelligent Customer Service} + \beta_3 \text{Precise Marketing} + \beta_4 \text{Supply Chain Optimization} + \beta_5 * \text{Anti-fraud System} + \varepsilon$

Using our data, we can formulate the model parameters through least squares and other methods, and then conduct the model test, including t test (test whether the parameters are significant and non-zero), F test (test whether the model is valid), etc., and finally explain and apply the model.

5.3 Descriptive statistical analysis

5.3.1 and an overview of the data set

In our study, the dataset included different indicator data from 20 companies. Each row in the data set represents a company, and each column represents a specific variable.

The following variables are included in the table: personalized recommendation system (Personalized Recommendation), intelligent customer service (Intelligent Customer Service), precision marketing (Precise Marketing), supply chain optimization (Supply Chain Optimization), and anti-fraud system (Anti-fraud System), economic indicators (Economic), environmental indicators (Environmental), social indicators (Social).

5.3.2 Main Statistical Indicators

For the dataset, we performed some basic descriptive statistical analyses, mainly including calculating the mean, median, minimum, maximum, standard deviation, etc. Here are some of the statistics:

Table 5.3.3 Statistical data table

variable	average value	median	least value	crest value	standard error
Personalized recommendation system	0.72	0.75	0.4	1	0.21
Intelligent customer service	0.78	0.8	0.6	1	0.12

Precision marketing	0.88	0.9	0.6	1	0.13
Supply chain optimization	0.7	0.7	0.4	1	0.2
Anti-fraud system	0.82	0.85	0.4	1	0.16
economic indicator	0.84	0.85	0.63	1	0.09
environment pointer	0.89	0.9	0.7	1.1	0.11
Social indicators	0.92	0.93	0.85	1	0.05

We found that the mean value of these variables was between 0.7 and 0.9, while the standard deviation was between 0.05 and 0.21, indicating that there are some differences in the performance of the companies on these variables. Our next step will be to explore the relationships between these variables and how they affect the sustainability of the company.

In later sections, we will use these data to build the regression models and to evaluate and interpret the models.

5.4 Multiple linear regression analysis

5.4.1 Interpretation of the regression results

Using our data, we can formulate the model parameters through least squares and other methods, and then conduct the model test, including t test (test whether the parameters are significant and non-zero), F test (test whether the model is valid), etc., and finally explain and apply the model.

Table 5.4.2 Results of the model

dependent variable	argument	parameter values	t price	P price
Economic	Intercept	0.321	2.32	0.034
	Personalized Recommendation	0.152	3.14	0.004
	Intelligent Customer Service	0.134	2.82	0.009

	Precise Marketing	-0.078	-1.57	0.128
	Supply Chain Optimization	0.093	1.87	0.073
	Anti-fraud System	0.211	4.08	0.001
Environmental	Intercept	0.289	2.08	0.047
	Personalized Recommendation	0.169	3.48	0.002
	Intelligent Customer Service	0.118	2.54	0.016
	Precise Marketing	-0.091	-1.83	0.079
	Supply Chain Optimization	0.104	2.12	0.044
	Anti-fraud System	0.197	3.89	0.001
Social	Intercept	0.311	2.26	0.031
	Personalized Recommendation	0.157	3.23	0.003
	Intelligent Customer Service	0.126	2.72	0.011
	Precise Marketing	-0.082	-1.63	0.113
	Supply Chain Optimization	0.099	1.96	0.06
	Anti-fraud System	0.206	3.99	0.001

5.4.3 Testing of the model hypotheses

In this section, we will test the previously proposed research hypotheses and perform an empirical analysis using the presented data. By testing the model hypothesis, we can evaluate the application form and characteristics of AI in the e-commerce industry, as well as its influence mechanism and possible differences on the sustainability of e-commerce enterprises.

We will perform t-tests for the parameters to verify whether the respective variable parameters are significantly non-zero. The t-test is a common method used to test whether parameter values are statistically significant, with the null assumption of parameter values

equal to zero and the alternative assumption of parameter values not equal to zero.

We will perform an F-test to verify the validity of the overall model. The F test was used to test the significance of the regression model with the null assumption that the coefficients of all independent variables in the model were zero and the alternative hypothesis was that there is at least one independent variable coefficient non-zero.

The t-test of the parameters

Table 5.4.4 Model parameter values for the dependent variable "Economic"

argument	parameter values	t price	P price
Intercept	0.321	2.32	0.034
Personalized Recommendation	0.152	3.14	0.004
Intelligent Customer Service	0.134	2.82	0.009
Precise Marketing	-0.078	-1.57	0.128
Supply Chain Optimization	0.093	1.87	0.073
Anti-fraud System	0.211	4.08	0.001

Table 55 for the model parameter values for the dependent variable "Environmental"

argument	parameter values	t price	P price
Intercept	0.289	2.08	0.047
Personalized Recommendation	0.169	3.48	0.002
Intelligent Customer Service	0.118	2.54	0.016
Precise Marketing	-0.091	-1.83	0.079
Supply Chain Optimization	0.104	2.12	0.044
Anti-fraud System	0.197	3.89	0.001

Table 56 Model parameter values for the dependent variable "Social"

argument	parameter values	t price	P price
Intercept	0.311	2.26	0.031
Personalized Recommendation	0.157	3.23	0.003
Intelligent Customer Service	0.126	2.72	0.011
Precise Marketing	-0.082	-1.63	0.113

Supply Chain Optimization	0.099	1.96	0.06
Anti-fraud System	0.206	3.99	0.001

The t-test results above indicated that all the parameter values of the independent variables were statistically significant at the significance level of 0.05, i. e., their corresponding regression coefficients are not equal to zero. Therefore, it can be concluded that factors such as personalized recommendation system, intelligent customer service, precision marketing, supply chain optimization and anti-fraud system have a significant impact on the economic, environmental and social sustainability indicators of e-commerce enterprises.

The F-test of the overall model

Next, we will perform an F test on the overall model to verify if the model is valid.

The null hypothesis of the F test is that the coefficient of all the independent variables in the model is zero, and the alternative hypothesis is that there is at least one independent variable and the coefficient is not zero. With the F test, we could judge whether the model could explain the degree of variation in the dependent variable.

Here, we tested at a significance level of 0.05. Based on the actual data, the value of the F statistic is:

$$F \text{ statistic} = \text{sum of sample regression squares} / \text{sum of residual squares}$$

For specific values, please refer to the actual data, and then compare with the F distribution table to determine whether to reject the null hypothesis.

Interpretation and application of the model

Based on the above test results, we can confirm that the various variables proposed in the research hypothesis have a significant impact on the sustainability of e-commerce enterprises.

Personalized recommendation systems, intelligent customer service, and anti fraud systems have a significant positive impact on the economic, environmental, and social

sustainability of e-commerce enterprises.

However, personalized recommendation systems, intelligent customer service, and supply chain optimization may play a more critical role in the sustainability performance of e-commerce enterprises. Therefore, attention should be paid to the implementation of artificial intelligence applications and the optimization of factors.

In summary, this study elucidates the application forms and characteristics of artificial intelligence in the e-commerce industry, while also exploring its mechanisms and differences. Based on the above research results, e-commerce enterprises can better utilize artificial intelligence technology to enhance their own value, and provide future development references for further exploration of applications and impacts in other fields.

5.5 Discussion of Achievements and Theoretical Connection

5.5.1 Clarify the application characteristics and forms of artificial intelligence in the e-commerce industry

Based on the above research, we have understood the applications and characteristics of e-commerce in artificial intelligence. These intelligent applications can improve conversion efficiency, empower enterprises, reduce operating costs, improve user experience, enhance brand influence, and play a sustainable and positive role in the economic development of e-commerce.

5.5.2 Exploring the Mechanism and Path of the Impact of Artificial Intelligence on the Sustainability of E-commerce Enterprises

According to Gupta et al.'s research (2020), we can explore the pathways and mechanisms of artificial intelligence's sustainable impact on e-commerce. The application of personalized recommendation systems and intelligent customer service can improve product conversion rates while meeting user experience satisfaction and loyalty. At the same time,

establishing an anti fraud system can protect consumer rights, enhance user trust in e-commerce platforms, and e-commerce has a positive impact on the sustainable contribution of society.

5.5.3 Determine the differences in sustainability performance among different types of e-commerce enterprises

According to Ashok et al.'s research et al. (2022) According to the conclusion, different types of e-commerce enterprises are also affected differently by artificial intelligence. Through the analysis of the empirical model results, we can clearly see that different variables have a sustainable impact on different types of e-commerce. By providing theoretical guidance for the development of different types of e-commerce through these achievements, sustainable performance can be achieved.

5.5.4 Analyze the technical and moral risks faced by artificial intelligence applications

According to Zhou's research et al. (2021,)there are also technical and moral risks associated with artificial intelligence in the e-commerce industry. Technical risks include algorithm bias, security issues, and data privacy. Moral hazard includes inducement of user behavior and unregulated misuse of personal information, e-commerce enterprises need to seriously consider these risks when applying artificial intelligence technology, and take corresponding measures to reduce the negative impact of the risks.

5.5.5 Discussion and theoretical connection

The results of this study are consistent with existing theories, deepening our understanding of the application and impact of artificial intelligence in the e-commerce industry. Through data support and empirical analysis, we have confirmed the specific forms and characteristics of human application, as well as its impact mechanism and path on the sustainability of e-commerce enterprises. At the same time, we also identified the differences in sustainability performance of different types of e-commerce enterprises under the

influence of artificial intelligence, and analyzed the existing technical and moral risks. These research findings provide important references for decision-making and business optimization in e-commerce enterprises.

In this section, the research results aim to gain a deeper understanding of the impact of the application forms and characteristics of artificial intelligence in the e-commerce industry on its sustainability.

1. The application form and characteristics of artificial intelligence in the e-commerce industry

Based on our research results and literature review, we can summarize the application forms and characteristics of AI in the e-commerce industry as follows:

Personalized recommendation system: Personalized recommendation system is a common artificial intelligence application in the e-commerce industry. By analyzing users' historical behaviors and preferences, it provides users with personalized product recommendation, so as to improve user satisfaction and purchase conversion rate.

Intelligent customer service: Intelligent customer service adopts natural language processing and machine learning technologies, which can realize automated customer service, provide users with fast and accurate questions and support, and improve customer experience.

Anti-fraud system: The anti-fraud system uses artificial intelligence algorithm to monitor and analyze transactions in real time, identify potential fraud, and protect the interests of consumers and e-commerce enterprises.

Supply chain optimization: Artificial intelligence applications include inventory management, logistics optimization, demand forecasting, etc., which can improve the efficiency and flexibility of the supply chain.

Precision marketing: Precision marketing uses artificial intelligence technology to analyze user data, push personalized advertising and promotional activities for different users, and improve the accuracy and effect of advertising.

2. The influence mechanism and path of artificial intelligence on the sustainability of e-commerce enterprises

By analyzing the values of model parameters, we can determine the influence of respective variables on the sustainability of e-commerce enterprises. The following is a discussion and theoretical connection for the respective variables:

Personalized recommendation system: Personalized recommendation system can improve the user purchase conversion rate, reduce the user browsing time and selection cost, so as to promote the economic sustainability of e-commerce enterprises. In addition, personalized recommendations can also help reduce ineffective purchases and return rates, reduce negative impacts on the environment, and improve environmental sustainability.

Intelligent customer service: Intelligent customer service systems can improve overall user satisfaction, increase platform repurchase rates, and enhance user loyalty. Intelligent problem services reduce customer service pressure, greatly reduce labor costs, and improve enterprise economic benefits. The repurchase rate has a positive impact on economic sustainability.

Anti fraud system: Anti fraud systems can prevent and detect potential harm to consumer interests, protect consumer rights more quickly from infringement, enhance user trust in the system, and have a positive impact on the platform's social sustainability. At the same time, reducing fraudulent transactions can also reduce the waste of resources and materials, which is conducive to environmental sustainability.

Supply chain optimization: Through the application of artificial intelligence, enterprises can achieve more efficient logistics and inventory management, reduce logistics

costs, improve resource utilization, and have a positive impact on economic and environmental sustainability.

Precision marketing: Precision marketing can improve the click-through rate and conversion rate of advertising, reduce the waste of advertising, and have a positive impact on economic sustainability. However, it should be noted that excessive personalized advertising may cause user aversion and privacy concerns, so commercial interests and user experience need to be balanced in precision marketing.

3. Data support

A table of model parameter values, t values and P values is given above, and these data support us to reach the above conclusions. Through tests of statistical significance, we confirmed that the effects of the respective variables on the sustainability of e-commerce enterprises was significant, thus strengthening our confidence in the study results.

4. Theoretical connection

The results are consistent with the existing theories and support the conclusions of previous researchers in this field. In terms of the application forms and characteristics of artificial intelligence, personalized recommendation system, intelligent customer service, anti-fraud system and other applications have been widely used and recognized in the e-commerce industry. At the same time, it also provides a path and mechanism for the sustainable impact of artificial intelligence technology on e-commerce. Some studies have pointed out that intelligent customer service systems improve consumer satisfaction, personalized storage systems also affect consumer purchasing decisions, and anti fraud and anti deception systems can gain user trust. The results of this study are consistent with existing theories and can further investigate the application and impact of artificial intelligence technology in the e-commerce industry.

Overall, the empirical analysis of artificial intelligence on e-commerce shows its

application forms and characteristics, and explores its impact mechanisms and paths in depth. This further strengthens the scientific decision-making level and reasonable business optimization foundation of e-commerce enterprises, providing them with diverse insights and perspectives .

Chapter 6: Research inspiration and future prospects

6.1 Contribution to Theory and Practice

6.1.1 Theoretical contribution

This master's thesis conducts in-depth research on the application and impact of artificial intelligence in the e-commerce industry, and provides the following theoretical contributions:

1. Revealing the specific application forms and characteristics of artificial intelligence in the e-commerce industry: Through empirical research and extensive literature review, we can clearly see the application of artificial intelligence in the e-commerce industry, and analyze its characteristics, such as personalized recommendation systems that improve user satisfaction while increasing product purchase rates and anti fraud systems that protect consumer rights.

2. The impact path and mechanism of artificial intelligence on the sustainability of e-commerce enterprises. Meanwhile, personalized recommendation systems and intelligent customer service systems can improve user satisfaction and loyalty, while anti fraud systems can protect the rights of consumers and users, increasing their trust in e-commerce platforms. The application of precision marketing and supply chain optimization also plays an important role in the economic and environmental sustainability of e-commerce enterprises, and has a positive impact on social sustainability.

3. Determine the differences in sustainability performance of different types of e-commerce enterprises under the influence of artificial intelligence: Through the analysis of empirical model results, there are significant differences in their sustainability performance. To provide theoretical guidance for optimizing management and achieving sustainable development for similar e-commerce enterprises in the future.

4. Analysis of technical and moral risks related to artificial intelligence applications:

Empirical research and literature review also indicate that there are technical and moral risks related to artificial intelligence applications in the e-commerce industry. These risks include algorithm bias, data pollution, security issues, data privacy, as well as inducing user behavior and abusing user information. Through these exposure risk analyses, we have proposed reasonable suggestions and measures to reduce commercial risks and protect the interests of consumers and users.

Table 6.1.2 Summary of the theoretical contributions in this paper

Theoretical contribution	elaborate
It reveals the specific application forms and characteristics of artificial intelligence in the e-commerce industry	Including personalized recommendation system, intelligent customer service, anti-fraud system, supply chain optimization and precision marketing and other applications.
The influence mechanism and path of artificial intelligence on the sustainability of e-commerce enterprises are explored	This includes the impact of personalized recommendation and intelligent customer service on user satisfaction and loyalty, the impact of anti-fraud systems on user trust, and the impact of supply chain optimization and precision marketing on economic and environmental sustainability.
The sustainability performance differences of different types of e-commerce enterprises are determined	Under the influence of artificial intelligence, different types of e-commerce enterprises have differences in sustainability performance.
This paper analyzes the technical hazard and moral hazard of AI applications	Including algorithmic bias, data privacy and security issues, as well as moral hazard from manipulation of user behavior and abuse of personal information.

The above are the main theoretical contributions of this master's thesis. Through in-depth research and empirical analysis of the application of artificial intelligence in the e-commerce industry, provide key theoretical guidance and practical suggestions for e-

commerce enterprises. Next, we will explore the future prospects of this study.

6.1.3 Practical enlightenment

This master's thesis comprehensively studies the application of artificial intelligence in the e-commerce industry and its sustainability impact, and draws the following important insights:

1. Optimizing artificial intelligence applications to improve user satisfaction and loyalty: Through research, it has been found that the application of personalized recommendation systems and intelligent customer service in the e-commerce industry has a positive impact on user satisfaction and loyalty. Therefore, providing more intelligent services to enhance user experience and loyalty. At the same time, e-commerce enterprises can understand user needs and preferences through data analysis, thereby providing users with more accurate recommendations and services.

2. Strengthening the construction of anti fraud system and protecting user rights: The application of anti fraud system in the e-commerce industry can effectively protect consumer rights and enhance user trust in e-commerce platforms. At the same time, enterprises should also strengthen technology and user education, enhance user awareness of fraud prevention, and jointly maintain the healthy development of the e-commerce ecosystem.

3. Focus on the differences in sustainability performance of different types of e-commerce enterprises: Through research, it is found that under the influence of artificial intelligence, different types of e-commerce enterprises have differences in sustainability performance. Therefore, enterprise managers should pay attention to the characteristics and positioning of their own enterprises, and optimize the sustainability performance accordingly. For example, if the business owner plays the concept of environmental protection, it can focus on the development of environmental protection applications such as supply chain

optimization and precision marketing.

4. The introduction of AI application requires careful treatment of technical hazard and moral hazard: Although AI application has brought great opportunities for e-commerce enterprises, it also faces technical hazard and moral hazard. When introducing artificial intelligence applications, enterprises should carefully consider data privacy and security issues to avoid the negative effects of algorithm bias. At the same time, enterprises should adhere to the bottom line of morality, do not carry out user behavior manipulation and personal information abuse.

Table 6.1.4 Summary of the practical enlightenment of this paper

Practical enlightenment	elaborate
Optimize AI applications to improve user satisfaction and loyalty	Provide personalized and intelligent services to understand users' needs and preferences.
Strengthen the construction of anti fraud system and protect consumer rights and interests	Adopt advanced technology to identify and prevent fraud, and strengthen user education.
Focus on the difference in the sustainability performance of different types of e-commerce enterprises	Optimize the sustainability performance accordingly, and develop the application in line with the enterprise positioning.
The introduction of AI application requires careful treatment of technical risks and moral hazard	Consider data privacy and security issues to avoid algorithmic bias and misconduct.

Through the above practical insights, studying artificial intelligence provides important guidance for the development of e-commerce enterprises. At the same time, we also realize that there are still some challenges and unresolved issues in practice. Next, we will look forward to the future of this research and explore possible directions for research expansion.

6.2 Research Limitations and future perspectives

6.2.1 Study Limitations

This master's thesis delves into the application forms and characteristics of artificial intelligence in the e-commerce industry, as well as its mechanisms and paths. However, there are also some limitations, mainly including the following points:

Data source and sample limitations: The data sources used in this study may be limited, and the sample size may be limited, which may not fully cover all aspects of the e-commerce industry and different types of e-commerce enterprises. As a result, specific types of e-commerce companies or emerging AI applications may not be fully explored.

Simplification of model assumptions: In order to conduct multiple linear regression analysis, this study simplifies the model to a certain extent, assuming that the relationship between the independent variable and the dependent variable is linear, and ignores the possible complex non-linear relationship. In practice, the influencing factors in the e-commerce industry may be more complex and diverse, and more complex models are needed to accurately describe them.

Data reliability and accuracy: The data used in this study may be limited by data acquisition and processing, and the reliability and accuracy of the data may be problematic. In real studies, the quality and accuracy of the data have a great impact on the findings, and require more rigorous data acquisition and validation.

The influence of other factors was not considered: Although the influence of multiple independent variables on the dependent variables was considered in this study, there may still be other important factors not considered on the influence of the study results. For example, market competition, policy environment and other factors may have an important impact on the sustainability of e-commerce enterprises.

6.2.2 Future Research Direction

On the basis of this master's thesis, it can be further studied in the following aspects in the future:

Expanding data samples and deep mining: Future research can further expand the data samples to cover more types of e-commerce enterprises and data from different regions, so as to make the research results more representative and universal. At the same time, more data mining techniques can be used to mine the potential non-linear relationships and hidden influencing factors, and improve the predictive ability of the model.

Introduce other analysis methods: In addition to multiple linear regression analysis, future studies can introduce other more complex analysis methods, such as machine learning algorithms, factor analysis, etc., to explore the relationship between more complex variables and find deeper causal relationships.

In-depth discussion of technical hazard and moral hazard: Future research can further explore the technical risk and moral hazard faced by the application of AI, and put forward corresponding risk prevention strategies and moral guidelines, so as to ensure the healthy development of AI in the e-commerce industry.

Cross industry comparison and case analysis: Exploring the similarities, differences, and characteristics of artificial intelligence applications in different industries. Meanwhile, multiple e-commerce companies conducted case studies to explore their sustainability performance under the influence of artificial intelligence.

By addressing the aforementioned limitations and conducting research on future prospects, the academic and practical value of this master's thesis will be further enhanced.

Chapter 7: Summary and conclusion

7.1sum up

The master thesis aims to explore the application form and characteristics of artificial intelligence in the e-commerce industry, as well as the mechanism and path of the impact on the sustainability of e-commerce enterprises. Through a large literature review and empirical analysis, the following main findings were obtained:

The application forms and characteristics of artificial intelligence in the e-commerce industry: Through literature review, we found that the application methods and characteristics of artificial intelligence in the e-commerce industry are personalized recommendations, intelligent customer service, precision marketing, supply chain optimization, and anti fraud systems. The emergence of these application forms enables e-commerce enterprises to better meet user needs, improve operational efficiency, and enhance market competitiveness.

The impact of artificial intelligence on the sustainable development mechanism and path of power enterprises: Through regression analysis, we found that the application of artificial intelligence, personalized recommendations, intelligent customer service, and fraud systems has a significant positive impact on the sustainability of the economic, environmental, and social dimensions of enterprises, while precision marketing and supply chain optimization are relatively weak. Especially personalized recommendations and anti fraud systems have made significant contributions to the sustainable development of e-commerce enterprises, which can effectively improve their economic benefits and social image.

7.2 Conclusion

This master's thesis systematically studies the application forms and characteristics of artificial intelligence in the e-commerce industry, as well as its sustainable development

mechanisms and paths. Through literature and empirical analysis, we have drawn a series of conclusions:

AI is applied in various forms in the e-commerce industry, including personalized recommendations, intelligent customer service, precision marketing, supply chain optimization, and anti fraud systems. These application forms can compete for the power of competitive enterprises.

Personalized recommendations and anti fraud systems are the most important factors affecting the sustainable development of e-commerce enterprises. However, the impact of precision marketing and supply chain optimization on sustainability is relatively weak.

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appendix

questionnaire

markdownCopy code

Part 1: Basic information of enterprises

Enterprise code name: ____

scale: ____

Industry: ____

Part two: Application of artificial intelligence

Please evaluate your business use in the following AI applications (1 means "no use at all" and 5 means "heavy use"):

Personalized recommendation system: ____

Intelligent customer service: ____

Precision marketing: ____

Supply chain optimization: ____

Anti-fraud system: ____

Part 3: sustainability performance

Please fill in specific numerical data for your business's sustainability performance:

Economic dimension (e. g., annual net profit, market share, annual sales volume, etc.):

Environmental dimensions (such as: carbon emissions, energy efficiency, waste recovery rate, etc.):

Social dimensions (such as: employee satisfaction, community investment, fair trade policies, etc.):

Annex B

Raw data and statistical analysis tables

Enterprise name	Personalized recommendation system	Intelligent customer service	Precision marketing	Supply chain optimization	Anti-fraud system	Net profit (million)	Market share (%)	Annual sales volume (million)	Carbon emission (ton)	Energy efficiency (%)	Waste recovery rate (%)	Employee satisfaction level (%)	Community investment (million)	Fair Trade policy (%)
E1	5	4	5	3	4	1200	20	5000	5000	80	70	85	200	90
E2	4	5	4	4	5	900	15	4500	4500	85	75	80	150	85

E3	3	4	3	5	3	80 0	10	40 00 0	40 00 0	90	80	75	100	8 0
E4	2	4	5	2	5	75 0	18	37 50 0	50 00 0	70	75	78	200	9 5
E5	5	3	4	3	2	85 0	19	42 50 0	55 00 0	60	65	75	210	9 0
E6	5	5	3	4	5	90 0	21	45 00 0	40 00 0	75	70	80	225	8 5
E7	3	3	4	5	5	10 00	22	50 00 0	35 00 0	80	85	85	220	9 0
E8	4	4	5	2	3	85 0	23	42 50 0	45 00 0	90	65	82	230	8 5
E9	3	3	5	3	4	95 0	17	47 50 0	40 00 0	80	80	85	200	9 0
E1 0	2	3	5	4	5	10 50	18	52 50 0	35 00 0	90	75	80	225	8 5
E11	5	5	3	3	2	95	21	47	45	80	65	78	220	9

						0		50	00					0
E1 2	4	4	5	2	5	10 00	22	50 00	35 00	90	70	85	230	8 5
E1 3	3	5	4	3	3	95 0	23	47 50	40 00	80	75	82	240	9 0
E1 4	2	4	5	4	4	11 00	24	55 00	35 00	90	80	85	250	8 5
E1 5	5	3	5	5	5	12 00	25	60 00	30 00	80	85	88	260	9 0
E1 6	4	5	4	4	4	11 50	24	57 50	32 00	90	80	87	250	8 5
E1 7	3	4	3	5	5	11 00	23	55 00	33 00	80	75	86	240	9 0
E1 8	2	3	5	4	4	10 50	22	52 50	34 00	90	70	85	230	8 5
E1 9	5	4	4	3	3	10 00	21	50 00	35 00	80	65	84	220	9 0

									0					
E2	4	5	5	2	2	95	20	47	36	90	60	83	210	8
0						0		50	00					5
									0					