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A study of the role of e-commerce platforms in improving transaction efficiency and transparency in the secondary housing market

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Abstract With the rapid development of e-commerce, the transaction mode of the second-hand housing market is undergoing profound changes. The traditional second-hand housing transaction has problems such as information asymmetry, low transaction efficiency and poor transparency, which not only affects the healthy development of the market, but also restricts consumers' choices. In this paper, an e-commerce platform for second-hand housing transactions based on blockchain technology is constructed, and its application effect in enhancing transaction efficiency and transparency is deeply analyzed. By using Max DEA software, the study compares and analyzes the changes in transaction efficiency of two companies between 2021 and 2024 after the application of the traditional transaction model and the e-commerce platform. The results show that the transaction efficiency of the enterprises after the application of the e-commerce platform is significantly improved, with a comprehensive efficiency of 0.882 in 2024, which is a significant increase from 0.693 in 2021. In addition, the e-commerce platform also improves the transparency of the transaction through the decentralized characteristics of the blockchain, so that the symmetry and data completeness of the housing information are improved from 3.57 and 3.27 to 4.37 and 4.25, respectively.The research in this paper shows that the second-hand housing transaction model based on the e-commerce platform can effectively improve the efficiency of the transaction and the transparency of the information, and provide consumers with a safer and more transparent transaction environment, and promote the healthy development of the market.

Index Terms e-commerce platform, second-hand housing, transaction efficiency, transparency, blockchain, satisfaction

I. Introduction

The real estate brokerage industry is an important part of the real estate industry, which has made great contributions to improving the efficiency of real estate transactions [1]. However, due to the low entry threshold of the industry, resulting in the average cultural quality of practitioners is not high, the professional ability is insufficient, the integrity of the industry is insufficient, the operation of irregularities, disruption of the market order and other undesirable phenomena are serious, and there are a lot of social criticisms and opinions of the people [2]-[5]. At the same time, the role of the management department in the industry is not only to formulate management policies and publish management systems, but also to rationally publicize market information based on its comprehensive mastery of housing information resources to reduce transaction costs and facilitate the people [6]-[9]. In order to better realize the above supervision and management requirements, housing e-commerce platform, as a kind of emerging industry, has shown strong vitality and broad prospects for development [10].

In today's rapid development of network technology, networking, big data, and artificial intelligence are bringing about an in-depth change. In order to cope with the broad market environment and the increasingly high consumption requirements of consumers, the traditional physical housing sales model can no longer meet the market development needs, so the physical housing trading market has entered the Internet era [11], [12]. Among them, the housing e-commerce platform combines a variety of advantages and features in one, flexible, able to provide the real estate industry as well as the people's housing to provide a variety of services such as real estate appraisal and consulting, and the position of the real estate industry as a whole is unshakeable in the development of the real estate industry [13]-[15]. Real estate e-commerce platform generally includes the demand side and supply side of land use rights. For the demand side, it can access the platform for information browsing to obtain information and profit, and for the supply side, it can provide products and services for potential targets [16], [17]. In particular, second-hand housing buyers can pay intermediary fees to second-hand housing transaction platforms

in order to obtain complete housing information, title processing, financial loans and other products or services, effectively breaking the monopoly of information and enhancing the efficiency of second-hand housing market transactions [18]-[20].

With the advancement of technology and changes in consumer demand, the traditional second-hand housing market is gradually transitioning to digital platform transactions. The traditional transaction model faces a series of problems such as asymmetric information and non-transparent transactions, and consumers often find it difficult to obtain real listing information, and the transaction process is complicated and inefficient. Based on these problems, many studies have begun to explore how to utilize modern technological means to enhance the transaction efficiency and transparency of the secondary housing market. E-commerce platforms, as a new transaction model, have become an important tool to promote the development of the second-hand housing market through their networked and platformized nature. In recent years, blockchain technology has been widely used to enhance transaction transparency, reduce information asymmetry, and enhance consumer trust due to its decentralized and tamper-proof features. Based on these backgrounds, this study focuses on constructing a blockchain-based e-commerce platform for second-hand housing and exploring its potential to improve market efficiency, transparency, and consumer satisfaction. The study first theoretically analyzes the impact of blockchain technology on transactions in the second-hand housing market, and constructs an e-commerce platform containing several functional modules. Then, it compares the changes in transaction efficiency before and after the application of the platform by empirically analyzing two different transaction models, and evaluates consumer satisfaction through a questionnaire survey. Through the analysis of Max DEA software and satisfaction survey data, this paper comprehensively evaluates the role of the e-commerce platform in improving the efficiency and transparency of second-hand housing transactions, and puts forward relevant optimization suggestions.

II. Construction of an e-commerce platform for second-hand housing transactions

Blockchain technology [21] as a new generation of technical support, its own technical characteristics and related technologies can play a huge role in e-commerce transactions, this paper borrows blockchain technology to build a second-hand housing transaction e-commerce platform to enhance its efficiency and transparency in the transaction.

(1) The core process of second-hand housing transaction e-commerce platform transaction

Figure 1 shows the core process of the second-hand housing transaction e-commerce platform, focusing on three aspects: the marketing channels of the e-commerce platform, the core aspects of the e-commerce platform, and the user's home-buying process.

The second-hand housing transaction e-commerce platform constructed in this paper covers three major links: pre-sale, sale and after-sale. The platform cooperates with real estate developers and real estate agents through the network and real estate APP to build diversified and cross-media marketing channels. It also provides online search consulting and customized and personalized services, and provides a series of value-added services to homebuyers after completing online transactions and offline signing and payment services.

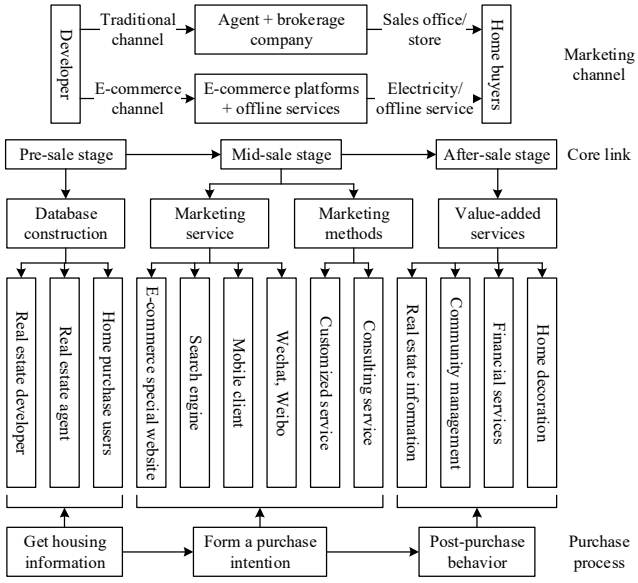

Figure 1: Core process of real estate e-commerce platform

(2) Structure of the e-commerce platform for second-hand housing transactions

Figure 2 shows the specific structure of the second-hand housing transaction e-commerce platform. The structure of the e-commerce platform includes an information platform, an advertising platform, an advisory platform, a sales platform, an exchange platform, and an after-sale management platform.

a) Information platform

The information platform carries out statistics, analysis and processing of basic real estate data, and regularly releases authoritative data and research reports. Information procurement is divided into two types: real estate developers' information procurement and users' information procurement, which can provide references and suggestions for upstream real estate enterprises in terms of land acquisition consulting, market analysis, and sales suggestions, and also provide downstream users with diversified choices and decision-making references in choosing properties, and satisfy users' customized and personalized services. In addition, the information platform can also organize and analyze the aggregated customer information, and feedback the processing information to the exchange platform and sales platform in a timely manner.

b) Advertising platform

The advertising platform is separated from the information platform, and provides specialized advertising for the real estate developer's products and projects, which not only includes large hard power advertising and soft promotion, but also realizes the integration of multi-channel media and cooperates with offline professional activities.

c) Consulting Platform

Consulting platform adhering to the concept of user-centered, convenient for consumers to browse the information encountered in any problem can be timely online communication and feedback, through professional advice and services to solve consumer problems and concerns, better access to consumer demand. In addition, the consulting platform also divides the online consulting service into pre-sale, after-sale and complaint and suggestion according to the link of network marketing, which on the one hand can help consumers choose the service they need more conveniently and accurately, and on the other hand is also conducive to the platform to reasonably allocate resources to meet the differentiated needs of different consumers.

d) Sales Platform

Sales platform refers to the second-hand housing transaction e-commerce platform to help real estate enterprises to conduct agency sales, with the help of group-buying, seconds, prepaid deposit and other forms of marketing and diversified network marketing tools to promote real estate network marketing, complete a series of marketing planning activities, and through a sizable number of visitor groups and stationed in the e-commerce platform professional real estate brokerage agencies and real estate agents to achieve transactions.

e) Exchange platform

Exchange platform can be timely and effective consumer questions and problems feedback to the platform, conducive to the e-commerce platform and real estate companies in the marketing process to identify problems and solve them in a timely manner. In addition, on the communication platform, not only have the function of message and comment, but also establish the owner community and owner forum, which greatly enhances the contact and communication between users, and also accelerates the formation of online community culture.

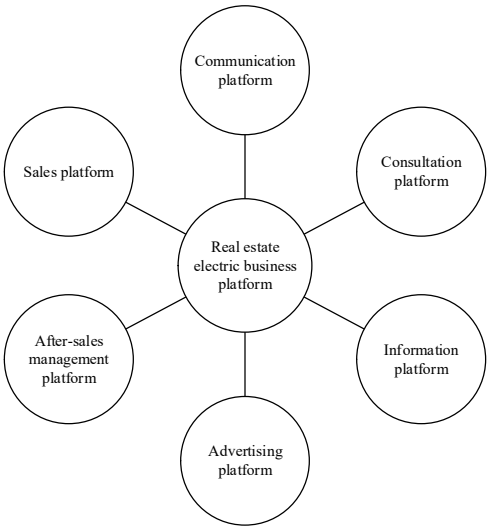

Figure 2: Structure of Third-party Real Estate E-commerce Platforms

f) After-sales management platform

The after-sales management platform can greatly improve the experience of homebuyers by providing a series of value-added services. At the same time, it can also maintain old users, listen to user suggestions and enhance user trust. Enough to better help real estate companies to shape the corporate image, strengthen the brand publicity, and get the user's word of mouth.

III. Indicator system for evaluating the effectiveness of e-commerce platform applications

This section uses network comments to reflect the effect of the application of user e-commerce platforms in the second-hand housing market, through the crawler tool Octopus crawled a number of network platforms with e-commerce platforms related to the application of the second-hand housing market in the comments. The platforms are mainly microblogging, Zhihu, and Baidu post bar. And then, the network comments are preprocessed and keyword analyzed, and reference to the extracted relevant keywords, the initial indicators constructed are screened, and the indicators that are not involved in the user comment data are eliminated, so as to finalize the evaluation index system of the application effect of the e-commerce platform in the second-hand housing market.

(1) Collection of network comment data

This paper chooses to collect data from multiple platforms. After comparing multiple social platforms, three platforms, namely Weibo, Zhihu and Baidu Post Bar, are selected to collect data with the keyword “e-commerce platform + second-hand housing”. The collection tool was Octopus, and a total of 4986 texts were collected.

(2) Web comment preprocessing and keyword extraction

In this section, the collected network comments are first pre-processed, including data cleaning and effective data screening. Data cleaning mainly removes invalid comments, i.e., comments with default values and duplicates. Meaningless content such as “top”, “good morning”, or punctuation marks are regarded as invalid comments to be cleaned. In addition, some of the comments in the data involve multiple dimensions in the evaluation index system at the same time, and adhering to the principle of independence, this paper splits such comments. Through manual screening, 1149 valid comments are finally retained. Secondly, the python program is used to perform word segmentation, word deactivation and word frequency statistics on the valid comments. Among them, the participle uses jieba Chinese participle and de-discontinued word part. After referring to the commonly used deactivated word dictionary on the csdn platform, this paper selects the HIT deactivated word dictionary, which contains words or symbols that are invalid for text analysis, such as punctuation, conjunction and number.

(3) Adjustment and determination of evaluation index system

According to the final extracted high-frequency keywords of online comments, it is found that users pay more attention to the ease of use, service quality, user trust and reputation, price and transparency, transaction efficiency and after-sale of the e-commerce platform. Therefore, the finalized evaluation index system for the application effect of e-commerce platform in the second-hand housing market is as follows, consisting of 5 dimensions and 12 indicators. They are as follows:

a) Platform ease of use: quality of housing information display, search and matching efficiency, and ease of operation.

b) Service quality: economic services, transaction guarantee, third-party services.

c) User trust and reputation: platform reputation, community interaction.

d) Price and transparency: price reasonableness, cost details.

e) Transaction efficiency and after-sales service: transaction cycle, after-sales service.

IV. Analysis of the role of efficiency gains in secondary housing transactions

This study applies Max DEA software to analyze the comprehensive efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE) of the transaction efficiency of two second-hand housing trading enterprises from 2021 to 2024. Among them, enterprise 1 is the traditional trading model, while enterprise 2 started to apply the e-commerce platform constructed in this paper for second-hand housing trading in 2022. The comprehensive efficiency is measured by the CCR model, and the pure technical efficiency and scale efficiency are measured by the BCC model. Comprehensive efficiency is a comprehensive evaluation of the multi-faceted capabilities such as resource utilization capacity and efficiency of the decision-making unit (DMU). Pure technical efficiency reflects the impact of factors such as system and management level on efficiency. Scale efficiency indicates whether the existing actual scale level is effective or not, reflecting the gap between the actual scale and the optimal scale. According to the measured results, the transaction efficiency of intelligent manufacturing enterprises is analyzed from two perspectives. Table 1 counts the transaction efficiency of two secondary housing enterprises from 2021 to 2024.

As can be seen from the table, in 2021, the trading comprehensive efficiency, pure technical efficiency, and scale efficiency of the two enterprises are relatively close to each other, and the relative error is between ±0.01. After 2021, the trading efficiency of enterprise 1 does not fluctuate much, while the trading efficiency index of enterprise 2 begins to grow. By 2024, the comprehensive efficiency, pure technical efficiency, and scale efficiency of enterprise 2 are 0.882, 0.851, and 0.875, respectively.From 2021 to 2024, the comprehensive efficiency, pure technical efficiency, and scale efficiency of enterprise 1 are 0.660, 0.688, and 0.681, respectively, while enterprise 2 reaches 0.824, 0.807, and 0.812, respectively.Comprehensive Analysis The reason for the low comprehensive efficiency of enterprise 1 is due to the double effect of the lowest pure technical efficiency and the lowest scale efficiency at the same time. The reason for the increased transaction efficiency of enterprise 2 is that the application of the platform in this paper enhances the pure technical efficiency.

Table 1: 2021~ 2024 the transaction efficiency of two enterprises

	Year	Integrated efficiency	Pure technical efficiency	Scale efficiency
Enterprise 1	2021	0.684	0.723	0.715
	2022	0.629	0.624	0.684
	2023	0.695	0.727	0.696
	2024	0.631	0.678	0.627
	Average	0.660	0.688	0.681
Enterprise 2	2021	0.693	0.719	0.708
	2022	0.849	0.820	0.812
	2023	0.871	0.838	0.853
	2024	0.882	0.851	0.875
	Average	0.824	0.807	0.812

V. Transparency in second-hand housing transactions based on e-commerce platforms

In this section, for the above second-hand housing enterprise2, the openness of second-hand housing transaction information, the symmetry of listing information, and the completeness of housing data were analyzed by means of a questionnaire survey counted before and after the application of this paper's e-commerce platform, in order to evaluate the role of the e-commerce platform in enhancing the transparency of transactions in the second-hand housing market. The survey respondents are buyers and sellers who have had transactions in the enterprise in recent years, totaling 100, and the questionnaire adopts a 5-level evaluation method, with higher ratings representing more transparent second-hand housing transactions.

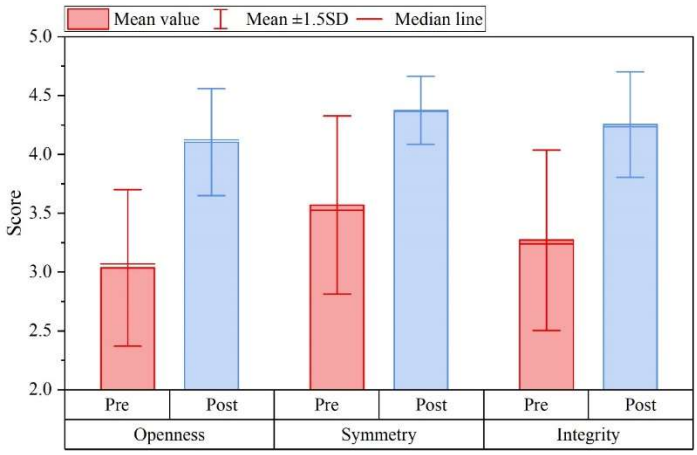

Figure 3: The results of the transparency of the second-hand housing market

Figure 3 shows the results of the survey of the e-commerce platform on the transparency of transactions in the second-hand housing market. It can be seen that after applying the e-commerce platform of this paper, the openness of second-hand housing transaction information, symmetry of listing information and housing data completeness of Enterprise 2 are improved from 3.04, 3.57 and 3.27 scores before application to 4.10, 4.37 and 4.25 scores, which show significant improvement.

This is because: the e-commerce platform makes use of the decentralized features and distributed ledger in the blockchain to ensure the openness and transparency of the transaction data, all transaction records are recorded on the blockchain and cannot be tampered with, and any participant can view and validate the transaction information, which ensures the authenticity and traceability of the transaction. Moreover, data consistency is guaranteed by consensus mechanism, and all network nodes are required to reach an agreement on transaction confirmation, which reduces the possibility of information asymmetry and misunderstanding, and improves the transparency and fairness of the transaction.

VI. Satisfaction survey of second-hand housing e-commerce platforms

Hierarchical analysis (AHP) [22] is a multi-objective system that decomposes the factors related to the overall goal of decision making into sub-goal, sub-criteria, sub-indicator and program levels, fuzzy quantifies the qualitative factors, and computes the weights of the factors in each level with respect to the factors belonging to the previous level by solving the judgment matrix and the maximum characteristic root, and ultimately recursively merges them in the final weights of the alternatives with respect to the overall goal. The method of decision making.

The application of hierarchical analysis here involves only the calculation, testing and use of the relative weights of the lowest level indicators in relation to the overall objective. With the data collected above, the total objective is to evaluate user satisfaction in the second-hand housing e-commerce market. It is decomposed into two levels of evaluation indicators, with 5 evaluation indicators at the first level and 12 evaluation indicators at the second level. For each level of evaluation indicators using the nine-quartile method to construct a two-by-two judgment matrix, and then use the square root method to calculate the relative weights between each level of evaluation indicators, and ultimately derive the weights of all the evaluation indicators at the second level relative to the overall goal. The final weights of all indicators are shown in Table 2. As can be seen from the table, the weights of the first-level indicators: ease of use of the platform, service quality, user trust and reputation, price and transparency, transaction efficiency and after-sales service are 0.10, 0.15, 0.25, 0.30 and 0.20 respectively. Users pay more attention to the price and transparency of listings for the application of e-commerce platforms in the secondary listing market, with price reasonableness receiving the highest overall weight of 0.21.

Table 2: Evaluation index weight of each satisfaction

Primary indicator	Weight	Secondary indicator	Weight	Final weight
Ease of use	0.10	Information quality	0.50	0.05
		Matching efficiency	0.30	0.03
		Convenience	0.20	0.02
Service quality	0.15	Economic service	0.20	0.03
		Trade guarantee	0.50	0.075
		Third party service	0.30	0.045
Trust and word of mouth	0.25	Platform reputation	0.60	0.15
		Community interaction	0.40	0.10
Price and transparency	0.30	Price rationality	0.70	0.21
		Cost detail	0.30	0.09
Trade efficiency and after-sales	0.20	Trading week	0.40	0.08
		After-sales service	0.60	0.12

Based on the 12 second-level evaluation indicators of user satisfaction of the e-commerce platform of the second-hand housing market constructed above, a questionnaire was created and researched through the Questionnaire Star platform for sellers who have operated on the platform in the past three years. A total of 337 questionnaires were distributed and 300 valid questionnaires were recovered. The questionnaires were evaluated using the five-degree evaluation method: very dissatisfied, relatively dissatisfied, basically satisfied, satisfied and very satisfied. SPSS software was used to test the reliability and validity of the research results of 300 questionnaires. The reliability test was tested using Cronbach's coefficient method and the validity test used KMO and Bartlett's spherical test to measure the validity of the data. The coefficient of this questionnaire is Cronbach's 0.915, which indicates that the questionnaire is credible, and the KMO value is 0.968, which indicates that the questionnaire is valid.

In addition, Figure 4 demonstrates the results of the survey users' satisfaction with the used housing e-commerce platform constructed in this paper. It can be seen that the survey is used for the application effect of this paper's platform with a high degree of satisfaction, and the weighted rating values of the platform's ease of use, service

quality, user trust and reputation, price and transparency, transaction efficiency and after-sales service reach 4.10, 4.30, 4.19, 4.59, 4.54, respectively, with ratings of more than 4, which is in a state of satisfaction. Among them, the satisfaction ratings of the platform's price and transparency, transaction efficiency and after-sales indicators are more outstanding, indicating that users show a high degree of approval for the platform in terms of information symmetry and honesty in operation, which enhances users' trust.

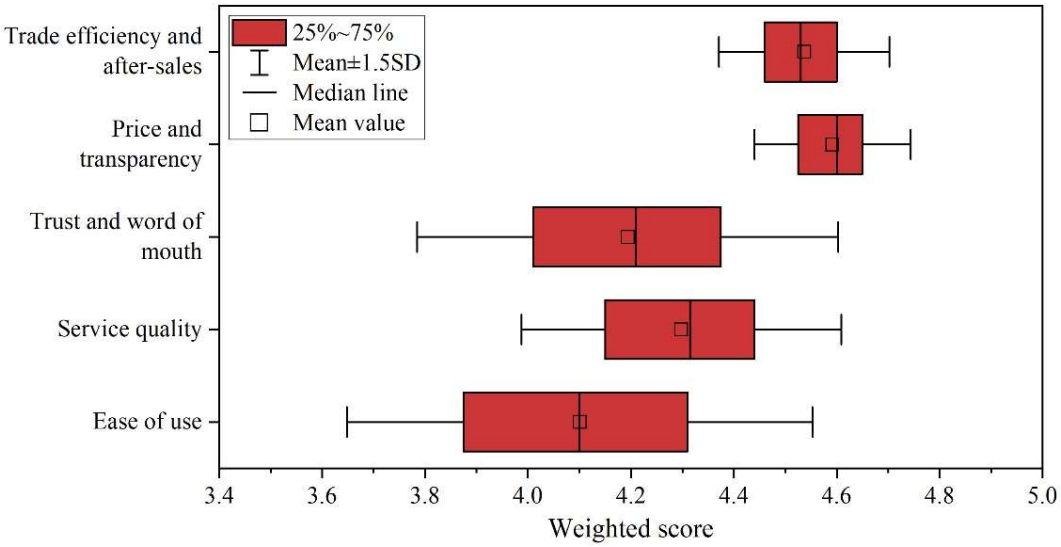

Figure 4: The satisfaction of the e-commerce platform

VII. Conclusion

The application of e-commerce platforms significantly improves the efficiency of transactions in the secondary housing market. The data shows that the comprehensive efficiency of enterprises applying e-commerce platforms is 0.882 in 2024, which is a significant improvement compared to 0.693 in 2021. In terms of technical efficiency and scale efficiency, the application of the platform also showed positive results, with pure technical efficiency increasing from 0.719 to 0.851 and scale efficiency from 0.708 to 0.875. In addition, the platform also played an important role in improving transaction transparency. After the application, the symmetry of listing information improved from 3.57 to 4.37, and data integrity improved from 3.27 to 4.25, indicating that the platform effectively solved the problem of information asymmetry. Consumer satisfaction with the platform is generally high, and the platform's price transparency and transaction efficiency are highly rated. Overall, the blockchain-based second-hand housing e-commerce platform not only improves transaction efficiency, but also enhances market transparency, providing consumers with a fairer and more trustworthy trading environment.

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