House-Keeping Services Platform Based on Consortium Blockchain Technology

Yinjie Zhao

International Academy, Beijing University of Post&Telecommunication, Beijing, 102206, China

zyj021011@bupt.edu.cn

Abstract. Consortium Blockchain (CB) technology has witnessed significant growth in popularity across various industries, such as finance, supply chain management, and healthcare. This paper introduces a housekeeping services platform that leverages the capabilities of CB. By capitalizing on the decentralized and tamper-proof nature of blockchain, the platform ensures transparency and security in home services. Through the implementation of smart contracts, the platform achieves automation and intelligence, ultimately enhancing service quality and efficiency. Consumers can access top-notch home services while benefiting from increased choices and fairer pricing. The paper delves into the technical implementation and operating model of the platform, showcasing its practicality and market potential. Moreover, it provides fresh perspectives and directions for the advancement of the home service industry. This innovative platform holds promise for transforming the sector by utilizing CB technology, bolstering trust, and driving operational excellence in the domain of home services.

Keywords: Consortium Blockchain, house-keeping services platform, market potential, smart contracts

1 Introduction

The traditional home service industry in China today faces many problems, such as unstable service quality, opaque pricing, information asymmetry, and the lack of trust. These issues make it difficult for consumers to obtain high-quality home services and also limit the development of the home service industry [1]. To solve these existing issues, this paper proposes a home service platform based on Consortium Blockchain (CB) technology. The platform utilizes the decentralized and tamper-proof characteristics of blockchain technology to ensure the transparency and security of home services. The platform connects home service providers and consumers, and consumers can select suitable service providers through the platform and view their evaluations and credibility. At the same time, the platform also adopts smart contract technology to realize the automation and intelligence of home services, improving service quality and efficiency. For example, consumers can arrange service time,

personnel, and content through smart contracts, avoiding human intervention and errors in traditional home services. On the platform, consumers can obtain high-quality home services while also having more choices and fairer prices. The tamper-proof nature of blockchain technology ensures the quality of service providers and the rights of consumers [2]. At the same time, the platform can automate payment, evaluation, and other processes through smart contracts, improving service efficiency and user experience. This paper also introduces the technical implementation and operation mode of the platform, including its architecture, functional modules, and algorithm design. The results show that the home service platform based on blockchain technology has good feasibility and market prospects, providing new ideas and directions for the development of the home service industry [3].

2   The Current Situation and Existing Problems of the House-Keeping Service Platforms in China.

2.1   The Current Market Analysis

Chinese Home Service Market Size: Regaining Growth. The domestic home service industry is an important industry that absorbs rural migrant workers. In recent years, the domestic service industry in China has experienced rapid growth, with its market size increasing from 277.6 billion yuan in 2015 to 1,014.9 billion yuan in 2021, entering the trillion-yuan market club, as shown in Fig.1. Driven by factors such as policy support for the standardized development of the industry, improved household consumption levels, and a significant increase in demand for childcare and elderly care services, the prospects for the domestic service market are becoming even more promising [4].
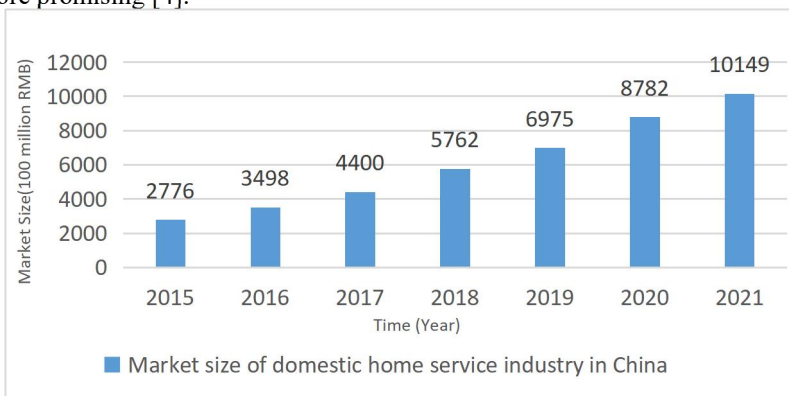

Fig. 1. Market size of China's Domestic Home Service Industry from 2015 to 2021 [4].

The Digital Transformation of China's Housekeeping Industry is Accelerating. As shown in Fig.2, with the development of the housekeeping industry over the years, competition among brands has accelerated, and the industry has entered an

elimination phase, leading to increased survival pressure for small platforms [5]. In the major subdivisions of the housekeeping industry, specialized housekeeping companies with significant competitive advantages will emerge. Whether it is in terms of demand, talent, or enterprise operations, digital operational capability will become increasingly important for housekeeping enterprises, and digital transformation has become one of the core competitive strengths of enterprises [4].
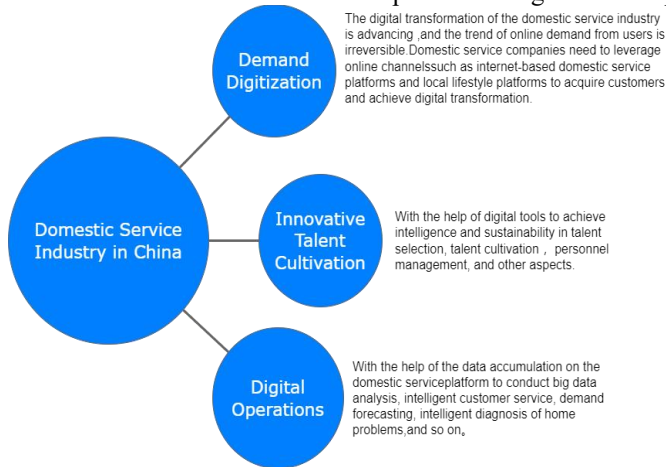

Fig. 2. The trend of operational transformation in China's home service industry (Photo credit: Original)

2.2   Existing Problems

Lack of Standardized Market Management and Missing Supervisory Mechanism. The home service industry does not have a unified and clear regulatory department, which is not conducive to the standardization of market management and can easily lead to industry confusion. The Ministry of Civil Affairs, Human Resources and Social Security, Industry and Commerce, Women's Federation, and other departments are all involved in market management to varying degrees, but with unclear division of labor [5]. Due to the lack of an effective supervision and restraint mechanism in the industry, disputes involving all parties frequently occur, and the difficulty of resolving disputes is high. The rights and interests of the three parties, home service agencies, practitioners, and consumers, have not been effectively protected to varying degrees [6].

Supply and Demand Contradiction. Supply shortage is the main problem facing the housekeeping service industry. The supply-demand contradiction in the domestic service industry is mainly reflected in the following three aspects: overall supply shortage, supply shortage in service quality, and seasonal supply shortage [6]. The overall supply shortage is reflected in the fact that the number of domestic service workers cannot meet the huge market demand. Supply shortage in service quality means that the comprehensive quality, professional skills, professional ethics, etc. of

service workers cannot meet the needs of consumers. The supply shortage in service quality also manifests in the lack of highly skilled and highly qualified professionals in domestic service. The shortage of high-level maternity nurses, advanced childcare workers, and other professionals makes it difficult to meet the growing high-end needs of consumers [7].

Chaotic Service Prices and Unsound Service Standards. The lack of standardization in the housekeeping market is mainly due to the lack of a good set of service standards and rules. At present, the industry's institutionalized construction needs to be improved, and the industry access system, qualification certification system, and regulatory system are all inadequate. The industry standardization construction is insufficient, and there is a lack of unified service quality, service process, and service charge standards. Currently, the establishment of standards is mainly determined by individual companies, making it difficult to standardize service standards, and most companies do not have the ability to establish a set of service standards for each project. Issues related to salary and service quality are the focus of disputes in household service disputes, and establishing charging and service quality standards for various types of household services can greatly reduce such disputes [7].

3 Introduction to Blockchain Technology and Analysis of Its Application Value.

3.1 Introduction to Background Technology

CB. Blockchain technology is a distributed ledger system that allows participants in a network to record and verify transactions in a secure and transparent way. It consists of chains of blocks that contain transaction data, which is validated by network participants through a consensus mechanism [8]. Once a transaction is verified and added onto the blockchain, it cannot be altered or deleted, providing an immutable and tamper-proof record of the transaction history [9].

CB is a type of blockchain network that is owned and controlled by a group of organizations working together towards a common goal. It differs from public blockchains in that it is permissioned, meaning that only approved participants can access and verify transactions on the network [10]. This allows for greater security and privacy, as well as improved efficiency and cost savings for the participating organizations. CB use various consensus mechanisms, such as Proof of Authority or Practical Byzantine Fault Tolerance (PBFT), to ensure that the network remains secure and the transactions are validated in a timely manner [11].

PBFT. PBFT is a consensus algorithm used in distributed computing to ensure the integrity of transactions in a network of nodes. It was developed in 1999 by Miguel Castro and Barbara Liskov.

PBFT is designed to allow a network of nodes to reach consensus even in the presence of faulty nodes, or nodes that may behave maliciously. It does this by requiring that each transaction is approved by a certain number of nodes, known as the "quorum". Each node must agree on the validity of a transaction before it can be added to the blockchain [9].

PBFT is used in CB where a limited number of nodes are trusted to maintain the network. By using PBFT, these nodes can reach consensus quickly and securely, without the need for a proof-of-work system or a large number of nodes.

Peer-to-Peer (P2P) Network. A P2P network is a type of network where each participant in the network acts as both a client and a server. In a P2P network, there is no central server or authority controlling the network. Instead, each node in the network communicates directly with other nodes to share resources, such as files or processing power [2]. The advantage of P2P networks is their resilience to failures, as there is no single point of failure that can bring down the network [12]. However, P2P networks can also be more difficult to manage and secure compared to centralized networks, as each node in the network has to be individually managed and secured [13].

3.2   Application Value Analysis

Although many housekeeping enterprises have risen with the help of "Internet +", most of them are small in scale and lack systematic management experience. In addition, the number and quality of service providers in these companies are limited, and the types of services that can be provided are relatively single, making it difficult to meet the demands of different customers. There is a high turnover rate of service providers within housekeeping enterprises, and many service providers start working without comprehensive and systematic training, often leaving users with an unprofessional impression. Before providing services, housekeeping companies do not sign service contracts with users, and it is difficult for users to obtain rights protection after suffering property losses, which further deepens users' distrust of housekeeping companies. Different housekeeping enterprises operate independently, and the service provider information cannot be shared with each other, forming a data island. Service providers and customers are matched by housekeeping companies, but they are not familiar with each other and have no mutual trust. Service standards developed by different housekeeping companies for different projects also vary greatly.

In order to effectively promote the standardization of the housekeeping industry and solve the trust relationship problem between employers and employees, the "publicly transparent", "difficult to tamper with" and "traceable" characteristics of blockchain technology can be utilized to effectively and standardized record various information in the housekeeping industry from the perspective of reforming the information field of the housekeeping industry [14]. The advantages of blockchain distributed storage and information encryption are tightly grasped to break the trust

barrier caused by information asymmetry, establish a more solid credit system, reduce trust costs, and innovate the industry's information system to ensure the basic rights of employers and employees[15].

CB is more suitable for developing a house-keeping service platform compared to public or private blockchains. This is because a CB is a semi-open network where only authorized nodes can publish and access transactions, ensuring data privacy and security for enterprise platforms that require confidentiality [15]. Additionally, because transaction information is only recorded and agreed upon by a subset of nodes, CBs have higher performance and lower costs than public blockchains [11]. Therefore, a CB can provide a better balance between data privacy, performance, and cost-effectiveness, making it a better choice for developing a house-keeping service platform.

4   Basic Framework of CB-based Housekeeping Service Platform

4.1   Overall Process of Information Storage and Processing
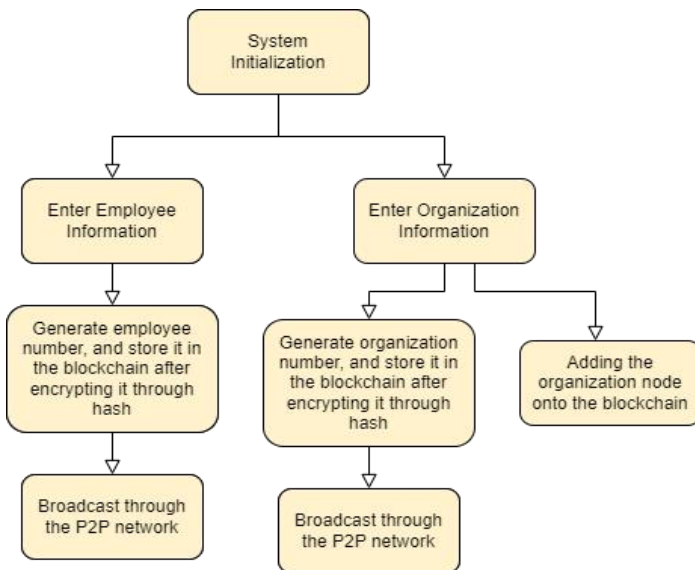

Fig. 3. Overall process of information storage and processing (Photo credit.Original)

The overall process of information storage and processing is shown in Fig. 3.

1）Enter personal information of housekeeping personnel, including name, gender, date of birth, and work information such as company and length of employment, into the information entry platform. During the entry process, it is necessary to carefully confirm the information to ensure its completeness and correctness.

2） After the housekeeping personnel information is entered, the system will automatically generate a corresponding employee number, encrypt the employee information using hash encryption, record the hash value on the blockchain, and enter the specific personnel information into the database.

3)   Broadcast the new blockchain through a P2P network so that all nodes can have an updated copy of the blockchain.
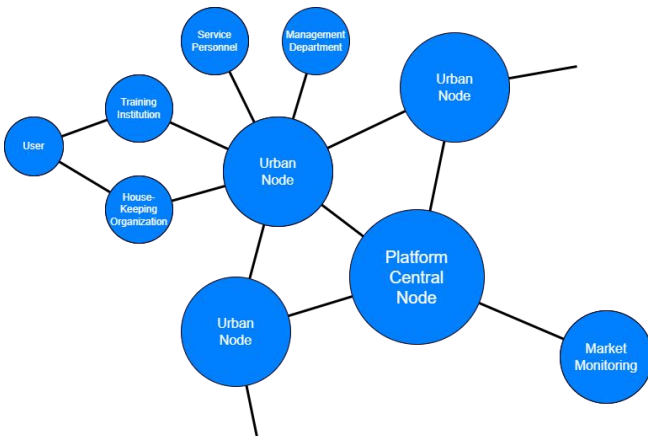
4.2   Node Composition

Fig. 4. Node Composition (Photo credit.Original)

The structure of node composition is shown in Fig.4. The nodes consist mainly of Urban nodes and platform center nodes, realizing a semi-open consortium chain. Each city sets up a node, which can operate independently and establish its own operating rules according to local characteristics. Each city node will record information of local service personnel, housekeeping companies, and training institutions, and set up a node management department for daily maintenance and operation. The platform acts as a central node and sets up smart contracts to establish contract relationships between users and employees. Smart contracts are digital contracts, which effectively prevent breach of contract. In addition, city nodes can make personalized modifications to smart contracts to meet different local needs. By supervising the order process through smart contracts, order execution is promoted.

Users can contact home service companies through the program provided by the platform to consult and negotiate the required home services. Once a transaction is reached, the transaction information will be stored on the blockchain. If a dispute arises, the relevant transaction information can be traced through information tracing. At the same time, users can also apply to become relevant service personnel through the program to contact home service companies or training institutions. After the application is submitted, it will be uniformly trained by a standard training institution

and rated by an independent management department. Those who pass the training will be employed as formal employees and their information will be recorded on the blockchain. The management department also needs to regularly assess the on-the-job employees, and the results will be recorded on the blockchain to form a standardized management and supervision system. The platform sets up a market monitoring department as the center node, regularly collects and organizes market feedback information, adjusts measures according to market conditions in a timely manner, and broadcasts information to various city nodes in a timely manner, realizing a reasonable feedback mechanism and ensuring the normal operation of the platform.
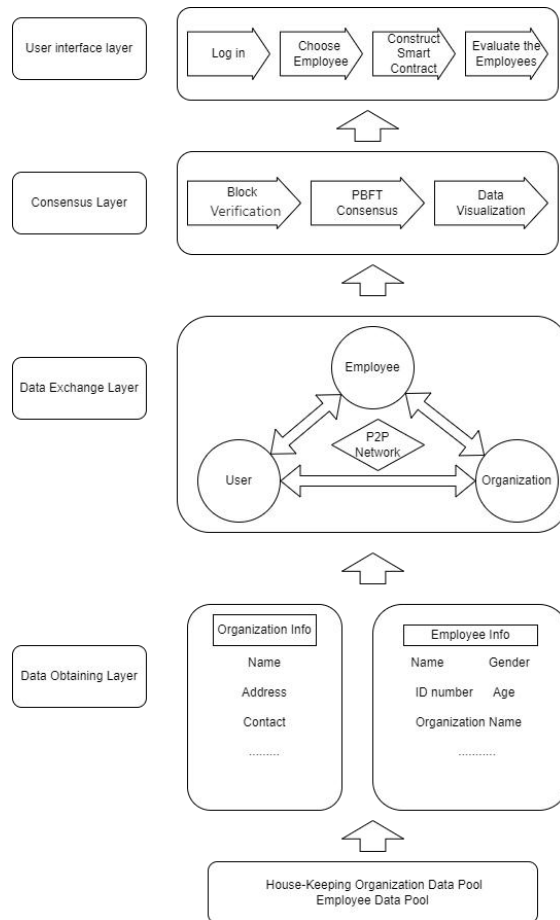
4.3   Overall System Framework

Fig. 5. Basic system structure (Photocredit.Original)

The overall system structure is shown in Fig. 5.

Data Obtaining Layer. Based on the existing employee data of small and medium-sized housekeeping enterprises, the employee and enterprise information entered into blockchain is processed and standardized in the data obtaining layer, and then encrypted through Hash and stored on the blockchain in the form of values.

Data Exchange Layer. In the data exchange layer, a closed-loop connection between employees, users, and enterprises is constructed in a decentralized manner through a P2P network. Through broadcasting on the P2P network, all nodes have updated blockchain. This helps prevent malicious tampering of information on some nodes [2].

Consensus Layer. The main task of this layer is to periodically verify the block data, recalculate and compare the hash values of the blocks to prevent abnormal situations such as "blockchain fracture" or "data tampering." Since the blockchain records events in time order, blocks only need to be verified in time order. In addition, new blocks are packed into the blockchain through the PBFT consensus mechanism, and through the operation of the consensus mechanism, rewards are provided to the nodes with reference to the evaluation system constructed.

User Interface Layer. Users can log in to the system to view employee and enterprise information, choose desired employees, and establish smart contracts with employees. In this system, smart contracts are generated using asymmetric encryption. Since the private key in asymmetric encryption can only be decrypted by the corresponding public key, and the contract is encrypted using a private key, when verifying the digital signature or viewing the corresponding transaction information, the corresponding public key that can be decrypted by the private key can be used. After successful verification of the digital signature, the contract will be executed automatically until the transaction is completed. After the contract is executed, users can evaluate employees, and the evaluation information will also be recorded on the blockchain. Each user can obtain information about all blocks through the P2P network after logging in.

5   Conclusion

This paper has addressed the critical challenges faced by the traditional home service industry in China, emphasizing the importance of digital transformation in the face of increased competition, and proposed a novel home service platform based on CB technology. The current home service sector suffers from issues such as information asymmetry, lack of trust, and opaque pricing, hindering the industry's growth and limiting consumers' access to high-quality services. To overcome these obstacles, the platform harnesses the decentralized and tamper-proof characteristics of blockchain, paving the way for a more transparent, secure, and efficient ecosystem by leveraging CB technology. The platform establishes a solid credit system, reducing trust costs,

and fostering mutual trust between home service providers and consumers, creating a standardized and regulated environment that protects the rights of all stakeholders, leading to better service quality and reduced disputes. And through the adoption of smart contract technology, home services are automated and streamlined, enhancing service quality and efficiency. Users can arrange service details through smart contracts, minimizing human intervention and errors associated with traditional home services. Additionally, the platform enables consumers to access a wide range of high-quality services with fairer prices, further bridging the supply and demand in the home service market.

In conclusion, the envisioned home service platform built upon CB technology presents a transformative opportunity for the housekeeping service industry in China, promoting transparency, standardization, and increased trust among all stakeholders, and has the potential to revolutionize the industry and create new avenues for growth and excellence in home services. Embracing this innovative approach will empower the industry to forge ahead with confidence, and shape the future of home services in China and beyond.

References

1. Li Yanmei.: Analysis of the current situation and standardization construction of domestic service industry in China. Social Scientist 2008(7), 107-110(2008).
2. Tao M, Wang Z.: Intelligent transaction strategy for multi-microgrids based on blockchain. Electric Power Construction 42(12), 116-126(2021).
3. Elsevier, https://www.sciencedirect.com/science/article/pii/S1084804520301302,last accessed:2023/7/7.
4. Huaon, https://www.huaon.com/channel/trend/856293.html, last accessed:2023/7/7.
5. Wu, X., Wang, Z., Wang, W.: Research on the Application Prospects of Block-chain Technology in the Home Services Industry. China Collective Economy 2021(22), 159-160 (2021).
6. Sohu, https://www.sohu.com/a/678040807_121114988, last accessed:2023/7/7.
7. Yue, Y., Huang, J., Zhang, X., et al.: Exploration of the Professional Development of the Home Services Industry in China and Inspiration from Foreign Experience. Trade Fair Economy 81(11), 110-113 (2023).
8. Liu J, Fu Z, Sun X. : Overview of blockchain security. Journal of Nanjing University of Information Science & Technology (Natural Science Edition) 11(05), 513-522 (2019).
9. Shao Q, Jin C, Zhang Z, et al.: Blockchain technology: architecture and progress. Chinese Journal of Computers 41(5), 969-988 (2018).
10. Zhang F, Shi B, Jiang W.: Survey of key technologies and applications of blockchain. Journal of Network and Information Security 4(4), 22-29 (2018).
11. Hindawi, https://www.hindawi.com/journals/scn/2021/7142048/, last accessed:2023/7/7.
12. Diffie, W., Hellman, M.: New directions in cryptography. IEEE Transactions on Information Theory 22 (6), 644-654 (1976).
13. Yantao Shen, Yang Lu, Zhili Wang, Xin Xv, Feng Qi, Ningzhe Xing and Ziyu Zhao.: DNS service model based on permissioned blockchain. Intelligent Automation and Soft Computing 27(1), 259-268 (2021).
14. Arxiv, https://doi.org/10.48550/arXiv.1806.02008, last accessed:2023/7/7.

15. Pan C, Liu Z, Liu Z, et al.: Research on blockchain scalability: problems and methods. Journal of Computer Research and Development 55(10), 2099-2110 (2018).