



# Financial Innovation of Smart Pension Based on Blockchain Technology

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**Abstract.** It is an objective need to actively respond to the aging population by embedding blockchain-based information technology and intelligent technology into the smart financial service system. It is an objective need to actively respond to the aging population by using blockchain-based information technology and intelligent technology to embed the smart senior care service system, which is an opportunity to meet the development trend of information technology society and promote the level of social governance. In this regard, this paper focuses on how to use the concept, technology and wisdom of smart pension to improve the capability and level of China's existing pension financial service model in the context of smart pension, which has the objective of providing systematic new ideas and new paths for optimizing China's pension service system from the perspective of wisdom pension for traditional pension models such as home pension, community pension and institutional pension. This paper does not define smart senior care as a new senior care service model, but considers it as a new concept energy, technology energy and wisdom energy, and injects it into the traditional senior care financial model, so as to cope with the aging of population through information technology.

**Keywords:** blockchain · aging society · smart pension finance · model innovation

## 1 Introduction

A phenomenon called population aging affects people's cultures as they move into industrial societies, especially post-industrial countries. It is defined by a rise in life expectancy per capita and an increase in the number of elderly people in the population as a whole. The growth of economic and social development as well as advances in medical treatment are the primary causes of population aging. The accepted wisdom is that China's population aging will peak in the 1950s of the 21st century. While this forecast is correct, it is wrong because once China attains the high level of population aging in the 1950s of this century, it will not be reversed and will instead continue for an extended period of time [1]. In other words, China's rapid aging process will continue for decades, eventually leading to an aging plateau. Social development will face an array of new challenges as a consequence of population aging, including how to meet

the special needs of the elderly after they cease working and how to handle their income needs after they lose their ability and intelligence. All of these problems have to be taken into account in an integrated manner.

Financial tools and technologies are additionally an important way to actively cope with the aging population, but also an essential means to adapt to the transformation of the traditional pension models and meet the growing demand of the public for retirement savings, which has given birth to the specialized field of pension finance. It depends on international experience. However, in recent years, the significance and application of the concept of pension finance, as well as the difference and connection among related concepts, have not been clarified, and the community is still lacking a scientific understanding of pension finance. This could be detrimental to the long-term sustainable development of the pension sector as well as the capacity to deal with the challenges of aging through financial instruments.

The general secretary, Xi Jinping, stated that “China is one of the countries with a relatively high degree of population aging, with the greatest number of elderly individuals, the fastest pace of aging, and the greatest difficulty of coping with population aging. The “National Medium and Long-term Plan for Actively Coping with Population Aging” was released the the State Council in 2019, designating it as a national plan for actively coping with population aging. Pension finance is an essential part of the overall strategy has an essential role in the overall strategy [2].

## 2 Blockchain Technology

### 2.1 Distributed Storage, First

Figure 1 shows the blockchain’s distributed storage process, that can be broken into the following six steps: Data slices ought to be created, secret, hashed, then duplicated in this order: Distribute the replicated slice following step 5, and add transactions to the ledger following step 6. For there to be a complete blockchain L for data-to-data circulation, each block has to include the hash of the block that came preceding it [3]. Namely

$$\begin{aligned}
 H_0 &= \text{SHA256}(0, N_0, T_0, R_0), \\
 H_1 &= \text{SHA256}(H_0, N_1, T_1, R_1), \\
 H_2 &= \text{SHA256}(H_1, N_2, T_2, R_2), \\
 &\dots\dots \\
 H_i &= \text{SHA256}(H_{i-1}, N_i, T_i, R_i)
 \end{aligned} \tag{1}$$

where: A block’s strong hash value;  $N_i$ - an insert-specific random number having a value between 1 and 232 (or greater);  $T_i$ - the block’s timestamp, which is a JSON value generated at the exact time a transaction record in  $r_i$ ; 0 genesis block; Secure Hash Algorithm (SHA256) utilizes the SHA256 one-way hash algorithm. While improving the information interoperability of all links in the industry chain, the distributed storage of blockchain interferes with the centralized data storage of the traditional traceability system. Information is stored in multiple nodes in a distributed manner and each node keeps a complete copy of the information, and the information on the chain is transparent

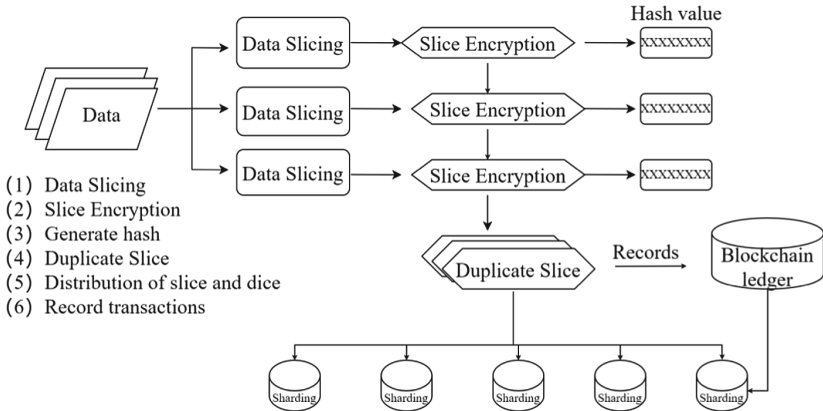


Fig. 1. Blockchain Distributed Stored Procedures

and verifiable to all participating members. It is an ideal match for the pension funding sector because of its decentralized, transparent, recoverable, and tamper-proof features [4]. As shown in Fig. 1.

**2.2 Smart Contracts**

A smart contract is a computer protocol that informally sells, validates, or executes a contract. A smart contract’s transactions can be trusted to be executed without any involvement of a third party and may be tracked irreversibly [5]. As a program that also interacts in the blockchain network environment, smart contracts is a more event-oriented application on the blockchain and its surroundings is isolated and secure. When the conditions are met, it can respond or convey relevant data, but it cannot generate or alter the contract itself. Rather, the contract will be triggered automatically. The isolated environment additionally guarantees that when the smart contract goes into effect, there is no effect on the inner workings of the blockchain system. As shown in Fig. 2.

Algorithm 1 Trading operations of pension financial products in smart contracts [6].

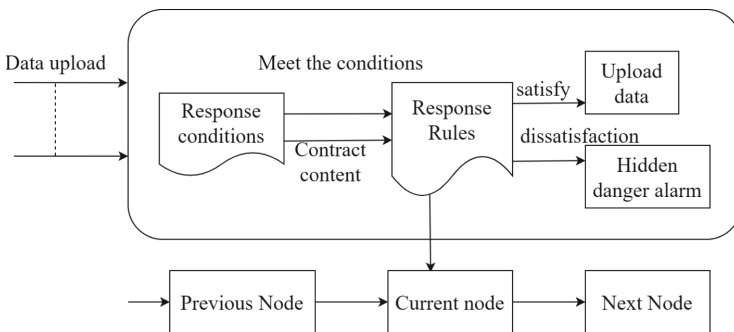


Fig. 2. Smart Contracts

The node number is `u_id`, the node role is `u_name`, the transaction number is `t_id`, the timestamp is `t_stamp`, and the product information is `p_information`.

```
// Register user and generate private key
user.id = u_id, user.name = u_name,; newKeyPair() ( u_id, [ ] byte) .
// for data information input and block generation
protected List <p_information > inputs.
pro_hash = sha256( p_information) , pro_time = t_stamp; gener-
ateBlock( p_information) .
// node validation
if proving( u_id) .equal == 0 then
return false.
// block broadcast and validation
else public boolean broadcast( Block p_information) ; isBlockValid( Block
p_information) .
AddBlockchain( ) .
return ture.
```

### 3 Problems with Ageing Finance

#### 3.1 A Single Category of Investments for Pensions

Bank deposits, funds, and insurance constitute almost all of the old-age financial products accessible in Zhaoqing at present, but each of the aforementioned has the drawback of merely providing one product type, which cannot meet all of the requirements of the elderly. For example, a lot of elderly individuals want to buy retirement properties to fund their retirement, but there are not many of these things accessible.

The vast majority of financial institutions have long held that older people spend more on medical care and less on other kinds of consumption, have lower levels of financial literacy and wealth, and exhibit traits linked to financial risk aversion. In order to meet their own profit maximization goals, financial organizations tend to be hesitant to generate financial products or provide financial services for older people due to these views. Despite the reality that China's old demographic has been increasing in recent years as well as banks, insurance companies, and other financial institutions are now starting to create new financial products and services for the elderly, it's still difficult in order to help the elderly and cannot successfully accomplish their fundamental requirements.

#### 3.2 The Elderly Lack Financial Literacy

A great deal of older people lack sufficient financial literacy, consequently their perception of the risk associated with the financial goods associated with pensions is also generally poor. They are easily duped by unscrupulous salesmen when making investments in pension funds, or their investment fails because they lack expertise in investing. In addition, a lot of senior people have a poor understanding and control of financial items, and some of these individuals have even been scammed. In addition, social security agencies and financial institutions are yet to establish practical application procedures

for the pension funding industry, which greatly impacts the ease that older people may run business.

### 1. Insufficient e-banking equipment

Currently, the majority of financial institutions quickly set up new intelligent terminals for various types of business, such as online banking, mobile banking, and WeChat banking, but they do not create suitable e-banking hardware devices for the elderly. As a result, the majority of elderly people are unable to take advantage of the convenient services offered by financial institutions. At the same time, a sizable portion of the elderly population currently resides in rural areas, where access to convenient mobile network services is restricted and geographical conditions make it difficult for them to experience intelligent financial services for the elderly, which lowers their perception of those services.

### 2. Absence of software applications

On the one hand, this is related to the characteristics of older people, and on the other, it reflects the lack of convenient financial applications for the elderly in financial institutions. Older people are typically used to conducting business with paper media such as savings passbooks and time deposit slips, and they are unfamiliar with some terminal applications. For instance, the absence of features, lack of humanization, and awkward operation are issues with the business software used by rural credit cooperatives. “The elderly in rural regions will surely find this to be a time-consuming process. The majority of older citizens can only access their cell phones with the help of bank employees; once they have done so, they are unable to carry out any more actions and are unable to use the necessary software if they are involved in replacing their cell phones. Due to this, the elderly have a smaller application usage surface, which significantly lowers the rate at which pension finance is adopted.

### 3. It is necessary to improve the basic comprehension of public pension financing

With regard to pension finance and investment awareness, 63.29% of the respondents believe that “income is not important, but the safety of principal is the most important,” while 18.23% believe that “pension investments should be on par with the inflation rate” and 15.97% believe that “pension wealth appreciation should exceed inflation.” 15.97% of respondents thought that “to outpace inflation to achieve wealth appreciation in retirement” was an aim. It appears from the findings of the poll that a majority of respondents put a great deal of value on safeguarding assets and have a conventional understanding of pension financial management. Second, pension funds have poor risk tolerance abilities. According to the study, simply 14.7% of respondents showed they could afford a loss of more than 20%, whereas 41.5% said they were capable of handling a loss of less than 10%, and 43.8% said they could not afford to lose any money at all. This indicates that the willingness of respondents to take chances is low. Finally, there’s a lack of general awareness of pension money [7]. A person’s level of financial knowledge ultimately determines the returns on pension expenditures, and consumers can only get returns along with wealth growth through a successful asset allocation plan with a better grasp of pension finance.

### 3.3 A Single Category of Investments for Pensions

Firstly, there is a small contribution rate on pension insurance. Zhaoqing's present pension insurance contribution rate is only 14%, which is significantly lower than the world-wide median. This not only has a bearing on the expansion of insurance funds but also makes it difficult to ensure the future level of living for the elderly. To establish a more suitable contribution policy and increase the contribution rate so as to ensure the continued existence of the pension insurance fund, it needs for greater cooperation between the government and companies.

Second, the rate of return on investment in pension insurance is poor. While the rate of investment return is very low, Zhaoqing's pension financing gets almost all of its income from government assets. The government should build a more effective investments system, improve the rate of return on investment, and strengthen the oversight and management of retirement savings accounts in order to tackle this condition. In order to boost the profitability of funds subject to suitable regulation, the public should also be encouraged to invest in pension finance.

Finally, the operation of pension insurance is unsuccessful. Data show that Zhaoqing had a significantly smaller percentage of pension insurance managers compared to other cities, and that managerial effectiveness and quality of service need to be improved. To improve the quality of management and services and increase older people's joy, the government and private companies ought to ramp up their talent recruitment and training initiatives.

### 3.4 The Pension Finance Market Lacks Able Talent

There is an acute lack of individuals with supervisory and leadership skills in the pension finance companies. A professional shortage within the pension funding industry. The field of pension finance needs experts with significant financial expertise and knowledge in the pension business, but due to the small size of the industry, here is not much demand for experts, leaving a lackluster talent pool lack of professional talent training methods. The creation and development of training mechanisms have been limited due to the need to continually improve the professional level and talent of individuals involved in the pension funding sector lack of professional talent introduction methods. The topic of pension finance needs experts with a certain set of abilities in order to advance business development, but recruiting of new experts can be difficult because this industry remains in its early stages. Due to this, Zhaoqing's senior care finance industry is difficult to efficiently oversee and manage risk. The primary explanation for this is that there hasn't been as much education and training given to appropriate professionals because the pension finance company hasn't received much attention in the past. In addition, as the population age groups, the importance of the pension finance sector increases and there is an associated increase in need for experts in this field. To promote the development of the senior care finance service industry, Zhaoqing region ought to boost the quality and level of industry talent and strengthen the training and introduction of talent for the senior care finance field.

### **3.5 The Market for Pension Financing is not Sufficiently Regulated**

The regulation of the pension finance market is currently insufficient and weak enough. Market speculative components abound, and the promoted financial solutions for pensions have numerous flaws. Such speculative activity will not only result in financial losses for the elderly but will also have detrimental effects on the financial market for senior care as a whole and will hinder the market's healthy growth. Because there aren't many regulators and no perfect system of regulators has been developed, the pension finance sector has insufficient oversight and a narrow range of regulatory tools. The safety and stability of the market for pension financing have suffered a number of negative repercussions as a result.

## **4 Feasibility of Applying Blockchain Technology in the Field of Pension Finance**

### **4.1 The Blockchain Technology Opens How for the Finances Realization of Services for Seniors**

Blockchain technology enables to preserve and enhance the monetary worth of services for seniors. Senior care finance additionally includes fixed asset products in addition to monetary ones. At the same time, owing to the "emphasis on soil and roots" complex among the Chinese people, domestic people tend to retire on their own land. As a consequence, it is typical for people to work hard in large cities before dying in their hometowns. A retirement home purchase should not, however, be the sole choice for the allocation of fixed assets in pension service funding. Here should be more varied alternatives [8].

### **4.2 The Natural Collaboration Between Senior Service Finance and Social Governance is Aided by Blockchain Technology**

First off, the government can increase the effectiveness of senior care services by using blockchain technology and senior care financing. Even while the present administration favors furthering reform and stepping up "decentralization" measures, there are still certain drawbacks. The widespread use of blockchain technology can aid in improving the efficacy of government services for the elderly, particularly given that the current reform depends on digital platforms run by computer and mobile app software.

The use of blockchain technology in this setting enhances the efficiency of the appropriate departments. Furthermore, the issuance of important certificates under blockchain technology will undoubtedly be made simpler and will boost the efficiency of the appropriate departments. For instance, blockchain technology helps in the incorporation of intelligent solutions and reduces the difficulty of operation for senior citizens on the platform. Second, the integration of blockchain technology in senior service finance could guarantee the orderliness and standardization of the senior service finance company as well as enhanced oversight of the related industries.

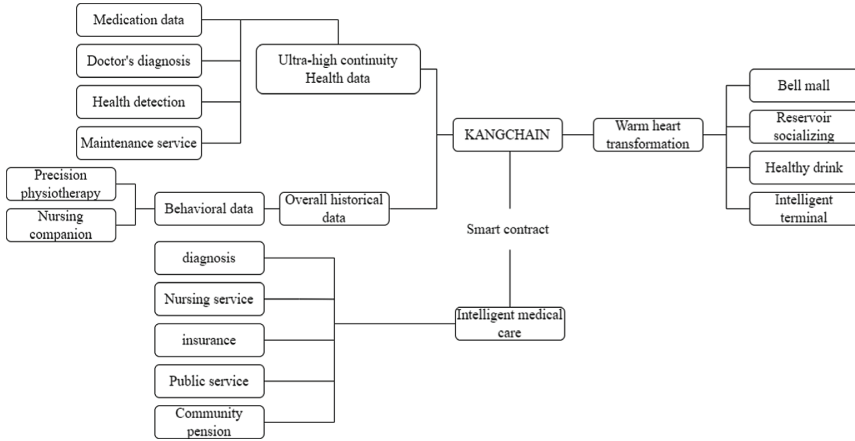


Fig. 3. Application of blockchain in Kang Chain Senior Care Platform

## 5 Case Analysis of Blockchain Financial Services for the Elderly

According to the three levels of family, public and community of senior care, three cases are selected in this paper.

### 5.1 Kangchain, a Representative Organization of Family Elderly Care

Kang Chain No. Takes the lead in laying more than 10,000 healthy senior care stations in China, and takes the lead in applying blockchain technology to offline scenarios, combining the online self-owned and affiliated mall, offline brand production base, experience store and shared medical services of Sunsun Group to form a complete senior care industry chain model, which has reference value for improving the level of family senior care services in China [9]. As shown in Fig. 3.

### 5.2 It is the Russian Public Pension Blockchain Practice

Like us, Russia has a large national population, and compared to other countries, it was among the first to begin keyboard shortcut-regulating pension blockchain technology uses at the governmental level. For instance, the Russian Pension Fund (PFR) handles employment contracts for the Russian populace utilizing blockchain technology, integrating all job-related information and data on the pension funds involved on a single digital platform. These implementations of blockchain technology at the government level have lowered the cost of database storage while making it possible to conduct efficient oversight using smart contracts and digital platforms, which has implications for China’s large-scale use of blockchain technology. As shown in Fig. 4.



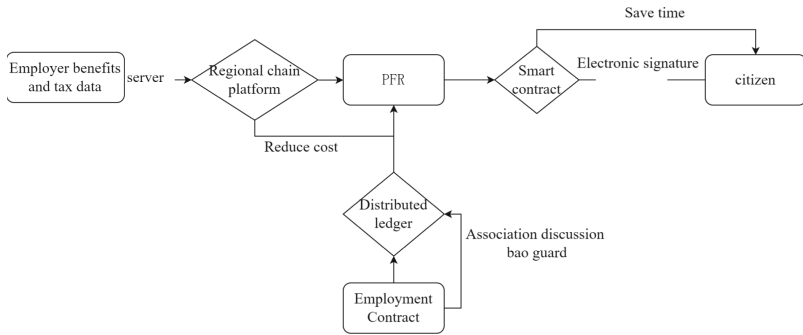


Fig. 4. Application of blockchain in Russian Pension Fund (PFR)

### 5.3 It is the Yueche Group of Community Aging and the Shanghai Putuo Community

Community-based and home-based senior care models are going to increase popular in China as a consequence of the implementation of an array of senior care rules, and the initiatives of the case communities and groups provide example and learning opportunities for the creation of fresh senior care models. As shown in Fig. 5.

Through the case study mentioned above, it becomes apparent that the use of blockchain technology across different scales in the field of elderly care offers developers an open and useful platform while providing users better all-around services, introducing digital assets into the social network structure of the elderly care process, forming an economy of data and information, and allowing participants in the blockchain ecosystem to generate returns on what they have invested.

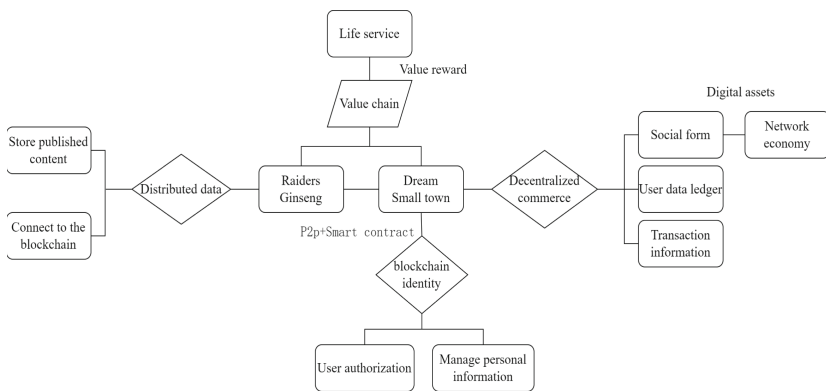


Fig. 5. Application of blockchain in Yueke Pension

## 6 Model Innovation in the Field of Elderly Care

A thorough examination of the issues with pension financing, the viability of blockchain technology in pension financing, and pertinent case studies demonstrates that, based on the traits of blockchain technology, the area of family pension can create a smart pension platform to store the health pension data of families and elderly people, which aids in raising the quality of family pension services. The national pension fund management agency or pertinent departments can establish a trust system in the area of public state pensions by working with significant pension financial institutions, build a blockchain platform that incorporates citizen labor relations and labor agreements, carry out sophisticated operations in the pension sector using the entire blockchain record, and support the substantial growth of the pension finance sector. By relying on the data platform to gather and analyze data, the field of community elderly care is able to segment the consumption patterns of the elderly, identify their individual needs for nursing care and elderly care, and expand new elderly care models like community collective elderly care, daycare elderly care, and off-site migratory bird care [10]. In order to do this, the integration infrastructure for blockchain applications in the aged care sector is still being built. As shown in Fig. 6.

Blockchain technology offers a framework and implementation path to address the “unique dilemma” of identity authentication in the context of pension insurance, guaranteeing its veracity and dependability. The technical basis for combating insurance fraud is good data and information traceability; Decentralization has reduced the need for many intermediaries; Issues with data tracking and health data anti-counterfeiting have been resolved by employing blockchain timestamp and distributed ledger features in combination with IoT technology [11, 12]. It can be argued that blockchain has overcome the constraints of time and space in information management in the field of pension insurance, providing technical support for innovation in pension insurance products and services, serving scenario-based innovation in particular, which aids in the design of dynamic insurance solutions and achieves individualized and effective pension insurance services.

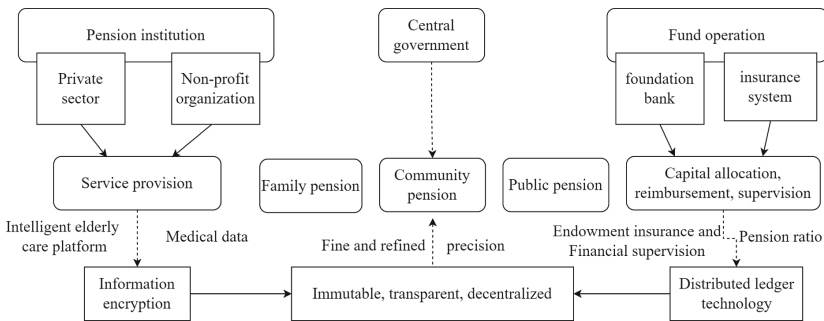


Fig. 6. Integration framework of pension model based on blockchain

## 7 Conclusion

By examining relevant literature and comparing concrete instances, this paper analyzes the importance and practicality of using blockchain technology in the field of elderly care. It then establishes a framework for including the elderly care model based on blockchain technology in order to offer novel viewpoints and practical answers for present issues from the perspective of blockchain technology. The theoretical value of this paper is mainly shown by the actualization of the integration of technological innovation and social innovation research perspectives, the systematic theoretical framework and application guidance between blockchain technology and the social system of senior care, the enhancing and enhancing integration of blockchain technology concept into social management field, and an expanding of the application surface and methodology of blockchain technology. This paper analyzes the current remaining problems and improves the solution ideas of three levels of blockchain application, which helps to provide a new perspective for the research of system, method, and business of pension industry and promotes research on the integration of blockchain technology and pension industry to be more concentrated. In meantime, along with the emerging practices such as pension finance and smart pension in the new era and the upgrading of pension industry.

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