

## Retraction

# Retracted: Information and Data Analysis Based on Big Data and Blockchain Technology in Promoting the Development of Cultural Tourism Industry

### Security and Communication Networks

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### References

- [1] X. Qin, "Information and Data Analysis Based on Big Data and Blockchain Technology in Promoting the Development of Cultural Tourism Industry," *Security and Communication Networks*, vol. 2022, Article ID 9400077, 11 pages, 2022.

## Research Article

# Information and Data Analysis Based on Big Data and Blockchain Technology in Promoting the Development of Cultural Tourism Industry

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With the introduction of the reform and opening-up policy, the Chinese tourism industry has made considerable progress, but the current development is facing new development shortcomings and limitations. With the rapid development of technology and informatization, big data and blockchain technology provide new ideas and directions for the development of information and data analysis in the cultural and tourism industry. Under big data and blockchain technology, an in-depth research is conducted on the statistical system and GDP accounting data of the two industries of culture and tourism using coupling coordination model, model setting, and proxy re-encryption technology. It coordinates the statistical system of cultural and tourism industries, forming a unified cultural and tourism statistical report and value-added accounting report. It uses blockchain technology to calculate and analyze that the total output value of the tourism industry and cultural integration development in the past two years has increased by 1,4677.5 billion yuan, with a growth rate of 42.79%. Under the integrated development of culture and tourism in various regions, the overall income has shown an upward trend, with the highest growth rate of nearly 50%. The deep integration and development of cultural and tourism industry will become the top priority of Chinese cultural and tourism work in the future. With the addition of big data and blockchain technology, the great development of cultural and tourism integration has been realized.

## 1. Introduction

The combination of big data and blockchain technology has improved the “quantity” and “quality” of interactive data collection. In the near future, with the development and growth of these two technologies, the amount of data will increase from terabytes to PB and EB levels, and traditional storage and processing methods will generate more budget costs. Big data were born before blockchain technology and developed earlier. The growth of its technology is higher than that of blockchain.

Big data are a large-scale data collection that greatly exceeds the capabilities of traditional database software tools in terms of acquisition, storage, management, and analysis. It has four characteristics: massive data scale, fast data flow,

diverse data types, and low value density. The blockchain is a new application mode of computer technology such as distributed data storage, point-to-point transmission, consensus mechanism, and encryption algorithm. It is a convergent technology with the characteristics of traceability, non-tampering, and open autonomy.

The application of new technologies in the cultural tourism industry is an area that needs to be explored, and there will be more research in the future. The integration of new technology, culture, and tourism has penetrated various fields, for example, the production process of tourism materials, tourism transportation, tourism catering, tourism purchase, tourism accommodation and media, news information, propaganda culture, and cultural system. Both of them imply the integration of culture and technology to

promote the development of culture and tourism. These new technologies will enhance the form of cultural expression, promote the integration of culture and tourism, and deepen and enhance the integration of tourism culture. This helps increase visitor engagement and create a better and more satisfying travel experience for them. Big data technology has given results, and people are no strangers to the use of big data technology, and there are many related studies.

Blockchain technology (BCT) was originally developed for Bitcoin cryptocurrency. It is a decentralized and complete credit management technology that can provide the security, confidentiality, and integrity of credit data without relying on any third party. Tribis et al. conducted a systematic review to examine all BCT-based SC-related research. The main inspiration for this work is to synthesize existing evidence, classify research trends available in the literature, and identify open themes and gaps in the development of the discipline. In addition, he has extracted 45 major papers from scientific databases. This systematic review provides a direction for future research on the application of BCT in SC [1]. An increasingly regrettable result of the reregulation after the 2008 global financial crisis is “de-risking”—banks and other financial institutions are increasingly detached from the market, and the market is considered to be more risky than potential profits. As banks located in the north of the world have begun to withdraw financial services from many emerging economies, de-risking has attracted attention because it undermines financial inclusion and development. Campbell-Verduyn et al. contributed to the IR theory of legality and re-risk. He explained how technology-based de-risking efforts seeking to pay attention to the opinions of foreign financiers can undermine the legitimacy of financial inclusion projects [2]. Sikorski et al. explored the application of blockchain technology related to the fourth industrial revolution and showed an example. Among them, blockchain is used to promote machine-to-machine (M2M) interaction and establish an M2M power market. All participants have access to real data generated by the process model. This work contributes to the proof-of-concept realization of this scenario [3]. Nowadays, the development of traditional business models is becoming more and more mature, and people use them to guide various e-commerce activities. The Internet of things (IoT), as an innovative revolution of the Internet, has become a new platform for e-commerce. However, the old business model is difficult to transition to the e-commerce Internet. Zhang and Wen introduced the e-commerce business Internet specially designed for e-commerce products. He redesigned many functions of traditional e-commerce business models to identify smart asset transactions and payment data [4]. Blockchain (BC) is the technology behind the Bitcoin cryptocurrency system. It is believed to ensure that enhanced security and privacy are both attractive and essential for various applications in many other fields, including the Internet. The Internet of things (IoT) ecosystem is currently undergoing in-depth research in academia and industry to apply blockchain technology to various applications. Miraz and Ali’s work proved that PoW is a cryptographic puzzle. He plays a vital role in ensuring the

safety of BC by maintaining a digital ledger of transactions considered to be incorruptible. In addition, BC uses a variable public key (PK) to record the user’s identity, which provides an additional layer of privacy [5]. The financial technology (FinTech) department believes that the cryptocurrency blockchain protocol or distributed ledger technology (DLT) has high potential value. However, the requirements and guarantees of the blockchain for cryptocurrency do not match the requirements and guarantees of financial technology from transaction throughput to security primitives and privacy. Ittay discussed how blockchain research other than Bitcoin closes these gaps and some of the challenges that still exist [6]. Mansfield-Devine said that most people mentioned the term “blockchain,” assuming they have heard of it, and they are likely to associate it with Bitcoin or another cryptocurrency. It serves as a decentralized, encrypted, and verified transaction record. Blockchain is the key concept that makes Bitcoin feasible. However, as Patrick Hubbard, director of technical product marketing at SolarWinds, explained in this interview, the application of the same concept goes far beyond the controversial world of alternative currencies—in fact, far beyond finance [7].

In fact, blockchain technology is generally expressed as an application or architecture running on a blockchain network, but this part is not available in blockchain technology. According to a report released by the Federal Reserve Bank of Apolis, the main blockchain technology is replacing traditional forms with new licensing or trust forms. Direct communication between people (point-to-point) perceived by blockchain technology also requires the establishment and implementation of specific models and established rules [8–10]. The big data blockchain technology factor has become an external catalyst for the development of information and data analysis in the cultural and tourism industry. This makes the development of the cultural tourism industry more diversified and has become a powerful external driving force in the analysis of information and data for the development of the cultural tourism industry.

## 2. Blockchain Technology Analysis

*2.1. The Origin of Blockchain Technology.* Blockchain is a new application mode of computer technology such as distributed data storage, point-to-point transmission, consensus mechanism, and encryption algorithm. It is an important concept of Bitcoin, which is essentially a decentralized database. At the same time, as the underlying technology of Bitcoin, it is a series of data blocks associated with cryptography. The Bitcoin network provides users with exchange and transfer services, and the value-added medium of the service is supported by transaction data defined by Ledger Bitcoin.

To maintain public account security and data permissions, the company creates a reward mechanism. That is, the public account creates a new Bitcoin for the node or the Bitcoin user runs the node to keep the public list together [11]. The operating mode of Bitcoin is shown in Figure 1.

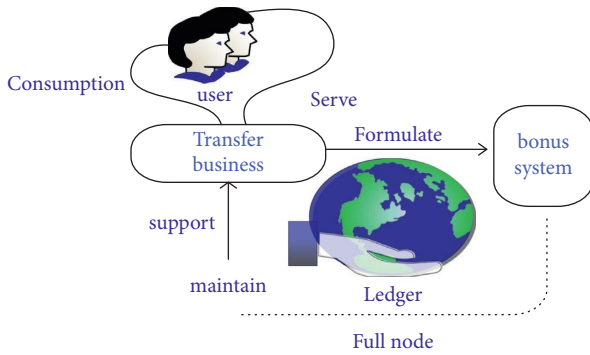


FIGURE 1: Bitcoin operating mode.

Currently, 99 countries including the United States, Germany, Japan, Brazil, Canada, and Australia have recognized the legal status of Bitcoin, the world's best-selling electronic currency, as shown in Table 1.

Table 1 compares and analyzes the various technology types of blockchain technology in terms of symbol, publish time, and author. From the data point of view, the earliest issuance is Bitcoin, and it is also the most popular technology with the highest usage rate. Due to the rapid development of Bitcoin in recent years, as an important breakthrough for independent innovation of core technologies, blockchain technology and industrial innovation must be promoted. "Blockchain" has entered the public's field of vision and has become the focus of attention of the society.

**2.2. Blockchain Platform.** There are two types of blockchain platforms: public chains and consortium chains. All nodes in the public chain are free to join or withdraw; nodes in the consortium chain must be allowed to join. The public chain nodes are usually anonymous, while the consortium chain must require member management services to verify the identity of the nodes. The following compares commonly used blockchain platforms in terms of access mechanisms, data formats, and consensus procedures [12–14], as shown in Tables 2 and 3.

Bitcoin is the most successful blockchain application, but it is limited to digital currency applications. To achieve this goal, the industry has launched a number of blockchain platforms that support standard applications [15]. The most popular website in the public series is Ethereum. Many blockchain sites, such as chord, are based on construction and expansion, and BigchainDB is the largest site in the alliance series.

Tables 2 and 3, respectively, analyze and compare different types of blockchain technologies and count the probabilities of using several technologies when they are hungry. Among them, Ethereum and Corda are the most used in the comparison of two different types of technologies. In today's development of the medium-sized sharing economy, blockchain, as a centralized data storage solution, solves the problem of debt distribution, thus becoming an ideal data platform.

**2.3. Blockchain System Architecture.** The current blockchain technology is based on the Bitcoin blockchain. Technology has been improved, but only some technical connections, new implementation methods, or changed models have been adopted, or new models have been added (such as smart contracts) [16].

Therefore, Bitcoin blockchain technology will be used to introduce the basic principles and key technologies of blockchain technology. Since blockchain technology is the result of the feasible integration of multiple technologies, therefore, blockchain technology can be divided into network coverage, shared insurance, data insurance, smart contract insurance, and application insurance according to the relevant workflow coverage, with a total of five layers [17, 18], including the use of data encryption technology to protect the data coverage of the underlying data in the Merkle tree structure; at the network level, most of the distributed network hardware, data transmission machines, and data identification tools are used to integrate the data of each node into the blockchain system. This standard is very common in verifying the accuracy of transactions between different nodes. This layer contains blockchain exchange algorithms; the level of incentive is that digital cryptocurrencies such as Bitcoin use financial factors such as driving forces to solve economic problems. It is presented to the blockchain system such as Bitcoin mining and the integration of this financial incentive cycle [19, 20]. It should be noted that there is no such integration in the structure of some blockchain technology for non-digital currencies; contract coverage is a decoration of the blockchain technology solution. The cover contains clear transactions, including various scripts and algorithms; the application layer promotes restricted specific application conditions. Although they are different in specific implementation, they have a lot in common in the overall structure of the system. The entire blockchain platform can be divided into five layers: network coverage, shared insurance, data insurance, smart contract insurance, and application insurance [21]. It is shown in Figure 2.

**2.4. Consensus Mechanism.** The blockchain system is essentially a large system. Everyone keeps accounts and maintains them together, and how to maintain it depends on the identification mechanism. In layman's terms, if a Chinese Weibo blogger, a virtual currency player in the United States, an African student, and a European traveler do not know each other, they all agree that they are a good person, so it can basically conclude that this person is not bad.

The consensus mechanism is to complete business settlement in a very short time through the election of the most important participants, and they have no reliance on their own trade rules [22, 23]. On the blockchain, the security framework is how national laws govern the national blockchain, which enables it to operate safely [24, 25]. The operation of the consensus mechanism is shown in Figure 3.

At present, the disk, memory, and CPU of the server are relatively good, and a database server can store hundreds of millions of data [26]. Its consideration of using distributed

TABLE 1: Comparison of the market value of current active electronic currencies on the Internet.

Currency	Symbol	Publish time	Author	Active	Market value	Bitcoin basics	Remark
Bitcoin	BTC	2009	Satoshi Nakamoto	Yes	US\$1 billion	Yes	SHA-256
Litecoin	LTC	2011	Coblee	Yes	38 million USD	Yes	SCRYPT
Unlimited Coins	IFC	2012	Ifcony	Yes	US\$4 million	Yes	SHA-256
Cocoa Coin	COL	2013	Colossuscoin	Yes	80 million USD	Yes	SHA-256
PPCoin	PPC	2012	Ppcion	Yes	US\$4 million	Yes	SHA-256
Namecoin	NMC	2011	Vinved	Yes	USD 4.5 million	Yes	DNA SHA-256

TABLE 2: Comparison of Bitcoin, Ethereum, Hyperledger Fabric, and Hyperledger Sawtooth.

Blockchain platform	Access mechanism	Data model	Formula algorithm	Smart contract language	Underlying database	Usage rate (%)
Bitcoin	Public chain	Transaction-based	PoW	Solidity	LevelDB	29
Ethereum	Public chain	Account-based	PoW/PoS	Go/Java	LevelDB	56
Hyperledger fabric	Alliance chain	Account-based	PBFT/SBFT	Python	LevelDB	12
Hyperledger Sawtooth	Public chain/alliance chain	Account-based	POFT	Java/Kotlin	—	3

TABLE 3: Comparison of Corda, Ripple, BigchainDB, and TrustSQL.

Blockchain platform	Access mechanism	Data model	Formula algorithm	Blockchain platform	Underlying database	Usage rate (%)
Corda	Alliance chain	Transaction-based	Raft	—	Commonly used relational database	63.5
Ripple	Alliance chain	Account-based	RPCA	Crypto	SQLite	0.9
BigchainDB	Alliance chain	Transaction-based	Quorum voting	JavaScript	MySQL	9.6
TrustSQL	Alliance chain	Account-based	BFT-Raft/PBFT		MySQL	26

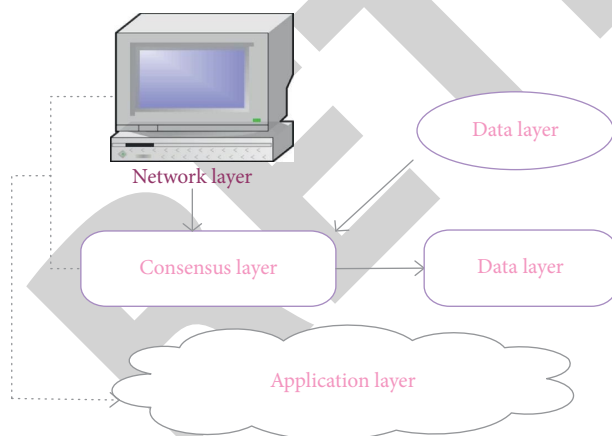


FIGURE 2: Overall level of the blockchain.

databases is definitely in terms of capacity or performance, because the existing stand-alone database cannot meet the needs of the business. Of course, it has encountered capacity or performance problems, and it does not necessarily have to use a distributed database. It can be solved by scale-up, that is, upgrading the CPU, memory, and disks of the database server and replacing SATA/SAS disks with SSD disks. However, compared with scale-up, the scale-out method of

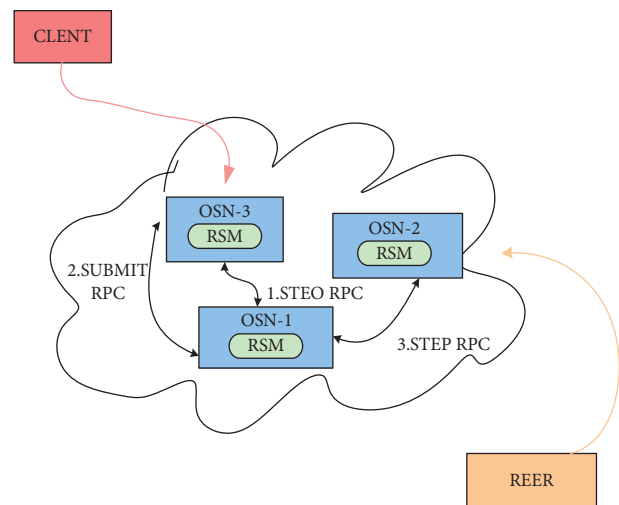


FIGURE 3: Operation of the consensus mechanism.

distributed database has stronger scalability and is generally more cost-effective [27].

An ordinary x86 server, a database server, stores hundreds of millions of data, but the premise is that it needs to be divided into databases or tables. A single table of hundreds of millions of data cannot be supported by ordinary servers.

After all, the amount of data becomes larger, the level of the B-tree corresponding to the table is higher, and the splitting and adjustment of the B-tree node during writing are also expensive [28]. At the same time, under the scale of hundreds of millions, a single database server may not be able to support intensive requests, and performance may be problematic [29]. Therefore, Paxos and Raft algorithms cannot be directly used for blockchain integration. This special category includes PoW tools that can be applied to public chains and PBFT algorithms that can be applied to consortium chains. As shown in Table 4, PoW and PBFT are compared and analyzed from features such as node admission mechanism, transaction throughput, scalability, and Byzantine fault tolerance.

**2.5. Smart Contract and Operating Mechanism.** A smart contract is a computer contract designed to distribute, verify, or execute a contract in the form of information. The smart agreement in the blockchain space has the following characteristics: the rules are open, the terms and data in the agreement are external, all transactions are visible, and there will be no false or hidden transactions. Therefore, we often say that blockchain technology has the characteristics of “openness and transparency” and “non-tampering,” which are actually given to the blockchain by smart contracts. There is a consensus in the world of programmers that people are more uncontrollable than programs and machines.

In traditional contract behavior, people make rules and execute them. Of course, it is up to people to define boundary problems or abnormalities, but with smart contracts, these become different. Developers formulate a set of rules through smart contracts and then publish them online, where people interact with smart contracts. The machine is used to complete the business part, thus avoiding the cheating behavior that may be caused by the execution of human beings. This further illustrates that the features of smart contracts are agreement, contract execution, and computer-readable code.

- (1) It reached an agreement.
- (2) Its contract execution.
- (3) Computer-readable code.

The operating mechanism of the smart contract is shown in Figure 4.

Smart contract is a piece of code deployed on the blockchain. Once an event triggers the terms in the contract, the code will automatically execute [30]. A smart contract is a digital contract based on high technology such as cryptography. The difference with traditional paper contracts is that vending machines are equivalent to smart contracts, and salespersons are equivalent to paper contracts. The characteristics of the smart contract running the blockchain on the blockchain system, block access area, and status data can be summarized as follows:

- (1) Decentralization: A blockchain network based on P2P technology will not have a centralized management

structure, and all nodes in the network have autonomous rights.

- (2) Open and transparent: Transaction records are transparent and open on the entire blockchain network, breaking the asymmetry of information.
- (3) Non-tampering: Blockchain technology first uses asymmetric encryption technology to encrypt transactions and then packages the transactions into blocks according to the time division and adds them to the chain. The front and back blocks are connected by means of encryption verification, and any tampering of a transaction will cause the chain structure to be disconnected. A complete blockchain can ensure that data have not been tampered with.
- (4) Distributed consensus: Blockchain technology will use a certain consensus algorithm to share data to each node server in a timely manner. When some nodes are attacked, the data on the nodes are tampered with or deleted maliciously, and it will not affect the normal operation of the entire system.
- (5) Security and credibility: It uses asymmetric encryption algorithms to encrypt data, which can effectively prevent data leakage, tampering, and other issues, and ensure that the data are safe and credible.

### 3. The Status Quo of Domestic Tourism and Cultural Industries

**3.1. Tourism Industry.** The definition of the concept of the tourism industry in China is mainly discussed from the aspects of the connotation, scope, and status of the tourism industry. For the study of the connotation of the tourism industry, the academic circles have not yet reached a unified standard. Based on the characteristics of the research, it is believed that the tourism industry covers the tourism industry itself, as well as related enterprises and enterprise aggregates that provide services, products, and facilities for tourism. It mainly measures the development of the tourism industry through the income of the tourism industry, the benefits of employees, industrial institutions, and related enterprises. The added value of tourism and related industries in the past two years is shown in Figures 5(a) and 5(b).

Using blockchain technology to calculate and analyze, it is found that the total output value of the tourism industry and cultural integration development in the past two years has increased by 1,4677.5 billion yuan, with a growth rate of 42.79%.

However, the biggest contradiction in Chinese economic activities is still the supply side. This is directly reflected in the large amount of new electricity and insufficient supply and efficiency. The products and services provided by the company may not be able to meet the diverse needs of customers. In terms of cultural tourism, there is also the problem of insufficient supply. For example, traditional production tourism has only structure, lack of characteristics, low supply quality, unrealistic satisfaction, and low supply efficiency. It is difficult to realize people's yearning for

TABLE 4: Comparison of PoW and PBFT.

	PoW	PBFT
Node admission mechanism	Public chain	Alliance chain
Transaction throughput	7TPS 20~30TPS	200~30TPS
Transaction confirmation time	60 min (Bitcoin) 3 min (Ethereum)	Milliseconds
Scalability	The number of nodes is less than 100,000	The number of nodes is less than 100
Byzantine fault tolerance	Less than 50% of the computing power	Less than 33% of votes
LF	Hash consumes computing resources	Broadcast consumes network resources
Fork possibility	Have	None
Final consistency	No	Yes

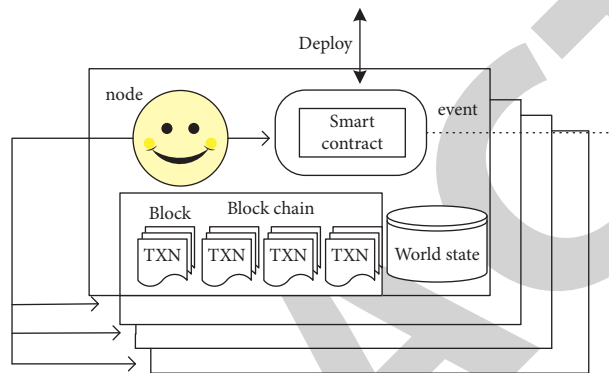


FIGURE 4: Operating mechanism of smart contracts.

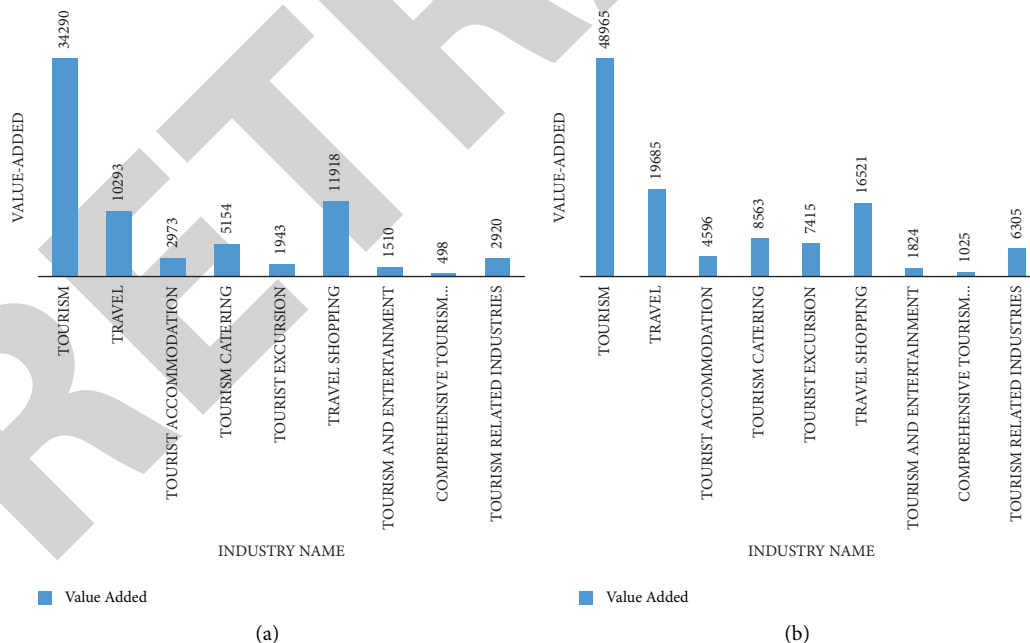


FIGURE 5: Growth value of tourism and related industries in the past two years.

a better life in cultural tourism. With the rapid growth of cultural products and tourism usage in the past few years, the growth of the overseas tourism market has shown that the cultural or tourism industry reflects the problem of insufficient supply, that is, results and services. The reason is that

companies cannot effectively meet the increasing number of tourists, personalization, and strong demand. To meet the demand for high-quality cultural production and tourism, it is necessary to deepen the reorganization of the cultural and tourism industry supply chain, keep pace with consumption,

increase cultural change and update, and establish a tourism industry oriented by digitization and product service information [31]. At the same time, the tourism industry also has a certain travel cycle, as shown in Figure 6.

The tourism cycle usually goes through several processes: exploration stage, development stage, critical stage of capacity, stable stage, stagnant stage, recovery stage, and decline stage. Therefore, in the current era, it is increasingly necessary to use big data and blockchain technology to bring fresh blood to the integration and development of culture and tourism.

**3.2. Cultural Industry.** The cultural industry was the first concept used in the book “Dialectics of Enlightenment” (1947). It particularly emphasizes that “cultural industries must be strictly excluded from general culture.” The cultural industry requires everyone to work together to inherit and develop, and a new way out can be found by looking at the issue of cultural industry development dialectically. The survey and analysis of the added value of culture and related industries in the past two years are shown in Figures 7(a) and 7(b).

Using blockchain technology to calculate and analyze, it is found that the total output value of cultural industry and tourism integrated development in the past two years has increased by 1,015 billion yuan, with a growth rate of 45.11%.

As a special cultural form and a special economic form, the cultural industry has affected the people’s understanding of the essence of the cultural industry. Different countries have different understandings of cultural industries from different angles. UNESCO’s definition of cultural industries is as follows: cultural industries are a series of activities that produce, reproduce, store, and distribute cultural products and services in accordance with industrial standards. It is defined from the perspective of industrial standardized production, circulation, distribution, consumption, and re-consumption of cultural products.

**3.3. Benefits of Cultural and Tourism Industry Integration.** Compared with developed countries in the tourism industry, China has made considerable progress in the implementation of the reform and opening policy at the development level. Faced with such a development situation, the country has proposed a development strategy for the integrated development of cultural and tourism industries including traditional tourism links. This not only meets the spiritual needs of tourists but also increases the potential value. In the tourism industry, the ultimate goal is to cultivate a culture of cooperation and win-win in the tourism industry. Industrial integration can not only optimize the industrial structure and improve the overall efficiency of the industry but also make use of functions such as big data collection, storage, sharing, and analysis. The domestic benefit statistics of the cultural industries of the following provinces in the past two years are shown in Figures 8(a) and 8(b).

The advantageous conditions for the development of the cultural industry in this province are mainly embodied in the three aspects of folk customs, religion, and Silk Road culture.

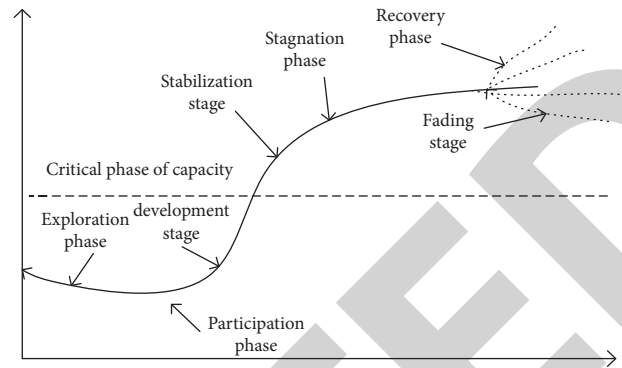


FIGURE 6: Travel cycle.

The folk customs and culture of the province area also attract many tourists to stop, so that the multiethnic settlements, all kinds of traditional culture, and living customs still maintain their unique characteristics during the long historical development process. In a material-oriented modern society, people have different spiritual feelings [32].

## 4. Integration Test of Cultural Tourism Industry

The statistics of cultural tourism and related industries and the calculation of added value are a very complicated subject. Cultural undertakings also have a statistical problem. How to deal with the connection, interweaving, and difference between cultural industries and cultural undertakings in actual work is a new problem. Coordinating the statistics and accounting of the cultural industry, cultural undertakings, and tourism industry is an extremely complex subject. The tourism industry can analyze and calculate from tourism transportation, catering, accommodation, shopping, and other aspects. Fortunately, in the era of big data, new paths and new tools are provided to solve this problem [33].

**4.1. Coordination Model.** Coupled-mode theory refers to a theory that studies the general laws of coupling between two or more electromagnetic wave modes. The coupling can occur between different electromagnetic wave modes in the same waveguide (cavity) or between electromagnetic wave modes in different waveguides. Coupling coordination degree model is the most commonly used method to measure the integration and development of regional tourism industry and cultural industry. The calculation method is as follows:

$$D_i = \sqrt{T_i * F_i}. \quad (1)$$

Among them,  $K$  represents the coordination degree of the two subsystems of culture and tourism,  $C$  represents the contribution value of the two subsystems of culture and tourism to the coupling degree, and  $A$  represents the integration of culture and tourism measured by the coupling model. Its numerical value is positively correlated with the degree of cultural and tourism integration. That is, the larger the value, the closer it is to 1, the higher the integration of



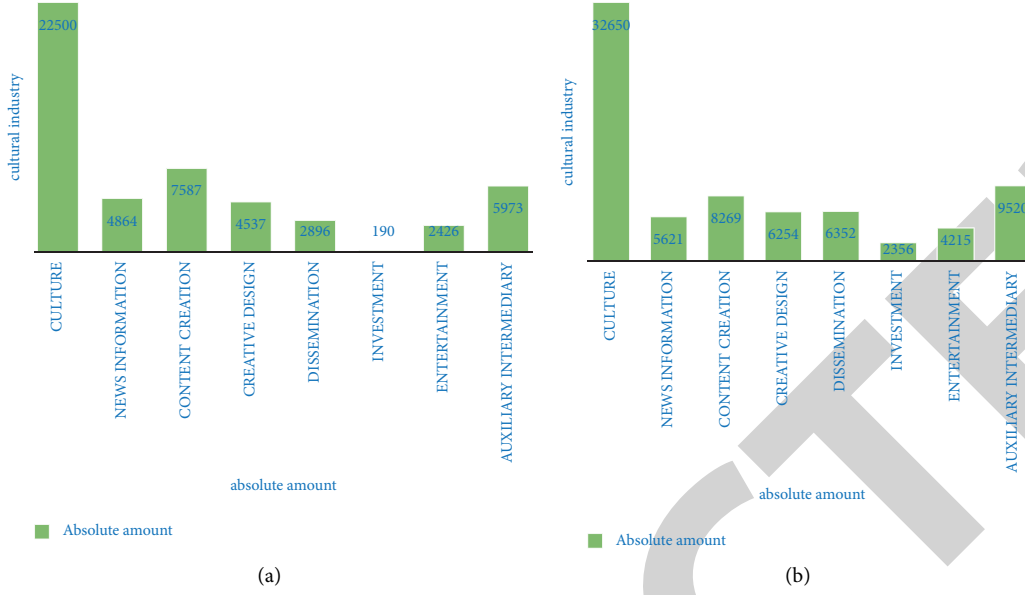


FIGURE 7: Increased output value of cultural industry-related industries in the past two years.

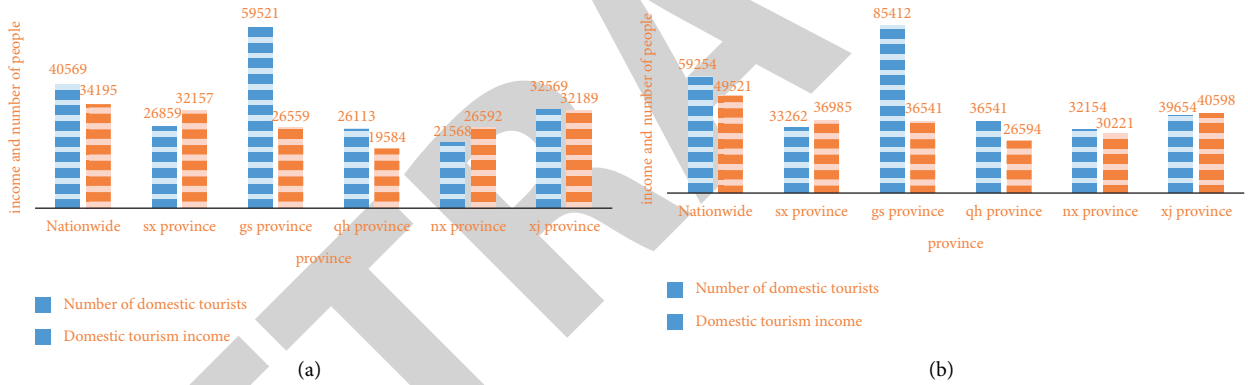


FIGURE 8: Income of the domestic cultural industry in the past two years.

culture and tourism, and the better the integration of culture and tourism.

$$T_i = \sqrt{\frac{C_c C_t}{C_c + C_t}}, \quad (2)$$

$$F_i = W_1 C_t + W_2 C_c.$$

Among them,  $W_1$  and  $W_2$  are the weights of the subsystems.

In addition, the range standardization method can also be used to nondimensionalize the metadata. QI eliminates the inconsistency of selected indicator units and ensures the accuracy of the analysis results. The formula is as follows:

$$x'_{ij} = \frac{(x_{ij} - x_{\min})}{(x_{\max} - x_{\min}) + 1}. \quad (3)$$

Among them,  $i$  represents the year order and  $j$  represents the number of indicators.

**4.2. Model Setting.** To test the role of blockchain technology in promoting the integration of culture and tourism, the balanced panel data are used to construct a hybrid panel regression model. The constructed mixed regression model is as follows:

$$y_{it} = \alpha + \beta_1 X_{it} + \beta_2 Z_{it} + \varepsilon_{it}. \quad (4)$$

Among them,  $y_{it}$  represents the explained variable, which is the degree of cultural and travel integration.  $x_{it}$  represents the core explanatory variable,  $z_{it}$  represents the control variable, including 4 variables including government regulation, human capital, tertiary industry development level, and opening to the outside world, and  $\varepsilon_{it}$  is the disturbance item.

If regression is performed directly, it means that all variables are regression without difference [34]. The premise of this regression is that the individual characteristics of all variables are the same by default. However, in panel data, there will be large individual differences

between variables. This difference is difficult to observe, which leads to the problem of missing variable deviations. Therefore, it is necessary to further obtain more robust conclusions:

$$y_{it} = \varepsilon + \beta_1 x_{it} + \beta_2 z_{it} + \mu_i + \varepsilon_{it}. \quad (5)$$

Among them,  $U_i$  represents the individual fixed effect that only changes with the individual but not with time.

One thing that needs to be explained is that the two intermediary variables in this study are the three major influencing factors that promote the integration of culture and tourism. It is an important influencing variable in the regression of factors influencing cultural and tourism integration and cannot be omitted.

Mediating variables refer to variables that can partially explain the indirect effects of independent variables on dependent variables. The mediating effect refers to the mechanism by which explanatory variables affect the explained variables through mediating variables. This article follows the analysis of the mediation effect model and tests the mediation effect model based on the construction of a multiple panel regression model. It specifically includes the following three measurement equations:

$$\begin{aligned} \text{conver}_{it} &= \alpha + \beta_1 \text{inter}_{it} + \gamma_j \sum X_{itj} + f_i + \varepsilon_{it}, \\ M_{it} &= \alpha + \beta_2 \text{inter}_{it} + \gamma_j \sum X_{itj} + f_i + \varepsilon_{it}, \\ \text{conver}_{it} &= \alpha + \beta_3 \text{inter}_{it} + \beta_4 M_{it} + \gamma_j \sum X_{itj} + f_i + \varepsilon_{it}. \end{aligned} \quad (6)$$

The above three measurement equations show the three steps to test the mediation effect. Among them,  $M$  represents the intermediary variable-consumer demand and technological innovation, and the meaning of the remaining characters is consistent with the meaning of the previous section.

**4.3. Proxy Re-Encryption Technology.** Proxy re-encryption technology is a key conversion mechanism between ciphertexts, which can realize cloud ciphertext data sharing P1 without leaking the private key of the data owner. The following paper uses proxy re-encryption technology to cooperate with the lattice blockchain model structure to realize the access control authority management of data ownership [35]. It is shown in Figure 9.

Assuming that the user Xiaolan wants to share the ciphertext with Xiaohong, but does not want to reveal his public key, the specific process of using proxy re-encryption is as follows.

*Step 1.* First, Xiaolan uses her private key.

$$\text{pk}_A = \alpha \in Z_q^*. \quad (7)$$

It randomly selected  $r \in Z_q^*$  and encrypted the file  $m$ , as in the formula:

$$\text{ct} = e(g, g)^r \cdot m. \quad (8)$$

It stores the ciphertext  $\text{ct}$  and  $g^{ra}$  in the cloud server.

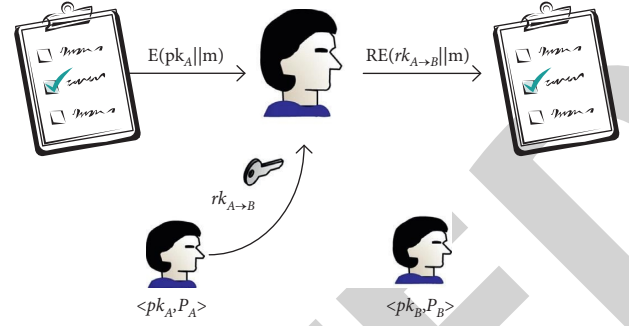


FIGURE 9: Proxy re-encryption technology calculation process.

*Step 2.* If Xiaolan wants Xiaohong to access her encrypted data stored in the cloud, she can use Xiaohong's public key  $g^b$ , and  $\text{pk}_A = \alpha \in Z_q^*$  of them. The following formula can be used to calculate the proxy re-encryption key  $\text{rk}_{A \rightarrow B}$  and send it to the cloud server:

$$\text{rk}_{A \rightarrow B} = (g^b)^{1/a} = g^{b/a}. \quad (9)$$

*Step 3.* If Xiaohong wants to get Xiaolan's data  $m$  from the cloud, the cloud server sends the encrypted data  $e(g, g)^r \cdot m$  and the proxy re-encryption key  $e(g^{ra}, \text{rk}_{A \rightarrow B})$  to Xiaohong.

*Step 4.* Xiaohong uses the formula to obtain the data  $m$  shared by Xiaolan.

$$m = \frac{e(g, g)^r \cdot m}{e(g, g)^{rb} \cdot e(g^{1/b}, g)} = \frac{e(g, g)^r \cdot m}{e(g, g)^r}. \quad (10)$$

**4.4. Hierarchical Deterministic Seed Agreement.** The core of the hierarchical deterministic seed protocol is the process of generating a master key from a random seed and then deriving a large number of sub-keys from the master key. There are two methods for deriving sub-keys from the master key: normal derivation and enhanced derivation. The normal derivation simplification method is shown in formulas (11) and (12), and the enhanced derivation simplification method is shown in formulas (13)–(15).

$$l_n = \text{HMAC-SHA 512}(\text{pk}_{n-1}, i), \quad (11)$$

$$l_n = \text{HMAC-SHA 512}(p_{n-1}, i), \quad (12)$$

$$\text{pk}_n = \text{Left\_Parse}_{256}(l_n) + \text{pk}_{n-1}, \quad (13)$$

$$P_n = \text{Left\_Parse}_{256}(l_n) + P_{n-1}, \quad (14)$$

$$P_n = \text{pk}_n \times G. \quad (15)$$

It is concluded that candidate consensus nodes generate consensus identities based on their rights and interests. That is, consensus account  $w_i$  can generate consensus identity probability  $P\{x = k\}$  within the calculation of  $\beta$ :

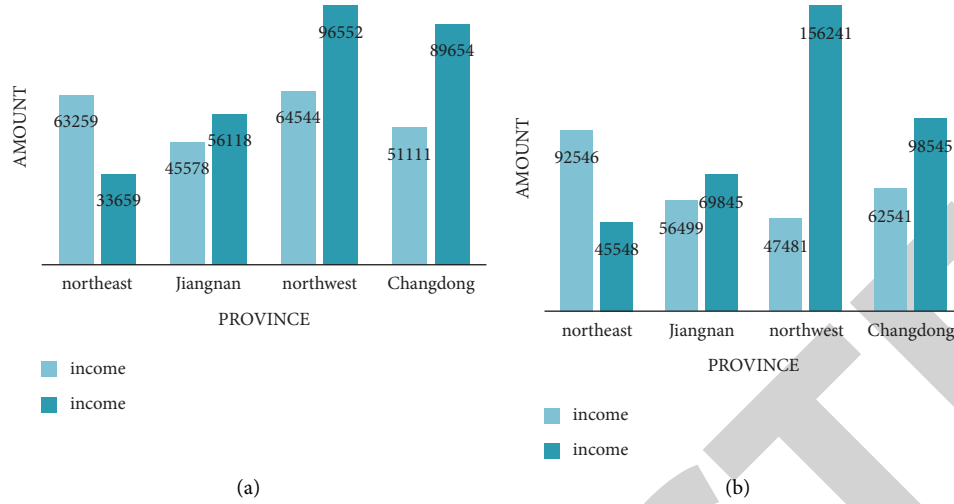


FIGURE 10: This year's regional comparative income.

$$P\{x = k\} = \left(\frac{\beta}{k}\right) \left(\frac{w_i}{w}\right)^k \left(1 - \frac{w_i}{w}\right)^{\beta-k}. \quad (16)$$

When the number of calculations  $\beta$  is equal to 100, 200, 300, 400, and 500, in the case of different safety parameters  $\lambda$ , the calculation is as follows:

$$\begin{cases} ID_{\text{good}} > 2 \times a_{\text{max}}, \\ ID_{\text{good}} \leq h_{\text{min}}, \\ 2 \times ID_{\text{good}} > \text{all}_{\text{max}}. \end{cases} \quad (17)$$

Based on the above algorithm, the regional comparative income of this year since the integration of the tourism industry and the cultural industry has been developed is shown in Figures 10(a) and 10(b).

Under the integrated development of culture and tourism in various regions, the overall income has shown an upward trend, with the highest growth rate of nearly 50%. Blockchain is a term in the field of information technology, and in essence, it is a shared database. The data or information stored in it has the characteristics of “unforgeable,” “full traces,” “traceable,” “open and transparent,” and “collective maintenance.” Based on these characteristics, blockchain technology has laid a solid foundation of “trust.” It has created a reliable “cooperation” mechanism and has broad application prospects.

## 5. Conclusion

As a universal technology, blockchain technology has accelerated the penetration of digital currency into other fields and has been innovatively integrated with all walks of life, but at present, blockchain technology is still in its infancy, and there are still many unsolved problems. In this state, the technology, talents, and resources of the Internet platform itself make it the most suitable investor for blockchain construction. Blockchain has undoubtedly development prospects, and the necessary condition for development prospects is to enter the mainstream market and

realize the integration and development of culture and tourism. It is necessary to explore new issues in the integration of cultural and tourism development from multiple perspectives, study new features, and expand multidisciplinary horizons. Then, it gradually establishes a systematic and overall research framework to encourage in-depth research on the integration of culture and tourism. Culture is the soul of tourism, and tourism is the carrier of culture. Tourism without culture has no charm, and culture without tourism lacks vitality. This promotes each other, complements each other, promotes the integrated development of the two, and achieves a win-win situation.

## Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

## Conflicts of Interest

The author(s) declare that there are no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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