



DOCTORATE of BUSINESS ADMINISTRATION

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An Empirical Study on Realization of Data Value:

Key Drivers and Challenges of Data Monetization in the Chinese Healthcare Industry

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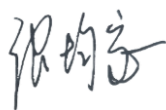
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The Business Science Institute and the iaelyon School of Management do not approve or disapprove of the opinions expressed in this thesis. These opinions are to be considered as those of the author.

Signed:



Date: November 30th 2024

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L'utilité multiplicatrice des éléments de données joue un rôle central dans le développement de la nouvelle productivité qualitative de la Chine, centrée sur l'intelligence artificielle, et il appartient à la Chine de saisir cette opportunité historique.

Xi Jinping, Président de la RPC

Janvier 2024

The multiplying utility of data elements plays a central role in the development of China's new qualitative productivity, centered on artificial intelligence, and it's up to China to seize this historic opportunity.

Xi Jinping, President of the PRC

January 2024

在以人工智能为核心的中国新质生产力发展过程中，数据要素的乘数效应发挥着核心作用，中国要抓住这一历史机遇。

中华人民共和国主席 习近平

2024年1月

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1 Introduction

Executive Summary

This thesis suggests utilizing the optimized DeLone & McLean model in the health insurance industry to examine the value and challenges of data circulation in China's healthcare sector. It also aims to demonstrate how to transform raw data into data products and assets, and enhance China's healthcare insurance underwriting and compliance processes through technological advancements and compliance measures. The goal is to increase automation and intelligence in order to maximize the overall data value of the strategy.

This paper adds value by revitalizing the traditional DeLone & McLean model and introducing a new approach to managing China's healthcare data. By focusing on the entire closed loop process from data collection to final analysis, this paper highlights the importance of data as a key factor in enhancing productivity. This innovative approach aims to leverage data to drive digital transformation and industrialization in China.

This dissertation takes the circulation of healthcare data elements in China as an example for empirical research, and establishes a research framework for data asset valuation and value realization by analyzing the automated underwriting and claims process of data circulation in healthcare companies. Through the application of DeLone & McLean model, the aim is to discover the root causes of poor data element circulation and propose solutions to make medical data circulation more efficient and maximize data value.

With the continuous progress of information technology, the application of big data in healthcare is becoming more and more widespread, and the value of China's healthcare data is gradually emerging. The purpose of this study is to explore the data value realization of Chinese medical data in health insurance underwriting and claims business.

Currently, China's health insurance industry is experiencing a wave of digital transformation, and healthcare data is becoming a key resource to drive this process. However, due to the

unique complexity and sensitivity of medical data and the many challenges in processing and application, how to effectively utilize these data resources to improve the efficiency of health insurance business and reduce fraud is a major issue facing the industry today. In addition, this study explores the key point of how to fully explore the potential value of medical data while ensuring data security and privacy protection with the development of artificial intelligence and machine learning technologies.

The purpose and significance of this study is to explore how to realize the value of medical data more effectively in health insurance business processes by analyzing the current situation and challenges of medical data application in health insurance underwriting and claims business in China, and adopting the Delone & McLean model as the research framework. The efficient utilization of medical data is important for reducing the operating costs of health insurance companies, improving service quality, and reducing the risk of fraud. Meanwhile, for the regulators, it can better promote the rational allocation and use of medical resources and enhance the sustainable utilization of health insurance funds.

In addition, this study will make recommendations on the standardization, integration and sharing mechanism of medical data to promote the orderly opening and utilization of medical data resources, and then enhance the overall efficiency and service level of the health insurance industry.

In terms of research methodology, this study first sorts out the background and challenges of medical data application in health insurance underwriting and claims business through literature review and case study analysis. Subsequently, the Delone & McLean Information System Success Model is adopted as the theoretical framework, and the value realization of medical data is explored in depth through a combination of qualitative analysis and empirical research. Specifically, this study investigates the use of medical data by medical insurance companies in the underwriting and claims process, analyzes the impact of key factors such as data quality, data sharing, system integration, and interoperability on business efficiency and effectiveness, and proposes corresponding optimization strategies. Meanwhile, this study analyzes a large number of health insurance cases to reveal the potential value of medical data in reducing fraud and improving the efficiency of decision support.

The main findings of this study suggest that high-quality medical data is the key to improving the efficiency and accuracy of health insurance underwriting and claims operations. The value realization of medical data is affected by a variety of factors, including the completeness, accuracy, real-time, and accessibility of the data, as well as the maturity of the data processing technology. The establishment of data standardization and sharing mechanisms, as well as the application of advanced data analytics, can significantly enhance the efficiency and value of medical data utilization. In addition, this study finds that the integration and interoperability of healthcare information systems is an important driver for improving the efficiency of healthcare business processes. By optimizing data flow and processing processes, healthcare insurers are able to respond faster to market changes and control risks and costs more effectively.

Looking ahead, the value realization of medical data will become an important trend in the health insurance industry. With the advancement of technology and the improvement of the policy environment, the ability to collect, process and analyze medical data will be further improved, which will bring more innovative possibilities for the health insurance industry.

Therefore, this dissertation suggests that future research should focus on the advancement of medical data processing technology and explore data analysis methods based on artificial intelligence and machine learning in order to further enhance the intelligence of health insurance underwriting and claims business. At the same time, attention should also be paid to the improvement of medical data protection regulations to ensure that patient privacy and data security are safeguarded while realizing the value of medical data, so as to realize the sustainable development of the health insurance industry.

The realization of the ultimate value of data is a long path, but it will eventually be reached.

1.1 Subject of Thesis

An Empirical Study on Realization of Data Value: Key Drivers and Challenges of Data Monetization in the Chinese Healthcare Industry

1.2 Research Question

How the circulation of data affect the monetization of data value in China?

1.3 Important Definitions in the Thesis

1.3.1 The following Key concepts will be highlighted in the paper,

- DeLone & McLean Optimized Model
- Circulation of Medical Data in China
- Business automation and intelligence in Insurance industry
- Data Infrastructure
- Data Privacy
- Data Governance and Data Security
- Legislative Constraints and institutional design
- Data Asset Monetization

1.3.2 Key Drivers of Data Monetization is summarized as below,

- Policy support
- Technology advances
- Economic transformation
- Digitalization demand
- Cross boarder convergence

1.3.3 Key Obstacles of Data Monetization are:

- Data privacy and securities
- Data governance
- Technical standards and interoperability

- Data silos
- Inadequate market mechanism

1.3.4 Definition of Data Monetization

Refers to the process of transforming data assets into quantifiable economic value, the data becomes an economic resource that can be traded, evaluated, and used as a basis for asset management and optimized decision-making.

1.3.5 Deep driver of Data Monetization is as below,

- Valuation and pricing of data assets
- Establishment and improvement of data transaction mechanisms
- Commercial application and service of data to realize the data value
- Protection of data privacy and security as the foundation

1.3.6 Realization of Data Value includes the below key elements,

- Data collection and quality management
- Data Analytics and Applications
- Data Security and Compliance
- Data Asset Assessment

1.4 Management and Academic interest

As EDBA candidate, the paper will provide very clear value from management and academic perspective.

1.4.1 Management Interest

- Understanding and addressing drivers that facilitate the flow and barriers of data elements

- Balancing data security and privacy protection with data value development
- Improving the efficiency of healthcare data flow and operational management
- Promote information technology in the health insurance industry to enhance the automation and intelligence, reduce labor costs, and improve work efficiency and service quality

1.4.2 Academic Interests includes,

- Deepening understanding of the data economy, data governance and information society
- Optimizing the application of the DeLone & McLean model
- Theoretical basis for advancing the informatization of the medical insurance industry
- Improving the overall service level of the medical and health insurance

1.5 D&M Model is the best option among IS models

Couples of models are researched and analyzed, but eventually the D&M models are chosen as the research framework of the thesis.

1.5.1 TAM (Technology Acceptance Model)

Proposed in the field of information technology adoption by F. Davis in 1989, it focuses on the user's perceived usefulness and perceived ease of use of technology to explain user adoption behavior. It emphasizes the critical role of user attitudes in the use of information systems.

1.5.2 TTF (Task-Technology Fit Model)

Proposed by Goodhue and Thompson in 1995, it focuses on the degree of fit between technology and job tasks, emphasizing how technology can effectively support the

completion of a particular task, echoing the information use dimension of the DeLone & McLean model.

1.5.3 UTAUT (Unified Theory of Acceptance and Use of Technology)

A model proposed by Venkatesh in 2003, which integrates several adoption models, including TAM and TTF, and adds variables such as social impact and ease-of-use to provide a more comprehensive perspective on technology adoption.

1.5.4 TIS Success Model by Seddon

Seddon proposes a simplified version of the IS Success Model that focuses on system quality, user satisfaction, and user productivity, which overlaps with the DeLone & McLean model but is more streamlined.

1.5.5 EAST (Ease of Access, Satisfaction, Trust) Model

In the field of e-commerce, the EAST model emphasizes ease of access, user satisfaction, and trust, which equally affect different aspects of information system success.

1.6 D&M Model Evaluation

The effectiveness of information systems is comprehensively evaluated through six core dimensions:

- System quality
- Information quality
- Service quality
- Utilization
- User satisfaction
- Net benefits

D&M mode has Causality framework to emphasizes the causal relationships and time series between these dimensions, which provides a theoretical basis for understanding the dynamic process of information. (DeLone & McLean, 2003)

1.7 Leverage D&M Model to analyze Chinese Medical Data Circulation

D&M model is a very interesting tool to analyze the Chinese medical data circulation form the high level perspective.

1.7.1 Model Components and Dimensions

System quality, information quality and service quality are updated to affect the net benefits of the system.

1.7.2 Causality

Interrelated causal relationships to stipulate the system quality and information quality directly affect user satisfaction and information system use.

1.7.3 Assessment Tools

Standardized assessment tools play a key role in driving the development of standardized models and methods for measuring the success of information systems.

1.7.4 Empirical Analysis

Compares predefined success criteria to assess the level of success of a system and directions for improvement.

1.7.5 Scope of Application

The model is widely used for different research goals and objectives and can be well applied as a scientometrics analysis method in the field of information systems research.

1.7.6 Optimization in the Digital Era

Optimize the DeLone and McLean model in the context of the digital economy in order to address the key challenges and barriers in data circulation and monetization.

1.7.7 Applicability to Emerging Information Technologies

Applicability in assessing emerging information technology systems such as artificial intelligence and big data analytics.

1.7.8 Industry-specific Applications

The research features the use of the DeLone & McLean model as a theoretical framework to examine the flow and management of healthcare data and to propose customized strategies and recommendations based on the specific context of the Chinese healthcare industry.

1.8 Analyze the key challenges in China Insurance Industry

Underwriting process and Claim process are the most critical processes in data value realization, so the business process and how data is used should be analyzed clearly.

1.8.1 Underwriting Process

In the underwriting process, Claim forms initiate the claim process, Supporting documentation is used to verify claim details, Police reports confirm that an accident occurred, Repair estimates calculate the cost of a claim, and Eyewitness statements are used to assist in fact checking. These data are critical to both processes, helping to improve processing efficiency and decision-making quality. (Zhang Jiannan et al., 2020)

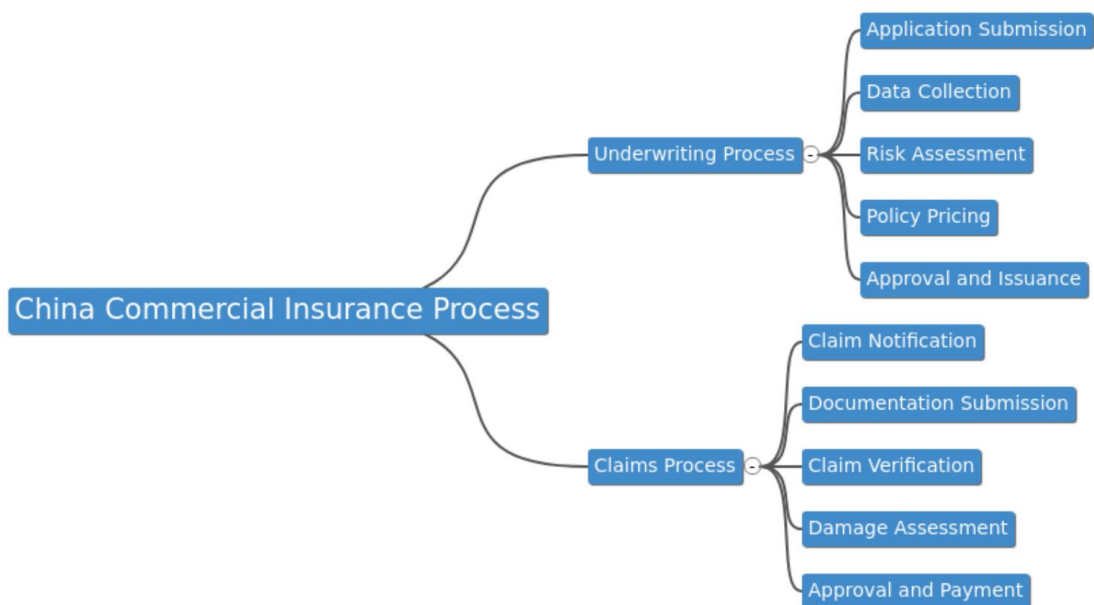


Figure 1.1 China Commercial Insurance Process

1.8.2 Data Source for Efficiency

The important role of data in the underwriting and claims process of commercial insurance in China is emphasized. In the underwriting process, applicant information is used to assess eligibility, credit scores are used to determine financial stability, business history helps understand business operations, risk data is used to assess risk levels, and insurance history examines past claims.

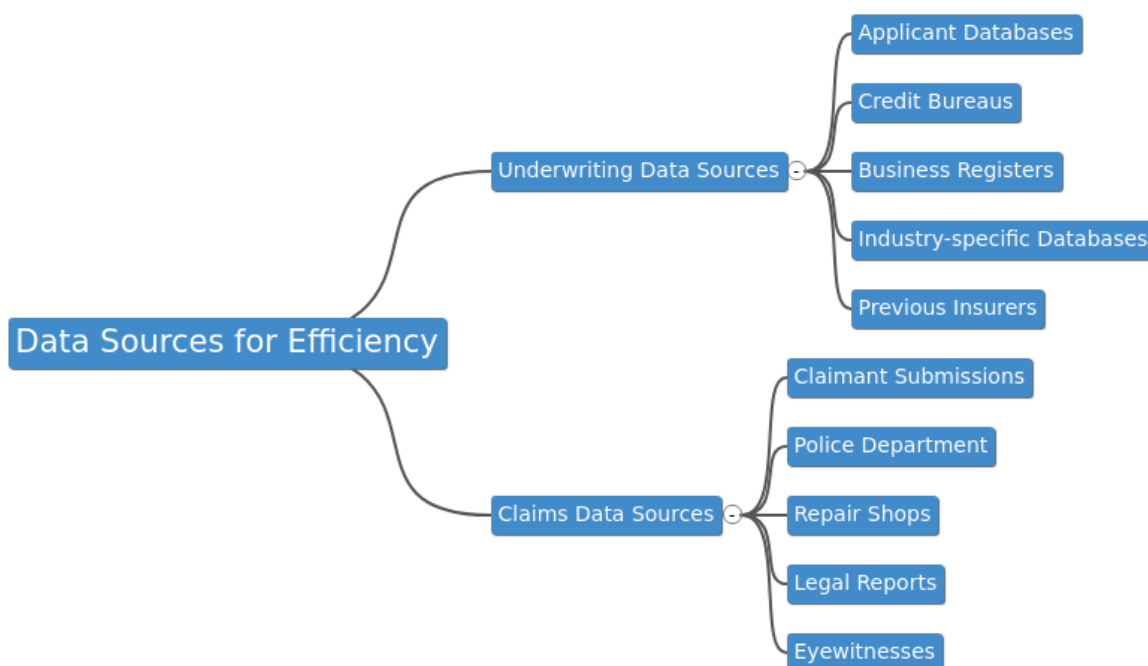


Figure 1.2 The value of data in the insurance process

1.9 Optimize D&M Model in Data Circulation and Monetization

The DeLone & McLean model has been optimized in the context of the new digital economy by adding new independent variables. These variables may involve technological advances, compliance measures, and other factors related to healthcare data flow. (DeLone & McLean, 2003)

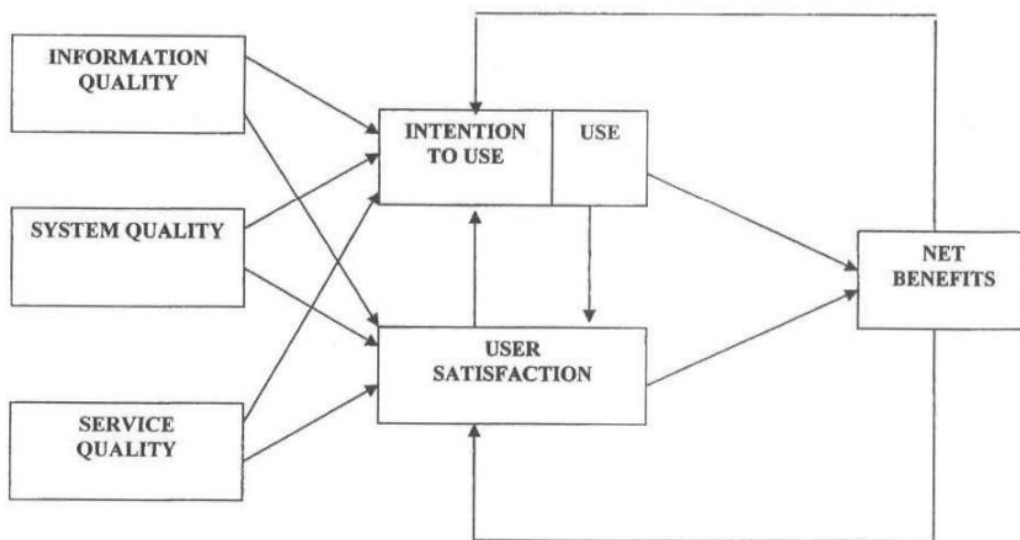


Figure 1.3 D&M Model in Information Age

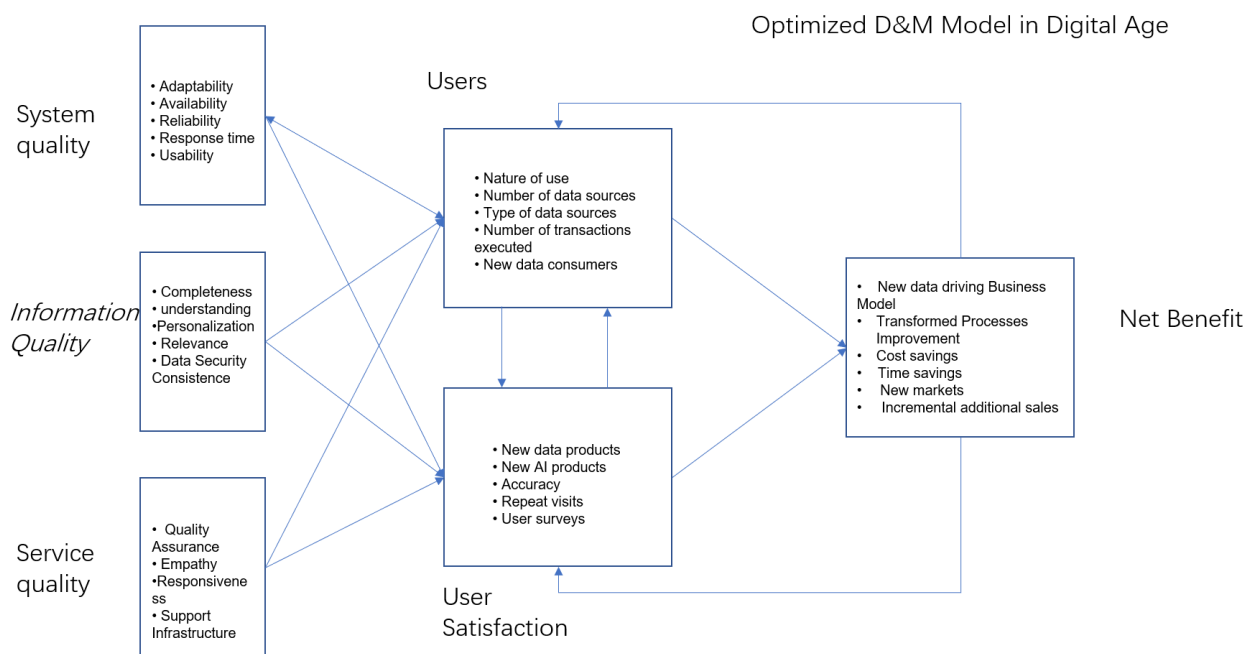


Figure 1.4 Optimized D&M Model in Digital Age

Couples of new metrics are added into the existing D&M framework as below,

◆ System Quality

- ◆ Information Quality
- ◆ Services Quality
- ◆ Users
- ◆ User Satisfaction
- ◆ Net Benefits

In compliance with the premise of D & M framework, in each of the key factors added details, these details are in the digital age. IT managers, as the most concerned factors, in the back of the questionnaire question and answer are selected from the latest elements of several key factors for CIO questionnaire, and analysis in the era of AI, in the process of realizing the value of data, which in the data value played the most important role.

By enriching and optimizing the D & M framework, it shows that D & M still plays a role in the digital age. We do not need to change this framework, we just need to enrich and correctly use this framework. (DeLone & McLean, 2004)

1.10 Strategy and Methods of monetizing digital assets

The process of monetize the digital assets is a very complicated process , the strategy and methods should be planned well.

1.10.1 Medical Data Circulation and Health Insurance Underwriting

By analyzing the circulation of medical data in China and how to utilize these data in the health insurance underwriting process, a possible path for data monetization is presented.

1.10.2 Core Business Automation and Intelligence

Based on empirical cases of dual core business automation and intelligence, the method of monetizing data assets is explored.

1.10.3 Data Asset Value Realization

It involves a series of processes such as data asset recognition, value assessment, and financial statement booking, and how these processes can help enterprises maximize the value of data assets.

1.10.4 Market operation attempts and innovations

Operational models for monetizing data circulation and transactions are explored under the premise of ensuring compliance and security, such as encouraging enterprises to engage in data leasing to protect the original data ownership from infringement.

1.11 Optimize D&M Model to Data Practice

D&M model is a very mature framework to analyze the IT process, in the new digital age, the model will be optimized in the following area to play new role.

1.11.1 Extension of the scope of application

DeLone and McLean IS model is widely accepted as a model for evaluating information systems (IS) and in the context of the digital age, the model has been optimized to address the key challenges and barriers encountered in data flow and monetization.

1.11.2 Applicability to emerging information technologies

Proposes the D&M model is also suitable for evaluating emerging information technology systems such as artificial intelligence (AI) and big data analytics systems.

1.11.3 Proposed Optimization Approach

Proposes optimization methods for the DeLone & McLean model, take into account the impact of market demand, technological advances, and other macroeconomic factors to provide a more reliable basis for assessing the value of data assets.

1.11.4 Strategies for maximizing data value

Optimize D&M model to maximize the value of data assets, include improving the information quality such as accuracy, completeness, timeliness and relevance of the data assets and ensuring that the data are updated in a timely manner.

1.12 Contribution to the Research Area

The paper contribute a lot in the following area,

1.12.1 Exploration of data monetization

Explores the key drivers and challenges of data monetization in China's healthcare industry and fills the current academic research gap accordingly.

1.12.2 2 Value Realization of Medical Data

Analyzes in detail how raw data can be transformed into data products and assets, and how technological advances and compliance measures can enhance China's health insurance and compliance processes.

1.12.3 Innovation of theoretical framework

Optimizes the Delone & McLean model, adds new independent variables, and proposes a new approach applicable to medical data management in China.

1.12.4 Closed-loop process of data circulation

Establishes a research framework for data asset valuation and value realization through empirical research on the closed-loop process of medical data circulation.

1.12.5 Depth of empirical research

Collects a large amount of data through questionnaires and interviews, and conducts quantitative analysis to verify the specific value of data in the process of medical insurance underwriting and claims, this empirical study provides strong support for the theoretical model.

1.12.6 Guiding significance for policy and practice

Proposes a mechanism for data standardization, integration and sharing, aiming to promote the orderly opening and utilization of medical data resources, which has great guiding significance to policy makers and industry practitioners.

2 Research Background

This EDDBA paper mainly describes the data challenges faced by the medical industry in China, as well as the importance of the circulation of medical data elements and its application status in the medical insurance industry.

2.1 Background Briefing

The circulation of medical data elements is of great significance for improving the quality of medical services and reducing the cost. The circulation of medical data in China is in a critical transition period, which not only needs to cope with the challenges such as technology and regulations, but also needs to grasp the development opportunities brought by medical big data. (Balde et al., 2023)

This section mainly analyzes the main challenges facing the current data circulation of China's medical industry, discusses the role of data circulation in ensuring the quality of medical services, improving the efficiency of the medical insurance industry, and analyzes the current situation of data application in the medical insurance industry.

2.2 Challenges of medical data flow

The flow of medical data faces many challenges in China, mainly including:

(Ahmed et al., 2023)

- (1) Data standards and interoperability: China's medical informatization develops rapidly, but there are problems of inconsistent data standards among different medical institutions and within the industry, which makes it difficult to realize data integration and sharing.
- (2) Privacy protection and data security: With the implementation of the Personal Information Protection Law of the People's Republic of China, how to collect, store and

circulate medical data under the premise of protecting personal privacy has become a severe challenge.

- (3) Policy and regulatory constraints: The flow of medical data in China is strictly regulated by the policies and regulations. Cross-border transmission of medical data and its storage and use on cloud platforms urgently need clear legal guidance.
- (4) Technical limitations and uneven distribution of resources are major challenges in China's medical informatization. Currently, some regions have low levels of medical data automation and electronization, leading to inefficient data circulation due to uneven resource allocation.

2.3 The Importance of the circulation of medical data elements

The importance of the circulation of medical data elements is described briefly as follows: (Ahmed et al., 2023)

- (1) Strengthening the ability of disease diagnosis and treatment is crucial: the effective circulation of data elements can accelerate clinical research, improve the accuracy of medical diagnosis, and enhance the personalized level of treatment.
- (2) Promote the optimal allocation of medical resources: Through data analysis, the allocation of medical resources can be optimized, the efficiency of health services can be improved, and the medical costs can be reduced.
- (3) Improve the speed of public health emergency response by enhancing the flow of data elements. In the case of public health events such as outbreaks, quick collection of information can effectively guide decision-making and enhance the speed of emergency response.

2.4 Current application status of data in the medical insurance industry

The medical insurance industry is an important field of medical data circulation, and the application of data is mainly reflected in the following aspects: (Shim et al., 2023)

- (1) Insurance business management: Medical insurance companies analyze customers' use data of medical services, and conduct actuarial and risk assessment to develop reasonable pricing strategies for insurance products.
- (2) Fraud detection and risk control: Apply big data analysis technology to identify fraud, reduce unnecessary losses, and protect the interests of customers and companies.

Product innovation and personalized service are key components of the strategy. The customer health data is utilized to develop personalized medical insurance products and offer customized medical consultation and health management services. This approach helps enhance user stickiness and satisfaction.

A decision support system is a valuable tool that utilizes data analysis to provide decision support for medical insurance companies. By optimizing business processes and resource allocation, these systems can help companies make informed decisions and improve overall efficiency.

2.5 Combination of medical data and Medicare

The combination of medical data and health insurance business is an interdisciplinary field, including the integration of knowledge of information technology, medicine and insurance business. We can integrate medical data into the health care business through the following feasible ways and suggestions: (Jakovljevic et al., 2023)

2.5.1 Data Sharing Agreement

Firstly, appropriate legal protocols and technical standards must be established to ensure that access to medical data is both safe and compliant. This may include measures like privacy protection, data encryption, and anonymity. (Dankar, 2023)

2.5.2 Electronic Health Record (EHR) system

Using the EHR system can help healthcare providers create, manage, and share medical health records. Medicare companies can use this data through partnerships to accelerate claims processing, risk assessment, and policy design.

2.5.3 Automated claim processing

By leveraging medical data, the health care business can automate the processing of claims, reducing human error and processing time. Natural language processing (NLP) and machine learning techniques can be used to extract key information in medical records and invoices.

2.5.4 Preventive medical treatment and health management

Using the historical patient medical data and real-time health data, insurance companies are able to provide personalized health management programs and preventive care services, reducing overall medical expenditures. (Chen & Liu)

2.5.5 Risk Assessment and Pricing Strategy

Accurate medical data can help health care companies more accurately assess risks and thus design more reasonable premium pricing models. Through big data analysis, more precise predictions can be made of health risks in different populations. (李刚 et al. , 2021)

2.5.6 Industry Cooperation and Compliance

It is suggested that medical service institutions and health insurance companies work closely with relevant government departments to ensure that all data use complies with industry norms and laws and regulations. (LiuHui @xiajing, 2022)

Implementing these strategies may require interdisciplinary teamwork, including data scientists, medical experts, and insurance business specialists. In addition, the technology and workflow can be continuously optimized and adjusted to respond to the changes in laws and regulations, the development of technology and the needs of the market.

2.6 Research question

2.6.1 Research purpose

The goal is to optimize the data circulation of medical insurance companies by automating the underwriting and compensation process, exploring methods for data asset evaluation and value realization, and ultimately achieving the integration of data assets into the system to complete the closed loop of data value realization.

2.6.2 Research question

How the circulation of data affect the monetization of data value in China?

This paper focuses on Chinese medical data circulation and medical insurance underwriting, nuclear claims, dual-core business automation, and intelligence as empirical evidence. It utilizes the DeLone & McLean model as the basic research framework to optimize the model and add new independent variables. The goal is to determine the best path for Chinese medical data value and the only way to maximize data assets.

2.6.3 Management and Academic value

From a managerial perspective, understanding and addressing these drivers and barriers is critical to promoting the efficient flow of data elements. Managers need to design reasonable policies and mechanisms to promote a balance between data security and privacy protection and data value development to activate the potential of data.

At the academic level, studying the drivers and barriers to data flow can help deepen our understanding of the data economy, data governance, and the information society. Scholars can propose more precise theoretical models to analyze the impact of data circulation on economic growth, social development and innovation capacity, and provide theoretical support for policy making and business decision making.

In conclusion, promoting the circulation of data elements is both a complex technical issue and a deep-rooted institutional and management problem. Solving these problems requires the joint efforts of the Government, enterprises and all sectors of society. (唐金成 et al., 2021)

2.6.4 Research Scope and Limitations

The scope of research includes the key drivers of data circulation in China, the current challenges, and the application optimization of the DeLone & McLean model in health insurance data management.

However, this paper is an EDDBA paper with a core focus on management. Therefore, it will not dedicate a lot of space to studying technologies related to data governance and data security, such as data cleaning, blood analysis, BI, and privacy computing. Instead, the paper will focus on explaining the relevant theories of data element circulation, with necessary technologies being involved.

2.6.5 Paper Structure

This paper firstly introduces the research background, explaining why this topic was chosen and discuss its research and practical value. The basic theory and research framework are used to analyze the Chinese medical data circulation and data monetization. Then the innovation and the value of management science are mentioned.

The second part of this paper will focus on the literature analysis of the relationship between data elements circulation and the implementation of the DeLone & McLean model in China. It will analyze the existing relevant domestic and foreign literature to study the methods adopted, findings, and shortcomings. The paper will also explore how data elements play a critical role in various business processes within the medical insurance industry, and how the value is implemented.

The third part enters the details of the medical industry, studying the data in the medical industry, where the data is distributed, and why the data cannot be shared. The challenges of sharing this data are equivalent to identifying Chinese medical data, both of them are very difficult.

The fourth part analyzes the medical insurance industry of the data users, analyzing which business processes need data, what kind of data is needed, what role these data can play, and how these data will improve efficiency and cost. It also explores how data value can eventually be realized in the health care industry.

The fifth part will use questionnaires and interviews to collect the data of insurance and China's health care industry data. Quantitative analysis will be conducted to determine the specific valuation of the data in each process. Based on the data valuation methodology, including cost, income, or market methods, this paper will combine specific scenarios to quantify the data value and empirically verify it.

The sixth part will explain the whole process of data, from the original data to the end of the data asset, and finally into the finance table.

The seventh part is about the references of this article and the questionnaires used.

2.7 Conclusion

The circulation of medical data is of great significance to improving the level of medical services in China and promoting the development of the medical insurance industry. In the face of the existing challenges, relevant departments need to work together to formulate scientific and reasonable policies, strengthen data security protection, and promote the standardization and interoperability of medical data to ensure the safety and efficiency of medical data circulation. In the future, the medical insurance industry should deepen the application of data, strengthen personal privacy protection, enhance risk management through data analysis, drive insurance product innovation, and enhance service quality and efficiency.

The paper will further elaborate on the above points, and support the paper with data, cases and in-depth analysis.

At the end of the chapter, some of examples are given to make the description of the essay more appealing.

In order to make the description of this essay more appealing, I would further demonstrate the key ideas and innovative highlights of the paper through several concrete examples.

These examples will help readers to understand the theoretical and practical application values more clearly. The following are specific examples that incorporate the content of the thesis:

2.7.1 Closed-loop data management and productivity improvement

Example 1: In a large hospital, a data closed-loop management system is applied to manage the whole process of data management by collecting data from the first visit of patients to the final analysis of treatment effects. The system not only significantly improves doctors' diagnostic accuracy, but also drastically reduces patients' waiting time. For example, when a patient is admitted to the hospital, all the examination data and historical treatment records are immediately uploaded to the central database, and the doctor quickly formulates the optimal treatment plan through data analysis tools, and the final treatment effect is improved by 30% compared with the treatment method without data support.

2.7.2. Empirical Study of Automated Underwriting and Intelligent Claims Settlement

Example 2: A health insurance company implemented an AI-based automated underwriting system. Integrating medical data from multiple sources, such as electronic health records (EHRs), medical images, and lab results, the system is able to quickly assess a patient's risk factors and automatically generate underwriting decisions when he or she applies for coverage. In one trial, the system reduced underwriting time from an average of three days to less than an hour and improved underwriting accuracy by about 25 percent compared to traditional manual underwriting methods.

Example 3: In the claims process, an insurance company applied an intelligent data analysis system to identify and prevent fraud. Big data analytics identified unreasonable claims payment patterns, such as excessive single treatment costs by certain doctors or hospitals or unusually high frequency of prescribing certain specific medications. In one case, the system helped the company identify a patient who frequently submitted claims, and through in-depth analysis of his medical data, it was ultimately discovered that the patient had colluded with a hospital to misrepresent his condition and fraudulently claim for benefits. Through the application of this system, the insurance company successfully reduced fraudulent claims by about 40%.

2.7.3 Construction of data standardization and sharing mechanism

Example 4: A regional healthcare alliance has established a standardized data sharing platform that connects all hospitals, clinics and pharmacies in the region. The platform utilizes a unified data standard that allows for smooth data sharing between different healthcare organizations. For example, when a cardiac patient in need of referral is transferred from a secondary hospital to a tertiary hospital, all of his or her examination records, diagnostic reports, and treatment plans can be transmitted in real time to the new hospital's system, ensuring that the patient receives continuous and efficient treatment. Through this mechanism, patients' referral time and procedures are drastically reduced, and medical resources are more rationally allocated.

2.7.4 Enhancing medical data governance and privacy protection

Example 5: A large hospital group has implemented a rigorous healthcare data governance strategy that employs advanced privacy protection techniques, such as differential privacy and federated learning, to ensure that patient privacy is adequately protected during data sharing and analysis. In practice, the hospital researched and developed a new type of insurance product with an insurance company through the federated learning model, where patient data is always kept locally when analyzed, thus effectively avoiding the risk of data leakage. This strategy enables insurance companies to accurately design personalized insurance products, while patient privacy is also protected.

2.7.5 Realizing a deeper theoretical understanding of the data economy and information society

Example 6: By optimizing the DeLone & McLean model, the thesis demonstrates the importance of healthcare data in driving digital transformation and industrialization. For example, within a local healthcare group, the model was used for data asset valuation and it was found that by optimizing the flow and processing of data, the efficiency of healthcare and quality of service across the group improved by 20%. This result not only validates the usefulness of the model, but also provides a valuable reference for other healthcare organizations.

2.7.6 Summary

Through these concrete and practical examples, the theoretical and practical values in the article are not only demonstrated more vividly and concretely, but also readers can more intuitively understand the great potential and effectiveness of measures such as closed-loop data management, integration of emerging technologies, and optimization of business processes in practical applications. This will help promote the public and the industry's awareness and application of healthcare data circulation and value realization, and promote further development and innovation in the field.

3 Literature review

3.1 Introduction

3.1.1 Origin and development of the DeLone & McLean model

The DeLone & McLean information system success model (D & M model) originates from William H. DeLone and Ephraim R. McLean, two scholars who collaborated with the aim to quantify and evaluate the success of information systems. The model has undergone several important evolutions and refinements since its first introduction in 1992.

In 1992, DeLone and McLean first proposed the D & M model by analyzing the literature of authoritative information system journals between 1981 and 1987. “The model initially included two main dimensions: system quality and information quality, arguing that these two quality dimensions together affect the success of the information system”. (DeLone & McLean, 2003)

However, with time and the rapid development of the information system itself, the model faces some challenges in measuring information system success. The main reason is that the nature of the information system is constantly changing, and the original model fails to keep pace with the times.

Regarding these challenges, DeLone and McLean refined the D & M model in 2004 and introduced quality of service as a key dimension. The updated D & M model includes three dimensions: system quality, information quality, and service quality. They not only affect users' willingness and satisfaction to use the system, but also further affect the net benefits of the system. This improvement strengthens the comprehensiveness of the model, allowing it to more fully evaluate the effectiveness of the information system.

DeLone and McLean are suitable for use as baseline comparison theory and can handle different research objectives and purposes. For example, if the success of an established health information system (HIS) is assessed, the DeLone and McLean information system

success models would be a very appropriate benchmark for comparison, covering all key dimensions of the success of the information system.

Another driver of the D & M model comes from the question Peter Keen raised at the International Conference on Information Systems (ICIS) about what are the key drivers of the success of information systems. To answer this question, the author made several attempts between 1992 and 2003 based on information theory (proposed by Shannon and Weaver in 1949) to identify key variables.

“The DeLone & McLean model, based on a comprehensive analysis of past literature and continuously refined over time, is now playing an increasingly important role in the information systems assessment”. (DeLone & McLean, 2003)

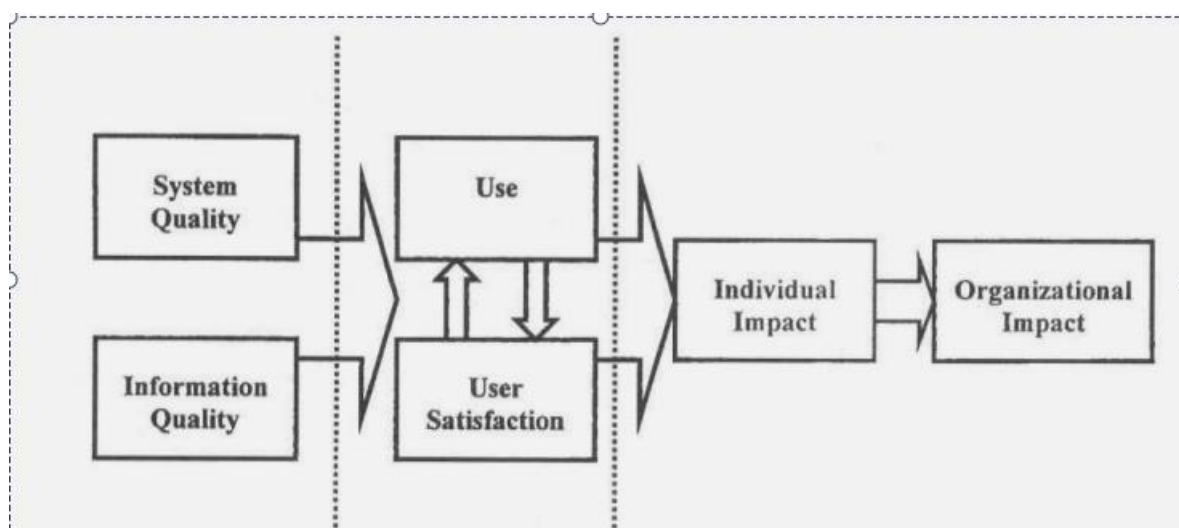


Figure 3.1 Traditional D&M Model in IT Age

3.1.2 Research significance of the successful model of the information system

Since the successful model of DeLone & McLean information system was proposed, it has produced important research and practical significance for understanding and evaluating the success of information systems. (Bianchi & Trimigno, 2021)

Systematic evaluation framework: The DeLone and McLean models provide a systematic theoretical framework for evaluating the success of the information system. “Its six core

dimensions - system quality, information quality, service quality, usage, user satisfaction, and net benefit - provide a comprehensive perspective for understanding the value brought by the information system”.

Guiding the research direction: The model analyzes the multi-dimensional factors of the success of the information system, and promotes the academic circle to conduct more extensive and in-depth research, rather than being limited to a single dimension. “This has promoted the development and enrichment of research methods and theories in the field of information systems “.

Guiding value in practice: Since the model provides specific dimensions and measurement indicators, enterprises and organizations can use this model to evaluate the implementation effect of their own information system, and make decisions to improve or enhance the strategy and actions of the information system accordingly.

Support for interdisciplinary research: The success of information systems is not only related to the technical level, but also interacts with multiple disciplines, such as organizational management and user behavior. “The proposal of DeLone and McLean models has stimulated cross-domain dialogue and research, and enhanced the understanding and cooperation between different disciplines” .

Verification and development of theoretical model: After the model was proposed, many scholars devoted themselves to verifying and extending its theory, and at the same time, “adjusting and updating the model based on new technologies and application environment, reflecting the dynamic development process of theoretical model in the research of information system” .The basis of scientometric analysis: DeLone and McLean's model enables the scientometric analysis method to be well applied to the field of information system research, providing the tools and framework for evaluating research trends, literature influence, and theoretical popularity.

Standardized assessment tools play a crucial role in promoting the development of models and methods for standardizing the measurement of information systems' success. This is especially important for multinational companies and diverse organizations looking to evaluate their global information systems.

The DeLone & McLean information system model has achieved significant success in both academic research and practical application. With the continuous development of information technology, this model is evolving and its effectiveness in new environments is constantly improving.

3.2 Detailed explanation of the DeLone & McLean model

3.2.1 Analysis of model components

The component analysis of the success model of DeLone and McLean information systems is critical because it helps researchers and practitioners to better understand and evaluate the effectiveness of information systems. The following is a detailed analysis of the main components of the DeLone & McLean model: (DeLone & McLean, 2003)

Component	Elaborate
System Quality (System Quality, SYQ)	Refers to the performance of the IT infrastructure, such as ease of use, reliability, response time, etc.
Information Quality (Information Quality, INQ)	It involves the relevance of the system output content, including accuracy, completeness, comprehensibility, timeliness and other characteristics.
Make use of (Use)	It reflects the actual user's use of the information system, usually measured by the login frequency, session time and other indicators.
User satisfaction (User Satisfaction, SAT)	It represents the user's overall satisfaction with the information system, which involves the perception of the system quality, information quality and service quality.

Component	Elaborate
Individual impact (Individual Impact)	Assess the impact of the system on user work performance, productivity, or decision quality.
Organizational impact (Organizational Impact)	Assess the changes brought about by the information system at the organizational level, such as efficiency improvement and revenue growth.
Quality of Service (Service Quality, SRQ)	It involves the quality of support services received by the information system users, such as technical support and customer service responsiveness.

Table 3.1 The component analysis of the DeLone and McLean information systems

Based on these components, the DeLone and McLean models propose a set of interrelated causal relationships, stipulating that the system quality and information quality directly affect user satisfaction and the use of information systems. “User satisfaction with the system and the usage can further affect the benefits at the individual and organizational levels”.(Pushparaj et al., 2023)

Service quality is a key dimension added to the model in a later update, and it is directly linked to system use and user satisfaction. The significance of service quality in measuring information system performance has been highlighted by the model, making it a crucial construct for evaluating the effectiveness of the information system. For example, the link between service quality and user satisfaction is also empirically supported.

At the same time, the research literature on information systems suggests that the quality of systems and information are two key dimensions for assessing the success of information systems. As one of the most widely used successful models for information systems, the

models of DeLone and McLean have been tested, extended and modified by researchers in many contexts

The limitations of the model in measuring the effectiveness of information systems have attracted the attention of researchers, especially in the changing electronic information systems (EIS) environment. These studies provide the basis for the evolution of the model, and continuously promote the optimization and adjustment of the model in practical application.

In conclusion, the successful model of DeLone and McLean information systems provides a structured theoretical framework for understanding and evaluating information systems through the analysis of the above components.

3.2.2 Scope of application for the D&M model

The DeLone and McLean models, widely accepted as assessment information systems (IS), have a wide range of applications. This model not only covers multiple dimensions of the information system but also facilitates the successful evaluation and understanding of different types of information systems.

The main scope of the DeLone and McLean models are as follows:

Domain	Description of applicable scope
Business information system	Evaluate enterprise-level applications such as enterprise resource planning (ERP) and customer relationship management (CRM) systems, and check their impact on enterprise operational efficiency, employee satisfaction and final output.
Electronic Commerce	It is suitable for the analysis of e-commerce platforms, such as online retail, e-market, etc., measuring system quality, consumer satisfaction with information, and transaction success indicators.

Domain	Description of applicable scope
Government and public sector information systems	It is used for government information systems, electronic services (e-Government) implemented by public departments, health information systems, etc., to investigate the effect of information transmission and evaluate the improvement of public services.
Educational technology system	It is suitable for the success evaluation of online learning management system (LMS) and distance education platform, including the use and satisfaction of users (students, teachers) and the measurement of teaching effect.
Social media system	To evaluate the effectiveness of information dissemination in social media and online communities, user engagement and the role of platforms in promoting information sharing and social interaction.
Medical and health information system	Information system construction and its utility for clinics, hospitals, and telemedicine services, such as the promotion of electronic health records (EHRs) systems, and the impact on health outcomes and patient satisfaction.
Small and medium-sized enterprise information systems	Analyze the frequency of system use, the quality of information circulation and its impact on business growth after small and medium-sized enterprises adopt information technology.
Information system management of	Examine the unified performance of information systems, information consistency, and overall business impact of large

Domain	Description of applicable scope
multinational enterprises	enterprises in different countries or regions in cross-cultural backgrounds.
Scientific research information system	In scientific research institutions, the information accuracy, system responsiveness and the ability of scientific research database and laboratory information management system (LIMS) to improve research efficiency are evaluated.
Custom information system development	Evaluate the success of custom-developed information systems, such as ERP customized modules, in achieving specific business requirements.

Table 3.2 The scope of the DeLone and McLean model

Through professional and academic quantitative research, combined with scientometric analysis, we can gain deep insight into the application and evaluation of successful models of DeLone and McLean information systems. Since this model measures the success of the information system at multiple levels, including technical hierarchy, semantic hierarchy and effect hierarchy, it is extremely useful to evaluate the success of the implementation of the information system in the organization.

In practical application, different organizations and researchers can choose the corresponding evaluation dimensions according to their own needs, and use appropriate evaluation tools, such as questionnaire survey, data log analysis, key performance indicators (KPIs) and other methods, to evaluate multiple aspects of the success of the information system.

In progressive IT fields and especially areas of digital transformation, the effectiveness and scope of application of the DeLone and McLean models are expected to be further expanded.

3.2.3 Measure and evaluate the D&M models in practical application

In practical applications, the DeLone and McLean information system success models are usually measured and evaluated in the following ways:

- (1) “System quality (System Quality) is measured by technical indicators, including system response time, ease of use, reliability, functionality, and matching to user requirements”.(Taipalus et al., 2023)
- (2) Information Quality: To assess the accuracy, completeness, format, timeliness, and relevance of the information. Data are often collected through user surveys, feedback forms, or focus group discussions.
- (3) Use (use): Measures how and how frequently the user uses the system, which may be tracked by system log analysis, such as login times, page browsing, and other behavioral data.
- (4) User satisfaction (User Satisfaction): Multiple questions need to be included in questionnaires to fully reflect the overall satisfaction with the system, which is usually measured by user satisfaction.
- (5) Individual impact (Individual Impact): How much the measurement system improves the user's work performance, productivity or decision quality, which may be measured by before and after comparison and key performance indicators (KPIs).
- (6) Organizational impact (Organisational Impact): To evaluate the changes brought about by the implementation of the system at the organizational level, such as revenue growth rate, market share, and efficiency improvement of internal processes, it is important to consider the overall impact on the company's performance and success.

Delone and McLean included the "quality of service" dimension in their 2003 model update, along with references to "intended use" and "net benefit" in the measurements. These dimensions are typically evaluated through user surveys and organizational performance reports.

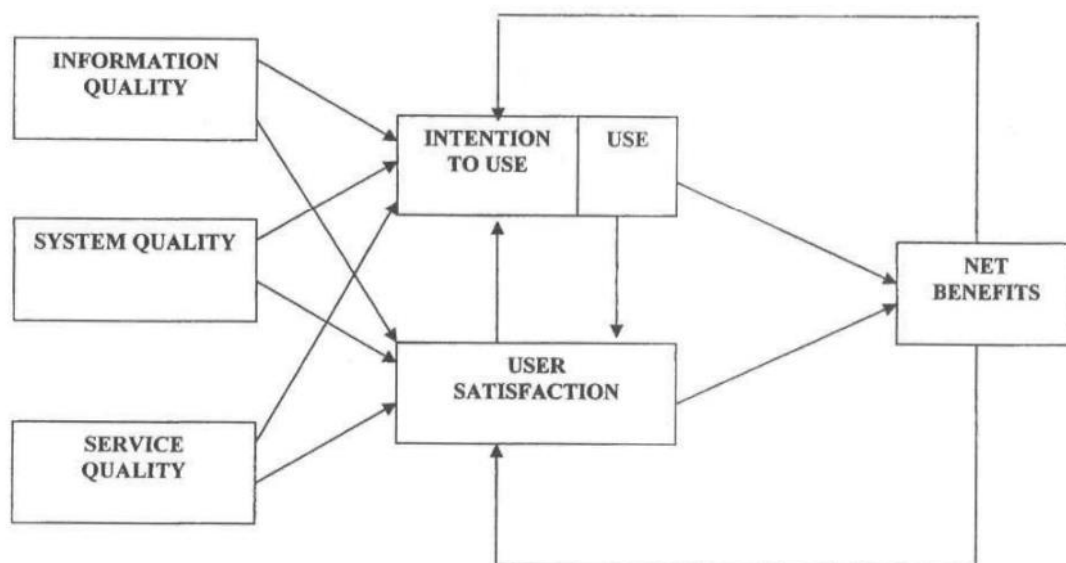


Figure 3.1 The optimized version of the DeLone and McLean model

When implementing measurements and assessments, the methodology usually includes the following steps:

- ◆ Collect relevant data, possibly including quantitative indicators of system use and qualitative user feedback information.
- ◆ The data were analyzed using the statistical analysis tool (SPSSAU) to reveal the relationships between the dimensions.
- ◆ The results of the empirical analysis were compared with the preset success criteria to assess the degree of success of the system and the direction of improvement.

In this way, the DeLone and McLean models provide a powerful tool to help practitioners to understand and evaluate the implementation effect of the information system from multiple levels, and to guide subsequent decision-making and improvement strategies.

The thesis propose an optimized D&M model in Digital age, especially use the model to solve the key challenges and obstacles in data circulation and magnetization:

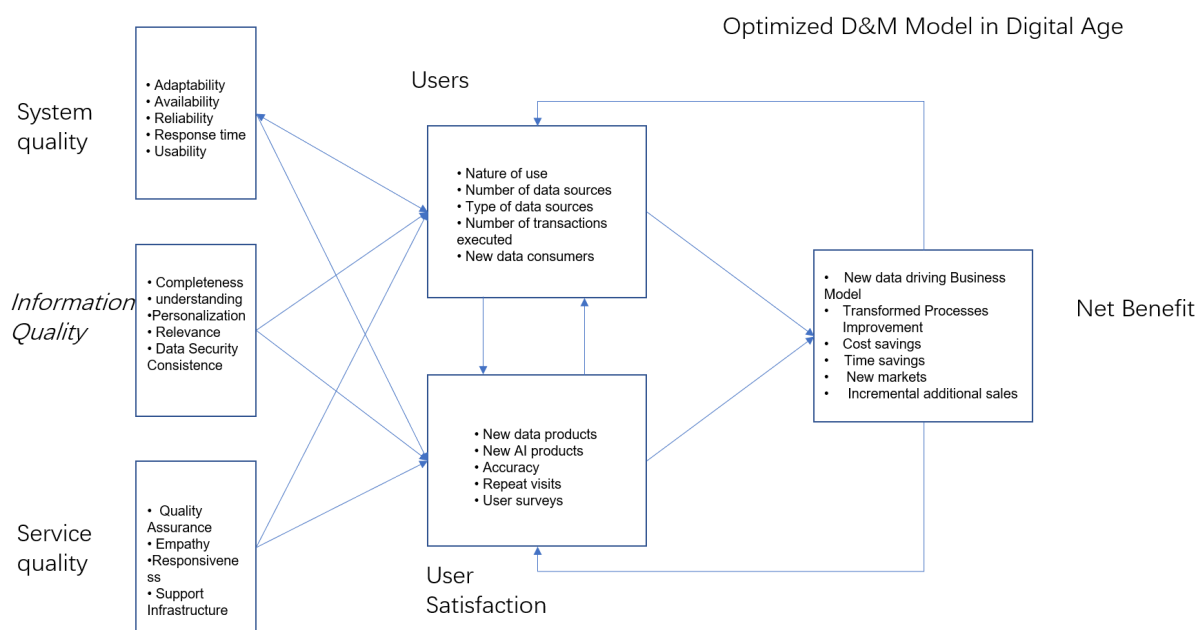


Figure 3.2 The optimized DeLone and McLean model in the digital age

3.2.4 Steps for Applying DeLone and McLean to evaluate the IS Model

In enterprise practice, the following steps are applied to evaluate information systems: (DeLone & McLean, 2003)

(1) Define the evaluation objectives

Whether the main purpose of the assessment is to evaluate the effectiveness of the existing information system or to provide decision support when the information system is upgraded or replaced, it is important for enterprises to consider various factors. For example, enterprises may want to assess the user satisfaction and effectiveness of their enterprise resource planning (ERP) system before making any decisions regarding upgrades or replacements.

(2) Build an evaluation framework

According to the DeLone and Mclean models, the evaluation framework is designed with the following six core dimensions:

Dimension	Description
System Quality (System Quality)	Availability, reliability, performance and ease of use. For example, the information system response time is 2 seconds.
Information Quality (Information Quality)	Accuracy, completeness, format, and timeliness of the information generated through the system. For example, the system provides a 5-minute delay.
Quality of Service (Service Quality)	Satisfaction with user support and services. For example, IT supports an average response time of 30 minutes.
System Use (Use)	The actual degree of use of the system, such as the number of logins or the frequency of using specific functions. For example, the average of 200 logins per day.
User satisfaction (User Satisfaction)	Overall user satisfaction with the information system. Usually measured on a questionnaire scale, with a full score of 7 and an average score of 5.2.
Net benefit (Net Benefits)	Value and benefits of using information systems to individuals and organizations. For example, sales increased by 15% after the ERP system was implemented.

Table 3.3 The 6 dimensions of the DeLone and McLean model

(3) Collect the data

The needed data for the assessment were collected through questionnaires and interviews. For example, questionnaires are designed to measure user ratings of the information quality of the ERP systems, setting specific questions and measurement criteria around each dimension.

(4) Analyze the data

Statistical methods and analysis tool SPSSAU were used to analyze the collected data, including descriptive statistics, factor analysis, path analysis, or structural equation model (SEM). These analyses were used to determine the current status of individual dimensions and explore the correlation and causality between dimensions. For example, service quality may be found to have a significant positive effect on user satisfaction, ultimately leading to increased customer loyalty and repeat business.

(5) Explain the results

Based on the analysis results, the performance of each dimension was evaluated and the possible problems were explained. The analysis results should be linked to the business objectives and strategies of the enterprise to more fully understand the impact of information systems. For example, if the service quality score is low, it may need to evaluate the IT support process and propose improvements.

(6) Implement the improvement

Make an action plan according to the analysis results, and improve on the problems found. This may involve investing in new technologies, focusing on designing system interfaces, improving the response speed of IT support services, conducting user training, etc. For example, the user interface may be redesigned for the user report within the next six months.

By following a series of steps, companies can utilize DeLone and Mclean's information system success models to conduct a thorough evaluation of their information systems and strive for continuous improvement to enhance organizational effectiveness. This model offers a structured methodological framework that aims to ensure the systematic and comprehensive nature of the evaluation process.

3.2.5 D&M models equally effective in different types of information system studies

In studying different types of information systems, the effectiveness of the DeLone and McLean models depends on multiple factors, including the specific objectives of the study, the type of information system, the implementation environment, and the characteristics of the user. Since DeLone and McLean proposed their information system success model in 1992, this model has proven useful for studying a wide range of information system implementations.”In 2003, this model was updated to understand the success of information system implementation in six interrelated dimensions: information quality, system quality, service quality, system use, user satisfaction, and intention use”(Taipalus et al., 2023).

This model is widely used in the evaluation of various information systems, such as:

- ◆ E-commerce system
- ◆ The Enterprise Resource Planning (ERP) system
- ◆ The Customer Relationship Management (CRM) system
- ◆ Electronic health record (EHR) system, etc

Among these dimensions, the quality of service is a key factor that is later included in the model. This factor has a direct correlation to both user satisfaction and system use.

Although the DeLone and McLean models have considerable versatility and widespread application potential, they are not always as effective in specific types of information system studies.

The following factors may affect the effectiveness of the model:

- (1) System complexity: For highly complex information systems, additional dimensions or construction may be required to capture the diversity of success.
- (2) User characteristics: The diversity of user backgrounds, needs, and expectations may have an impact on the key dimensions of the model.

- (3) Technological impacts: The evolving technological environment requires models to adapt to new information system types and applications.

Industry specificity is a key factor to consider when evaluating information systems. Different industries have unique requirements and evaluation criteria, necessitating the need to adjust the model's applicability based on the specific industry environment.

In some specific cases, the original DeLone and McLean models may need to be optimized to ensure effective application in a new or specific type of information system research. Studies suggest that there may be limitations to the effectiveness of assessment models in a changing information system environment. We infer that with the continuous evolution of information systems (IS) technology, the original model may not adequately measure emerging information systems. Because the nature of the information system is changing, the model needs to be constantly updated to adapt to new system features and user needs.

- (4) Limitations of model dimension: Although DeLone and McLean models have been evaluated systematically and in terms of information system quality, in fact, the model may need to be expanded and modified according to different application backgrounds to cover more factors for the success of the information system.

- (5) Complexity of measurement methods: The model proposes six interrelated dimensions: system quality, information quality, service quality, system use, user satisfaction, and intended use. Such multidimensional measurements require the use of sophisticated statistical analysis techniques, such as structural equation modeling (SEM), which can be a technical challenge for researchers.

The certainty of causality in the model can be either positive or negative cycles. In practice, these relationships are not always clearly identifiable or easily quantified, requiring researchers to conduct in-depth analysis to clarify the specific path of action between these dimensions.

- (6) User diversity: Different user groups may have different expectations and usage behaviors for the system, and a single evaluation model may not cover the diversity of

all users. This point is particularly important in cross-cultural or cross-industry applications.

Assessment of organizational and individual impact: The assessment of individual impact and organizational impact included in the model often requires in-depth understanding and effective measurement in combination with qualitative and quantitative research methods. This process may be more demanding for implementer in resources and technology.

Monitoring and evaluation of long-term effects: The success of the implementation of the information system largely depends on the effect after long-term use. However, data collected in the short term may not fully reflect long-term success, thus necessitating long-term follow-up studies.

- (7) Quantification of net benefit: Although the model proposes the concept of net benefit, how to quantify it and evaluate it effectively in different situations is often complex. Especially in the non-financial aspects of the estimated impact, such as user satisfaction and individual impact 3.

Overall, these general questions and challenges need to be identified and addressed in the practical application of DeLone and McLean's successful information system models to ensure the validity of model evaluation and the utility of relevant studies.

The topic of this paper is how to realize the value of data in the context of digital transformation and the circulation of data elements. What are the drivers in realizing the value of the data? What are the obstacles?

In this paper, the DeLone and McLean models are optimized in the new digital economy context.

3.2.6 The method to apply the D&M model for customer information systems

“Are the DeLone and Mclean models suitable for evaluating emerging information technologies, such as artificial intelligence and big data analysis systems?”(Zahid et al., 2023)

The information system (IS) success model of DeLone and Mclean is also potentially applicable when evaluating emerging information technology systems, such as artificial intelligence (AI) and big data analysis systems. Since its introduction in 1992, the model has been widely recognized and used to understand and evaluate the success dimensions of specific information systems.

The 2003 update considers six interrelated dimensions to understand the success of information system implementation: system quality, information quality, service quality (technical quality dimension), and system use, user satisfaction and intention use (user behavior dimension), which affect the generation of net benefits. These dimensions respectively focus on the accuracy and efficiency of the information system when generating and transmitting the information (technical layer), whether the information is successfully conveyed according to the original meaning (semantic layer), and the actual impact of the information on the receiver (effect layer).

When applied to artificial intelligence and big data analysis systems, this model provides the following analysis framework:

- (1) System quality: Performance, response time, reliability, and system availability are critical in AI and big data systems. The model allowed us to assess the quality of these systems when performing the task.
- (2) Information quality: The success or failure of AI and big data systems is largely dependent on the quality of the information they provide, including accuracy, integrity, and timeliness.
- (3) Quality of service: User support and services are critical in information systems, especially given that the complexity of AI and big data analysis systems may be beyond the understanding of general users.
- (4) System usage can be measured by analyzing the system log and the frequency of use of AI and big data systems.

- (5) User satisfaction: Overall user satisfaction with AI and big data analysis system is typically measured through questionnaires to gather feedback on the system's performance and usability.
- (6) Net benefit: This dimension measures the actual value that AI and big data analytics systems bring to an organization, such as cost savings, efficiency improvements, and the realization of new insights and strategies.

Nonetheless, models also face challenges when applied to evaluate emerging technologies such as AI and big data analysis systems. For example, features unique to emerging information technologies, such as algorithm interoperability, data privacy, and system transparency, may not have been comprehensively considered in the original model. These factors may have a significant impact on user satisfaction and net benefit. Therefore, while the original model provides a framework for evaluation, its specific dimensions may need to be modified and adjusted according to the characteristics of emerging information technologies. In addition, with the development of technology, the data extraction and processing methods may also change, further affecting the practical application effect of the model.

To sum up, the DeLone and Mclean model has certain applicability in the evaluation of artificial intelligence, big data analysis, and other emerging information technology systems. However, in its application, it may be necessary to learn from the latest research results and industry best practices, make appropriate adjustments to the model dimensions, and ensure that it can fully reflect the unique properties of the system and success measures. With the continuous evolution of information technology, it is necessary to continuously update and verify the model to maintain its applicability and effectiveness in evaluating information systems.

3.2.7 Evolution paths of D&M models under the future technology development trend

Under the future development trend of science and technology, the possible evolution paths of DeLone and McLean information system success models include the deepening and expansion of the existing dimensions, and the addition of new dimensions to adapt to

technological progress and social change. Here are several possible paths of evolution predicted based on the available scientific data:

(1) Deepen the existing dimension

Information quality can be improved by adding new sub-dimensions such as authenticity, transparency, and predictive accuracy. These sub-dimensions are important for enhancing the accuracy and generalization ability of the information.

System quality: With the popularity of cloud computing and distributed systems, scalability, security, and privacy protection have become important dimensions of evaluation.

Service quality can be greatly improved by introducing the principle of user experience (UX) design. It is important to carefully measure the contribution of interface design, personalized configuration, and other aspects to user satisfaction.

User satisfaction is crucial for increasing the consideration of users' psychological perception and expectation satisfaction degree, especially focusing on emotional experience and cognitive load during the interaction with the information system.

Net benefit: In addition to economic benefits, non-monetary benefits should also be considered, such as time saving and efficiency improvement.

We can also introduce new dimensions, such as:

Quality of data governance: With the rise of big data and artificial intelligence, data governance and data ethics are affecting the success of the information system.

Algorithm quality: Especially in artificial intelligence systems, the effectiveness and interoperability of algorithms can be used as an independent dimension of success.

User engagement: Measure user engagement in information systems, especially for systems that rely on community-driven content, such as social media and collaboration platforms.

(2) Design reflects more levels of benefits, such as:

Individualization benefits: the more granular impact of information systems on users' improvement of personal efficiency and learning abilities.

Environmental benefits: Whether the system supports environmental sustainability and green IT practices, especially in the face of sustainability challenges, is a crucial factor to consider when evaluating its overall impact.

Social benefits refer to the impact of the system at the social level, such as its contribution to education, public health, and an inclusive society. These benefits are crucial in promoting overall well-being and equality within a community.

(3) Integration across domain and multidisciplinary disciplines

In the different branches of IS research, the model may integrate more perspectives and theories from sociology, cognitive psychology and management, seeking a more interdisciplinary evaluation framework.

(4) Dynamics and adaptive assessments

As the enterprise environment is constantly changing, the dynamic evaluation of successful information systems will become even more important. Model evolution can support continuous, dynamic measures of success.

(5) To quantify the accuracy of the model

By using new technologies and tools, we can improve the precision and predictability of measuring the interactions between dimensions, especially when estimating the complex relationships between system use, user satisfaction, and net benefit.

It is worth emphasizing that the evolution of the DeLone and McLean models is not only dependent on technological development but also influenced by the consensus and practice experience of the information systems research community. Thus, the above evolving paths may be shaped by the ongoing sharing of research, practice feedback, and social needs. The evolution of future models will allow them to more fully represent and predict the success of information systems in changing technology environments.

3.2.8 The case to apply the D&M information system success model

In real enterprises, DeLone and Mclean information system success models are widely used to evaluate and guide the implementation and optimization of various information system projects. However, based on the popularity of the model and its breadth of use in multiple industries, the following are possible application example scenarios:

(1) The ERP (Enterprise Resource Plan) system is implemented

When implementing ERP systems, enterprises can use DeLone and Mclean models to evaluate the three dimensions of system quality, information quality and service quality. By measuring user satisfaction and the actual use of the system, enterprises can evaluate the implementation effect of the ERP system and find ways to improve the net benefits of the ERP system.

(2) CRM (CRM) system optimization

The DeLone and Mclean models were used to assess the success of the ERP system. Measurement of system quality, information quality and service quality can help enterprises understand the contribution of ERP systems in improving customer satisfaction and customer loyalty.

(3) The Electronic Medical Record System (EHR)

Medical institutions often use DeLone and Mclean models to determine the success of electronic medical record systems. Those medical institutions focusing on improving the quality of medical services and improving physician and patient satisfaction can use this model to evaluate information and system quality and create greater net benefits.

(4) Development of e-commerce platforms

E-commerce companies can use this model to understand the quality of the user experience on their online platforms. By analyzing system quality, information quality, and service quality, companies can assess the overall success of the platform and adjust their strategies based on user satisfaction and usage.

It should be noted that the specific nature and utility of the system must be considered in the process of evaluation using the DeLone and Mclean models. Therefore, although the above scenarios provide enterprises with a method and framework to evaluate the success of information systems, different industries and organizations may need to customize the application of models to reflect their own unique needs and challenges.

Because enterprises have different definitions and evaluation criteria for the success of information systems, detailed and in-depth application cases often need to be combined with specific enterprise environment and business processes. The specific data and results of these cases may not be completely transparent in the publicly available research literature, but some businesses may have actually applied DeLone and Mclean models in their internal reporting and evaluation to guide the investment and optimization of their information systems.

3.2.9 The general problems and challenges that the model face in its application

In the application of the successful models of DeLone and McLean information systems, researchers and practitioners face a series of common problems and challenges.

Here are some specific challenges:

(1) Adaptive challenges:

As information systems (IS) technologies continue to evolve, the original model may not adequately measure emerging information systems. Because the nature of the information system is changing, the model needs to be constantly updated to adapt to new system features and user needs.

(2) Limitations of the model dimension:

Although the DeLone and McLean models have evaluated the system and information dimensions in the terms of quality of the information system, in fact the model may need to be extended and modified according to different application backgrounds to cover the information system successfully facing more dimensions.

(3) Complexity of the measurement methods:

The model proposes six interrelated dimensions, including system quality, information quality, service quality, system use, user satisfaction, and intention to use. Such multidimensional measurements require the use of sophisticated statistical analysis techniques, such as structural equation modeling (SEM), which can be a technical challenge for researchers.

(4) The certainty of causation:

The causal relationships between the dimensions in the model can be either positive or negative. In practice, these relationships are not always clearly identifiable or easily quantifiable, which requires researchers to conduct in-depth analysis to clarify the specific path of action between these dimensions.

(5) User diversity:

Different user groups may have different expectations and usage behaviors for the system, and a single evaluation model may not cover the diversity of all users. This point is particularly important in cross-cultural or cross-industry applications.

(6) Assessment of organizational and individual impact:

Assessing the individual and organizational influences included in models often requires a deep understanding and effective measurement through the combination of qualitative and quantitative research methods. This process may place higher demands on implementer for resources and technology.

(7) Monitoring and evaluation of the long-term effects:

The success of the implementation of the information system largely depends on the effects after long-term use. However, data collected in the short term may not fully reflect long-term success, thus necessitating long-term follow-up studies.

(8) Quantification of the net benefit:

Although the model proposes the concept of net benefit, quantifying and effectively evaluating it in different situations is actually very complicated. This is especially true when assessing non-financial variables, such as user satisfaction and individual effects.

Overall, these general questions and challenges need to be identified and addressed in the practical application of DeLone and McLean's successful information system models to ensure the validity of model evaluation and the utility of relevant studies.

3.2.10 The multivariate analysis methods using statistical analysis tools

When analyzing multivariate data, we should focus on the following multivariate analysis methods:

- (1) Structural Equation Model (SEM): SEM is a complex multivariate analysis technique used to assess causal relationships between multiple variables. It includes both observational and latent variables and can be used to test whether the preset model matches the collected data.
- (2) Multiple linear regression analysis: This is a commonly used multivariate analysis method to predict or evaluate the relationship between a quantitative feature and multiple other features. In this approach, each study feature was assessed one by one to determine their effect on the dependent variable.

Multivariate analysis of variance (MANOVA) is a statistical technique used for analyzing multiple continuous dependent variables that are influenced by multiple categorical independent variables. Unlike traditional uni variate ANOVA, MANOVA can handle multiple correlated response variables simultaneously.

The choice of these methods should be determined based on the specific nature of the research question, the type of data available, and the objectives of the analysis. For example, multiple linear regression may be an appropriate choice if the study goal is to understand how several independent variables affect a dependent variable. To explore the complex relationship between variables, especially the influence of the implied variables, the structural equation model is more appropriate. Multivariate ANOVA addresses experimental or observed data with multiple relevant output variables, especially when the researcher is

interested in both the experimental design and the multivariate nature of the data. Before implementing these analytical methods, it is important to ensure that the data meets the prerequisites applicable to the selected method.

3.3 The advantages and disadvantages of the DeLone & McLean model

When analyzing the advantages and disadvantages of the successful model of DeLone & McLean information system (hereinafter referred to as D & M model), we can start with the performance of the model in research and application.

“Here is a detailed analysis of the advantages and disadvantages:”(Bianchi & Trimigno, 2021)

Merit	Shortcoming
<p>Comprehensiveness: The D & M model provides a comprehensive framework, covering the three key quality dimensions: system quality, information quality, and service quality. These quality dimensions collectively influence information use and user satisfaction, ultimately resulting in a net benefit.</p>	<p>Insufficient dynamics: As the information system environment evolves, some of the original components of the model may not fully capture the characteristics of modern information systems, especially in the context of changing electronic information systems (EIS).</p>
<p>Theoretical support: The model is constructed based on a large number of information systems successfully related to the literature review, and has a solid theoretical basis.</p>	<p>Indicators: successful evaluation indicators may not be flexible enough to tailor to specific situations in different fields and backgrounds.</p>
<p>Adaptability: The model can be applied to different types of information system evaluation, such as enterprise systems, e-commerce, government and public sector</p>	<p>Cultural and organizational factors neglect: models may fail to fully consider the impact of organizational culture and personal differences on the</p>

Merit	Shortcoming
information systems, etc.	success of information systems.
<p>Generality: The model is suitable for information system evaluation of different sizes and types of organizations, and can be used in various situations at home and abroad.</p>	<p>Static model: The D & M model is a static model, which may not be fit enough for some systems requiring dynamic evaluation, such as the learning management system.</p>
<p>Extensive used: The model is one of the most widely cited and highly accepted models in the information systems field, and its applicability has been widely tested.</p>	<p>Methodological limitations: The application of models needs to rely on specific methodologies, such as questionnaires, and it may sometimes lack the depth of qualitative analysis.</p>
<p>Update: The D & M model can be updated and expanded according to developments in the field of information systems, such as improvements in 2003 and 2014.</p>	<p>Complexity of benefit measurement: the measurement of net benefit is more complex, affecting multiple dimensions, and it is difficult to measure accurately.</p>
<p>Strong dimensional correlation: the six dimensions are interrelated, forming a networked success evaluation system, which helps to deeply understand the performance of all aspects of the information system.</p>	<p>The effect of time delay is not reflected: the benefits introduced by the system may have a time delay, but the model fails to explicitly consider this dynamic change problem.</p>

Table 3.4 The advantages and disadvantages of the DeLone and McLean model

In conclusion, while the DeLone & McLean model has clear advantages and a broad range of applications in evaluating the success of information systems, it also faces new challenges with the rapid development of information technology. Therefore, it requires further modification and expansion to adapt to the changing environment and needs. Additionally, in specific applications, researchers and practitioners should customize and adjust the use of the model according to the purpose, object, and context of their research or practice. This will help maximize the evaluation value of the model in different scenarios.

3.4 Optimization method for the DeLone & McLean model

Since 1992, the model has become an important framework for evaluating the success of information systems. With the development of information technology and the change of enterprise environment, scholars and practitioners have proposed some optimization methods to enhance the applicability and explanatory power of the model.

Here are some professional and academic optimization suggestions:

Optimize the field	Specific methods	Explanation
Quality of service	Introduce new quality of service models with explicit metrics, such as SERVQUAL or SERVPERF models.	This can provide more detailed dimensions of service quality, such as reliability and empathy, and be able to provide specific operationalization methods.
Use and user engagement	Evaluation the intensity and frequency of the system for different types of users, distinguishing frequent and occasional users.	Custom analysis for different users can reveal more detailed differences in system usage and help understand how dependent different user groups rely on

Optimize the field	Specific methods	Explanation
		information systems.
User satisfaction	A multi-dimensional user satisfaction assessment tool was used, and was not limited to a single satisfaction indicator. Add two dimensions of emotion and cognition, as well as the consideration of user expectations.	This can deepen the understanding of user satisfaction, including understanding the emotional and rational reasons for user satisfaction, and the perspective of expectation confirmation theory.
Net contribution	Individual and tissue levels are clearly distinguished, measured and evaluated separately. For example, employee productivity indicators are used at the individual level, and attribution analysis, cost-benefit analysis, or data envelope analysis (DEA) are used at the organizational level.	By distinguishing between different levels, the impact of the information system on different stakeholders can be accurately assessed, and a more appropriate assessment method is adopted.
Sociocultural factor	Social-cultural dimensions such as organizational culture and national culture were introduced to evaluate the influence of these factors on the success of the information system.	Sociocultural context may influence the psychological and behavioral processes of information system adoption and use, and is therefore an important external variable for system

Optimize the field	Specific methods	Explanation
		success.
Implementation context	Consider the internal and external environment of information system implementation, including policies and regulations, market competition status, and be included in the model analysis.	System success is not only the result of technical and user influence, but also is greatly affected by the external environment. Therefore, expanding the research horizon to the implementation context is also an important aspect of the optimization model.
Dynamic adaptability	Develop a dynamic version of the model used to track the long-term effects of the information system and its benefits over time.	The benefits of information systems may be long-term cumulative, so the models also need to be able to capture such dynamic processes.
Evaluation tool optimization	Development or adoption of more refined scales and measurement tools, as well as the introduction of statistical learning and data mining techniques for deeper data analysis.	With the development of big data and machine learning techniques, the use of these advanced techniques can enhance the understanding and interpretation of the complex relationships between the variables in the model.

Optimize the field	Specific methods	Explanation
Theoretical Model integration	The D & M model is integrated with other theories, such as the technical acceptance model (TAM), the theory of planned behavior (TPB), and the extended Cognitive Fit theory, etc.	By integrating other theories, we can increase the explanatory power of D & M models and provide a richer analytical perspective for specific environments and scenarios.

Table 3.5 Professional and academic optimization suggestions of the D&M model

The above optimization method emphasizes that the successful evaluation model of the information system should continuously absorb the latest achievements of new theories, new technologies and social culture along with the development of the times. This requires researchers to balance accuracy and foresight in empirical research and model application, so that the models can remain relevant and effective in different research and practice scenarios.

3.5 Application of D&M model in the context of data element circulation

3.5.1 Concept and importance of data elements circulation

The circulation of data elements refers to the transmission and sharing of data between different subjects, which enables data to be used in a broader scope, releasing the economic value of data, and promoting the development of digital economy. When explaining the concept and importance of the circulation of data elements, we can elaborate from the following aspects: (Ma yunhe & Xu shuhan, 2023)

Dimension	Explanation
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Dimension	Explanation
Basic conditions	The circulation of data elements is the basis of data value transformation and application. If the data cannot circulate, it is just a pile of code in the storage media and has no real value.
Circulation characteristics	Different from the traditional production factors, the high liquidity of data enables it to be widely used in economic activities and releases the vitality of data elements.
System safeguard	The efficiency of data factor circulation needs to be guaranteed at the institutional level, such as circulation access principle, management system, identification and cross-border circulation rules.
Property right definition and trading rules	The particularity of data elements in the transaction circulation determines the essential difference between the property rights and transaction rules and the traditional production factors.
Value activation and the digital economy	Data element circulation and transaction is an important way to activate data value and promote the development of digital economy.
Data privacy and security	In the process of circulation, the rules of data security and privacy protection should be clarified to ensure that privacy protection is in place.
Technical efficiency	The circulation of data elements promotes the integration and

Dimension	Explanation
and productivity improvement	linkage of the key input elements in the production process, which is conducive to the improvement of the technical efficiency and labor productivity of the economic system.
Data resource transformation	Through the circulation of opening, collection, mining and other links, the data resources in a broad sense can be transformed into data elements with value creation potential.

Table 3.6 Concept of data element

The flow of data elements not only expands the application scenarios of data, but also is an important prerequisite for realizing efficient data management and utilization. Through circulation, data can span the space and organizational boundary from the origin, meet the actual needs of more data demanders, and maximize the value of data. Therefore, building a perfect data factor circulation mechanism is not only the key to the development of digital economy, but also a necessary condition to realize the value of data factor.

(Pushparaj et al., 2023)

3.5.2 Model adjustment in the face of data flow challenges

In the context of data element flow, the various dimensions of the DeLone and McLean models can be applied to evaluate the key elements of the success of data flow:

- (1) System quality: the systems or platforms that affect data flow need to be efficient, reliable and compatible. These features directly affect the success of the data exchange.
- (2) Information quality: The quality of data in circulation is critical. High-quality data is easier to apply and creates value.

- (3) Service quality: In the data circulation, providing high-quality data management services and technical support can enhance user satisfaction and promote data circulation and use.
- (4) Effective circulation of data elements requires users to truly use the data, so the interface should provide easy-to-use and intuitive access and operation.
- (5) User satisfaction: User satisfaction with the process of data acquisition, processing, and analysis directly affects the availability of data and the promotion and use of the system.
- (6) Personal and organizational impact: The ultimate goal of data flow is to improve the performance of individuals and organizations, such as supporting decisions through data to enhance effectiveness and efficiency.

The contribution of the DeLone and McLean models lies in providing a theoretical framework to help organizations understand which factors are key to success and should be focused on in achieving effective data flow.

By optimizing these key factors, the organization can improve the data flow mechanism, thus enhancing the application efficiency of data assets and realizing success in information system projects.

3.5.3 Case Study: Application examples of D&M models in the field of data circulation

In the field of data flow, the DeLone and McLean models can be used as a framework to evaluate the success of information systems (including data flow systems). The six interrelated dimensions involved in the model - system quality, information quality, service quality, usage, user satisfaction, and personal and organizational impact - can be used to comprehensively measure the effectiveness of data flow effects.

“The following is an application example that combines the dimensions of the information system cost model and is implemented in a data flow environment”.(Chen & Liu)

Dimension	Application instances
Mass of system	A set of efficient data sharing platform has been set up, such as providing excellent API interface performance that can quickly respond to user requests and handle large amounts of data exchange.
Information quality	This platform ensures that the circulating data has a high degree of accuracy and integrity, for example, through the implementation of data quality management measures and standardized processing processes, the data quality is guaranteed, and users can obtain the latest updated and unified format of data.
Quality of service	Provide high-quality user support and maintenance services, such as having a professional technical support team to regularly maintain the platform, and provide users with customized data service solutions.
Condition of service	The platform is designed to take into account the user experience to attract more users to participate in data sharing, while providing users with the necessary training and guidance resources so that they can make full use of the platform capabilities.
User satisfaction	By regularly collecting user feedback and conducting satisfaction surveys, the platform constantly optimizes its services according to their needs, such as making UI / UX improvements, and adding features that users need.
Personal and organizational	The results of data circulation are effectively used by the organization to support decision making. For example, the data circulating on the

Dimension	Application instances
impact	platform is used for market analysis and prediction, enabling the organization to make more information-supported decisions based on the data, thus improving work efficiency and market competitiveness.

Table 3.6 Application in data flow

Although this paper provides a routine application example, the reality may involve more complex and specific scenarios, which may require a degree of customized adjustment of the model to accommodate different data flow scenarios and goals.

The application of DeLone and McLean models in the field of data circulation can help identify and address potential problems affecting data sharing and use, and facilitate the successful implementation of information systems.

3.6 Process automation and intelligent analysis of China's medical insurance industry

3.6.1 Development situation of China's medical insurance industry

China's medical insurance industry has expanded from a simple urban centralized model to rural areas, forming a national public health insurance system with full coverage. The system continues to expand its coverage, providing a solid foundation for social stability.

By 2021, China's health insurance industry revenue had reached 844.7 billion yuan, achieving a positive growth rate of 3.2% compared with the negative growth of the insurance industry affected by the COVID-19 epidemic. This reflects the increasing market recognition of commercial health insurance, and the commercial health insurance market also presents a new trend of integration and development with many fields.

“The following is a detailed analysis of the development situation of China's medical insurance industry”.(Chen & Liu)

Dimension	Development situation
Premium income	In 2021, the revenue of health insurance business was about 844.7 billion yuan, with a growth rate of 3.2%.
Market acceptance	The market acceptance of commercial health insurance is increasing, and the COVID-19 epidemic has further stimulated the demand for commercial health insurance.
Area under canopy	Extending to rural areas, the majority of the population is currently covered by health insurance.
Annual fee	Older adults and children in urban areas can receive health insurance by paying an annual fee equivalent to RMB 200.
The country efforts	The government is actively promoting the national health care insurance system.
Resource growth	With the sustained and rapid economic development, China's medical resources (such as medical facilities, employees, beds, etc.) and the health insurance provided by the central government continue to grow.
Medical demand	Individual medical needs increased, and the number of outpatient and inpatient patients increased.

Dimension	Development situation
Health insurance index	The Health Insurance Quality and Access Index (HAQ) was 42.6 in 1990, rising to 77.9 in 2016 (a global average of 54.4 in 2016).
Integration trend	Commercial health insurance has begun to achieve integrated development in medical care, medicine, health services and other industries.

Table 3.6 Analysis of the development situation of China's medical insurance industry

According to the above data and analysis, it can be seen that China's medical insurance industry shows a trend of healthy development, with significant improvement in terms of premium income, market acceptance, coverage and resource growth. At the same time, commercial health insurance is also constantly innovating and developing, closely integrated with the whole health industry chain, in order to adapt to the growing market demand and improve the service quality. In terms of public health insurance, the active expansion and reform of the Chinese government can help to improve the social stability and citizen health level of the whole country.

3.6.2 Analysis of medical insurance system and policy status quo

The framework of China's medical insurance system has been gradually formed and continuously improved in the past twenty years, and has been expanded to rural areas. "The system aims to provide the protection of medical expenses for the majority of residents, and reduce the economic burden of individuals through policy measures, so as to improve social stability".(Chen & Liu)

The following will be analyzed in several dimensions:

- (1) Scope and type of system coverage

China's medical insurance system is built on the national health insurance framework, which provides coverage for all citizens. It requires income earners to pay monthly insurance fees, after which they and their families can access medical services by making a certain amount of self-payment.

In 2003, the Chinese government launched the new Rural Cooperative Medical System (NCMS) for residents in rural areas. Urban workers are covered by the Basic Medical Insurance for Urban Workers (UEBMI), while informal employment and students are covered by the Basic Medical Insurance for Urban Residents (URBMI).

(2) Financial Burden and the aid system

In urban areas, health insurance coverage for seniors and children costs an annual fee equivalent to \$20, significantly reducing the financial burden on individuals. The government has also set up a medical assistance system to provide taxpayer funds for low-income citizens who cannot support themselves or have difficulty in living conditions, providing medical and physical examination services.

(3) Policy nature

The high score points of the policy nature variable indicate that the current medical policy is comprehensive, but there is still room for improvement. Detailed policy documents scored low in terms of clarifying the policy prescription, while those with timeliness, such as medical and health system reform, the 12th Five-Year Plan, and the 13th Five-Year Plan, scored high. Still, the number of policies covering the full phase is too small compared to the increasing demand for comprehensive coverage.

(4) Policy receptors

The comprehensiveness of policy acceptors is increasing, meaning that policy documents are focusing more and more on different groups. Among the different types of policy documents, more attention has been paid to health insurance issues, such as commercial health insurance development, product and service design, operation and management, and supervision.

(5) Fairness and service utilization

From the perspective of using medical services, although the health status of low-income groups is poor, the probability and degree of using medical services are low, which exposes the room for improvement in the service fairness of the basic medical insurance system. Meanwhile, the analysis of follow-up control variables shows that men and groups with longer education years enjoy a higher probability of medical expenditure, while age and urban medical expenditure show a secondary curve relationship, which provides a direction for detailed adjustment of medical insurance policy 5.

To sum up, China's medical insurance system is constantly moving towards comprehensive coverage, but it is urgent to further optimize the policy timeliness, comprehensiveness and service fairness, so as to ensure that all groups of people can reasonably enjoy medical insurance.

3.6.3 Challenges facing the Medicare industry

“Although China's medical insurance industry has made remarkable achievements in promoting the health and well-being of the people, it still faces the following challenges in achieving affordable and accessible medical services”. (Ahmed et al., 2023)

(1) Economic burden

Although the coverage of the medical insurance system has increased, the adequacy and sustainability of the medical insurance fund have attracted much attention. It is crucial to address the issue of insufficient capital reserves in some insurance projects, as failure to do so may pose risks to the stability of the medical insurance system in the future.

(2) Service accessibility gap

Differences in benefits and reimbursement rates between different health insurance plans suggest welfare differences between urban and rural areas, between different socioeconomic groups, between formal and informal sector employees, and between insured persons across age groups.

(3) System fairness

With the growth of medical demand, inequalities in access and affordability of medical services appear between urban and rural areas, regions and social classes. This phenomenon is evident in the ability to obtain medical services and medicines in rural and urban areas.

(4) Older age population and the burden of chronic diseases

China's aging population and the increasing burden of chronic diseases place higher demands on the healthcare system. There is an increasing demand for quality, efficient, and accessible medical services. Despite the key developmental steps primary health care in China has witnessed over the last decade, current systems remain limited in terms of service capacity, quality of service, and affordability of care.

(5) Supervision and integrity system

The management, supervision, and credit system of the medical insurance fund are not perfect, and it is urgent to further strengthen them to ensure the reasonable use of the fund and prevent fraud risks.

(6) Innovative drugs and medical devices

In terms of manufacturing, import and market penetration, China has bottlenecks in innovative drugs such as monoclonal antibodies and targeted oncology drugs. China, which occupies an important position in the global medical industry, has seen significant growth in the local development of medical equipment and service quality, but the challenges of market allocation and resource integration still exist.

In addressing these challenges, continuing to expand health care coverage, optimize reimbursement policies, and improve fund management and regulatory mechanisms are key to current and future work. In addition, improving the popularity and fairness of medical services and narrowing the health differences between urban and rural areas and different social and economic groups will become an important aspect of the implementation of effective solution strategies.

3.7 Current situation of medical insurance process

3.7.1 Overview of the current Medicare process

The below is Chinese current medical process, the purpose to analyze the process is to understand the key drivers to improve the efficiencies and look for the solutions to improve, the key will be the 'data'.

(1) Medical insurance registration and participation

Target: urban workers, urban and rural residents

Method: Urban workers shall be registered through their employers, while urban and rural residents shall apply to the local social insurance institutions as individuals or family units.

Payment: Medical insurance for urban workers (UEBMI) is jointly paid by employees and employers. Medical insurance for urban and rural residents (URRBMI) is mainly paid by individuals with government subsidies.(Dankar, 2023)

(2) Medical insurance payment

Medical insurance for urban workers (UEBMI) requires payment based on a certain proportion of the total wages of the employees, which is shared by both the unit and the individual.

Medical insurance for urban and rural residents (URRBMI) features a relatively low contribution amount, which is typically paid by individuals, with the government also offering subsidies.

(3) Medical insurance reimbursement

Preliminary diagnosis and treatment: After personnel are protected by ginseng to reduce medical treatment costs, the first step is to seek medical attention at a primary level medical institution (such as a community health service center or county level hospital) or appoint a hospital for treatment.

(4) Payment: The insured shall pay all expenses in advance at the initial diagnosis or pay a portion according to the specific policy.

- (5) Reimbursement process: After the treatment, the patient goes to the Social Security Bureau for the reimbursement procedures with effective bills and medical procedures. The Social Security Bureau calculates the reimbursement amount according to the starting payment line, reimbursement ratio, and ceiling line, etc.

Account settlement will be conducted in two ways: the reimbursement part will be transferred to the individual medical insurance account in accordance with the prescribed proportion, or the corresponding medical expenses will be directly deducted.

- (6) Special drugs and medical treatment

Some special drugs and treatments for major diseases may require special applications and may be affected by specific policies and regional differences.

- (7) Adjustment of medical insurance expenses

The payment rate, starting payment line, reimbursement rate, and other items of medical insurance are adjusted timely according to the social development and the income and expenditure status of insurance funds.

- (8) Commercial insurance supplement

As a supplementary medical insurance, commercial health insurance can be purchased according to individual needs to obtain a wider range of protection.

- (9) Medical assistance

The government will provide additional support through the medical assistance system for economically disadvantaged and special needs groups in order to alleviate the burden of medical expenses.

- (10) Continuous improvement and reform

In the continuous improvement and reform, China's medical insurance system aims to protect the people's medical and health rights and interests and promote the establishment of a more efficient and just medical security system.

The entire medical insurance process reflects the principle of universal coverage and multi-level security within China's medical insurance system. It integrates social security and commercial insurance products to ensure economic security for various groups seeking medical services. However, as policies and medical needs evolve, the processes and details are continuously being adjusted to meet the challenges presented by an aging population and the growing burden of chronic diseases.

3.7.2 Problems existing in the medical insurance process

‘There are a series of problems in the Chinese health insurance process that challenge the effectiveness and sustainability of the health insurance system’. Here are some specific questions and their relevance analysis:(Zhao et al., 2023)

(1) Insufficient health insurance funds

Medicare funds are so inadequate that they struggle to cope with increasing medical needs. From 2012 to 2018, the health insurance expenditure has increased significantly, and the shortage of funds has become one of the major problems facing the health insurance system.

(2) Reimbursement policy is not uniform

Differences in benefits and reimbursement rates between health insurance programs lead to uneven benefits between regions and between different economic and social groups. This inequality may affect patient access to health care services, especially for vulnerable groups, such as the elderly, who often need more health care but receive less reimbursement.

(3) Integrity and supervision system is weak

The lack of effective management supervision and integrity system of health insurance funds makes this system vulnerable to abuse and fraud. This not only consumes the precious capital resources, but also damages the fairness and efficiency of the medical insurance system.

(4) The service capacity of the basic medical security is insufficient

Although China has made important steps in the development of the basic public medical service system, the current system still has problems such as insufficient service capacity, low service quality and unaffordable nursing costs. The lack of service may cause insurance enrollees to receive adequate support when assistance is truly needed.

(5) The stress of chronic disease and aging

With the increasing burden of chronic diseases and the aging of the population, the existing medical insurance system is facing great pressure to cope with the high incidence of chronic diseases and the increasing medical needs of the elderly.

(6) Challenges of economic and social transformation

The rapid transformation of China's economy and society has posed new challenges to the medical insurance system. The problems of high out-of-pocket medical expenses and medical service affordability before 2009 have not been fully solved, and the reform and adjustment are particularly critical during the economic and social transformation.

In view of the above problems, the key direction of the current medical insurance system is to continuously improve the medical insurance system, improve the efficiency and fairness of the fund, optimize the reimbursement policy and expand the scope of medical services, and strengthen the supervision and integrity system of the medical insurance fund are the key directions of the current medical insurance system reform.

3.7.3 Influence of informatization on the medical insurance process

The application of information technology in the medical insurance process has significantly improved the rapid delivery capacity of systematic medical services. For the medical insurance process, informatization not only affects data processing, information access, service quality, decision-making management and other aspects, but also plays a key role in reducing the possibility of mistakes, improving work efficiency, and enhancing the transparency and integrity of the medical insurance management system.

The following is a detailed analysis of the impact of information on the medical insurance process:

(1) Information receiving and processing

Information construction makes the information receiving and processing in the medical insurance process more rapid and accurate. Electronic data exchange (EDI) allows for the rapid transfer of data between different health insurance systems, thus reducing errors and time-consuming in manual operations.

(2) Information sharing and database construction

Through the construction of the medical insurance information system and database, the collection, sorting, storage and retrieval of information in the medical insurance process have become more convenient. Databases such as electronic health records and electronic medical records have played an important role in ensuring that information is updated all the time and basically covers the national population.

(3) Decision support and management improvement

The application of information technology in the medical insurance process improves the information integration ability and decision quality of the decision-making level, and enables managers to make decisions and plan more effectively. This includes the management of insurance funds, adjustments to reimbursement strategies, and the formulation of health insurance policies.

(4) Improvement in service efficiency

With the improvement of information level, the overall operating cost of medical insurance services will be reduced, and the work efficiency of medical insurance related staff can be improved, which helps the medical insurance system to become more efficient and cost-saving in bearing medical costs and providing services.

(5) The narrowing of the regional differences

The difference in the efficiency of medical insurance services between developed regions and less developed regions may be narrowed due to informatization. The medical technology and resources in the developed areas are spread to the less developed areas

through various information platforms, so that the latter can improve the efficiency of the medical insurance services in this region.

(6) Promotion of medical insurance information construction

It is emphasized that the high-quality development of medical insurance informatization construction must adhere to the basic principles of unity, efficiency, compatibility, convenience and security, keep up with the forefront of the development of information technology, constantly integrate new technologies, increase new drivers, and promote the sustainable development of digitalization, intelligence and intelligence.

In response to the challenges of China's medical insurance system reform and the aging of the population, informatization not only provides a series of solutions, but also becomes a key technical driving force for the sustainable development of the medical insurance system. By comprehensively promoting information construction, the quality and safety of medical insurance management can be effectively improved, and the long-term and steady development of medical undertakings can be comprehensively promoted.

3.8 Underwriting process and data requirements

3.8.1 Overview of the underwriting process

The underwriting process is a standard process for an insurance company to decide to assume insurance risks and formulate corresponding insurance policies. The process involves a series of preparatory activities to determine the insured risk and to determine the corresponding risk insurance rate. 'Here is a detailed description of the underwriting process':(Zhao et al., 2023)

(1) Information gathering

The first step in underwriting is to collect information about the insured. This includes the basic data, history, and risk status of the insured. For the network security insurance, this may also involve the understanding of the network security practice of the insured.

(2) Risk assessment

The underwriter will assess the risk status of the insured. This includes, but is not limited to, examining historical claims data, existing risk management measures, and security policies. At the same time, evaluate the business risk and warranty of the sponsor, and price it.

(3) Fix a price

Based on the information collected and the results of the risk assessment, the underwriter determines an appropriate insurance rate. The price must take into account the supply and demand situation of the market, namely the supply and demand of insurance services.

(4) Calibration marking calculation

The underwriting marker as an important factor in determining the final premium is usually obtained by simple exponentially-weighted moving average calculations. Here the weight is an input parameter known as the underwriting marker recency weight.

(5) Supply and demand adjustment

The supply and demand of insurance services affect the risk pricing, which is usually adjusted by the underwriter. The ators will adjust their prices according to the supply and demand situation of the market. Whether to raise or lower the prices should be determined in combination with the market trend.

(6) Report preparation

After identifying the members of the underwriting consortium, the underwriters will collect relevant information about the bond issuer and prepare the bond prospectus together with other middlemen. During the preparation and construction of the prospectus, information can be exchanged and shared among the middlemen to reduce the cost of information collection and avoid differences in information content.

To sum up, the underwriting process is a complex and detailed process, which requires the underwriter to determine the prices and terms of insurance products based on rich data and professional judgment. With the development of the insurance market and the progress of technology, such as the intervention of information technology, the underwriting process

will become more rapid and accurate, so as to effectively improve the risk management ability and market competitiveness of insurance companies. (Dankar, 2023)

3.8.2 Data types in the underwriting process

The underwriting process involves a variety of data types and corresponding data collection methods. The collected data and analysis periods will vary according to the insurance product differences (such as whole life insurance and private pension insurance). The following table details the typical data types and acquisition strategies during the underwriting process: (Zhao et al., 2023)

Data type	Description	Acquisition strategy	Data acquisition cycle
Basic customer information	Including the customer's age, gender, occupation, income and other information.	Collection via underwriting questionnaires, direct interview, or online forms.	unset
Medical and health records	Client's health status, medical history, family disease history, etc.	From the health examination report, medical records, family doctor recommendation letters, etc.	unset
financial information	Customer's assets, liabilities, credit records, etc.	Collect financial documents such as bank statements and credit reports.	unset

Data type	Description	Acquisition strategy	Data acquisition cycle
Previous insurance events and payout records	Involving the number of claims, claim amount and claim reasons, etc.	Historical claims data within the system or claim information shared by other insurers.	Last five years (whole life insurance) or past year (private pension insurance)
Payment records and call procedures	Customer's premium payment delay event and the corresponding request situation.	Record of payment system and notification within the insurance company.	Last five years (whole life insurance) or past year (private pension insurance)
Other contract information	Such as guarantee content, additional terms added, policy start and end date, etc.	Insurance company's contract management system and sales staff records.	unset
Market and macroeconomic data	Market interest rates, mortality rates, disease morbidity, and other macroeconomic indicators.	Open market data, official data released by the Bureau and data provided by collaborative research institutions.	Updated according to market conditions and needs

Table 3.7 Data types in the underwriting process

In the actual underwriting process, data collection is not limited to the above methods and cycles, but also involves customer-specific information collection. Insurance companies need to ensure that the data collected can correctly reflect the risk status of the insured, while considering how to improve the efficiency and accuracy of data collection through information means.

To achieve these goals, the data collection process should be as focused as possible on reducing bias and employing appropriate data collection methods. Different data sources within insurance companies also need to be integrated to make full use of all available information to make accurate underwriting decisions. In addition, insurers may also enhance the breadth and depth of data by collecting data online and offline.

In a word, there are various data types and collection methods in the underwriting process. Insurance companies need to conduct accurate analysis of all kinds of data to ensure the rationality of risk assessment and the fairness of premium pricing. By adopting advanced information collection and processing technology, the competitiveness of insurance products and the efficiency of the underwriting process can be further enhanced.

In the underwriting process of the insurance industry, the underwriter needs to make a detailed evaluation of the relevant information of the individual or enterprise applying for insurance to determine the terms and prices of the insurance contract. To make these decisions, they collect and analyze multiple types of data.

The following are data types and types common in the underwriting process:

Personal information

◆ *age*

◆ *sex*

◆ *occupation*

◆ *marital status*

- ◆ *domicile*
- ◆ *health condition*
- ◆ *Medical history*
- ◆ *Family health history*
- ◆ *Current health status*
- ◆ *Lifestyle (e. g. smoking, drinking habits)*
- ◆ *height and weight*
- ◆ *pecuniary condition*
- ◆ *Career and income*
- ◆ *assets and liabilities*
- ◆ *Credit history*

Type and type of commercial insurance underwriting data

- ◆ *Enterprise information*
- ◆ *Scale*
- ◆ *Established years*
- ◆ *Business nature*
- ◆ *financial standing*

Financial statements (income statement, balance sheet, etc.)

- ◆ *Cash flow information*
- ◆ *Debt situation*
- ◆ *capital composition*

- ◆ *Operational risk*
- ◆ *Industry risk*
- ◆ *Enterprise credit rating*
- ◆ *Legal compliance*
- ◆ *Workplace safety records*
- ◆ *Historical insurance records*
- ◆ *Past insurance claims history*
- ◆ *Historical changes in insurance coverage*
- ◆ *Data collection means*
- ◆ *Questionnaire and form*
- ◆ *Insurance application form*
- ◆ *Health declaration form*
- ◆ *Financial statement*
- ◆ *Third party database*
- ◆ *Credit rating agency*
- ◆ *Records of the healthcare providers*
- ◆ *Public records (for example, court records)*
- ◆ *Physical or medical examination*
- ◆ *Medical examination*
- ◆ *Safety assessment of the factory or office environment*
- ◆ *face interview*

3.8.3 Person-to-person health and occupational interviews

Face-to-face interviews with corporate management to understand operational details is very important.

Underwriting is a complex decision-making process that relies on deep understanding of the science and empirical evidence of risk assessment. Effective management and analysis of these data is key for insurance companies to design insurance products, pricing and risk management. With the development of science and technology, the data collection and analysis methods in the underwriting process have become more modern and automated, including the use of artificial intelligence and machine learning techniques to improve accuracy and efficiency.

3.8.4 Application and value of data in underwriting automation

In the process of underwriting automation, the application and value of data are reflected in multiple levels, especially in the optimization of the risk model and the improvement of the risk understanding of the policyholders. Machine learning is the growing amount of data that provides insurance companies with opportunities to optimize these things.

‘The following are the specific application and value of data in underwriting automation’:

(Ananna et al., 2023)

The below is specific areas of data applications,

Domain	Application and Value
Risk assessment	Using the big data analysis technology, a more accurate risk model can be established. Through these models, companies are able to classify policyholders from high risk to low risk based on the individual's possible claim behavior.

Domain	Application and Value
Pricing strategy	Using the data analysis method for accurate pricing and accurate judgment of the risk level makes the price of insurance products more competitive and more fair
Customer service	The use of data simplifies customer needs to provide information and reduces invasiveness, thus optimizing the customer experience. In addition, automation technology reduces the time of underwriting decisions and improves customer service quality
Fraud detection	By analyzing historical claims and user behavior data, machine learning is able to dig out potential patterns of fraud. This not only helps insurers save on costs, but also increases customer satisfaction and lowers premium rates.
Product design and research and development	The use of data science and technology in the product design and development stage enables us to develop insurance products that effectively meet the market demand based on the in-depth analysis of a large number of customer data.

Table 3.8 Specific areas of data applications

The below is key points of data value,

Value point	Description
Improve accuracy	Through data analysis, the risk level of the policyholder can be

Value point	Description
	assessed more accurately.
Cost-effectiveness improvement	Automated processing can reduce labor costs, serve more customers, and reduce the price of insurance products.
Service speed is accelerated	Rapid and automated data processing can substantially reduce the time required for the underwriting process.
Risk management optimization	Data analysis can help companies better manage risk and plan their business.
The market is becoming more adaptable	Data-driven product design can better adapt to market changes and customer needs.
Expand the coverage customer base	A more precise risk model means being able to serve a wider range of customers, including those traditionally seen as high risk.

Table 3.9 Key points of data value

In conclusion, the data play a crucial role in the automation process of underwriting. As the technology continues to evolve, the underwriting process optimized by data analytics and machine learning will bring profound changes to the insurance industry and create a win-win situation for both customers and the company itself.

3.9 Data requirements of the compensation verification process

3.9.1 Overview of the compensation verification process

“The claim verification process is the standard procedure for insurance companies to handle insurance claims, which ensures that claims are reviewed fairly, correctly and efficiently”.

The verification process includes the following key steps:

(Zhang Jiannan et al., 2020)

(1) Notification (Notification)

The insurance holder notifies the insurance company of its claims. At this stage, the insurance company receives the preliminary claim information from the insurance holder.

(2) Registration (Registration)

Insurance companies classify claims or layer cases according to their complexity to determine the procedural path to follow in handling their claims. This may include verification and documentation of customer details, policy numbers, customer identification numbers, case identification codes, etc.

(3) Audit (Audit)

At this step, the insurer will determine whether the claim falls within the scope covered by the policy. The process may involve the verification of customer-provided support documents, including evidence of air tickets, flight delay notification, and actual take-off and landing time.

(4) Adjustment (Settlement)

The claims personnel of the insurance company will calculate the insurance amount to be paid and the other expenses payable, based on the materials provided and the terms of the policy. Then confirm the amount of loss, review the insurance liability and the payment object in the verification process, so as to decide the final settlement result.

(5) Payment (Disbursement)

Once the claim is approved, the insurance company will pay the claim according to the final settlement result and complete the claim process.

(6) Case closing (Closing)

After the payment of the compensation, the insurance company will complete the settlement of the claim process, including the filing of the documents. If the insurance event is caused by the third party liability and the conditions for recovery are met, the insurance company will claim recovery to the responsible party in accordance with the legal provisions.

(7) Case decision (Resolution of Disputes)

If the claim amount is less than the insurance company quote, the claimant will usually accept the offer. If the claimant claims a higher amount than the insurer offers, the claimant may dispute the claimed amount. All claims will eventually be settled by an agreement or a court decision.

The compensation verification process is an important link in insurance activities, through which insurance companies ensure the correct implementation of insurance liability and provide accurate and legal economic compensation to insurance holders. At the same time, through efficient management and reasonable layered processing, it aims to provide fast services while controlling claims costs, ensuring the financial health and industry reputation of insurance companies.

3.9.2 Analysis of the key data involved in the compensation verification process

In the compensation verification process, the analysis of key data is crucial to improve the efficiency, accuracy and impartiality. These analyses cover multiple aspects, ranging from the setting of the initial probability distribution, the processing and interpretation of claims data, to fraud detection and risk assessment. (Ananna et al., 2023)

The following information summarizes the key data analysis content involved in the claim verification process:

Data analysis content	Description	Example method	Correlation analysis

Data analysis content	Description	Example method	Correlation analysis
Selection of the probability distribution for the initial data	The initial step involves initial analysis of the probability distribution of the claim data. This helps to understand the overall characteristics and patterns of claims data.	Fit the claims data using a theoretical distribution	Numerical and graphical technical analysis
Numerical analysis of the claims data	By operating the claims data to determine the best fit theoretical model.	Normal, exponential,etc	Evaluation of the claims dataset
Analysis of claim characteristics	In-depth analysis of the characteristics of the claim data, including location, time, amount, etc.	Analysis of the characteristics of the compensation data framework	Study the characteristics and trends of claims data
Big data risk analysis	Big data analysis is used to mine out abnormal patterns in claims data to detect suspicious claims.	Combining network information and traditional features	Fraud in detecting claims
Analysis of the medical records	Analyze electronic medical records (EMR) data to provide insight to	Risk model calculation for the EMR data	Assessing and pricing the medical risks

Data analysis content	Description	Example method	Correlation analysis
	healthcare providers.		
Comprehensive processing of compensation data	The claims data were data Preprocessed and grouped and screened, and then various data analysis methods were applied.	Preprocessing was performed using SPSS, Excel	Optimize the processing process of claims data
Market value and risk analysis	Analyze the market value, potential and existing risks of insurance companies, and put forward targeted problems and suggestions.	Big data analysis methods	Provide business decision support

Table 3.10 Key data analysis content in the Claim verification process

To sum up, data analysis plays a core role in the process of compensation, it through the precise probability distribution selection, the detailed characteristics of claim data and big data risk analysis, improve the efficiency and accuracy of compensation, reduce the fraud risk to assist insurance companies, and provide decision support for the healthy development of insurance business.

3.9.3 Role of data in compensation automation

In the process of compensation automation, the role of data is crucial in the insurance industry. Compensation automation uses all kinds of data to improve the efficiency, accuracy and fairness of claim processing. The application of the data covers the whole process from the initial receipt of the claim to the final settlement.

The following are the specific roles of data in compensation automation:

Role	Specific role	Practical significance
Risk assessment	Use historical claims data to build a predictive model to conduct a risk assessment of new claims cases.	Improved the accuracy and efficiency of the judgment
Fraud detection	Big data analysis is used to mine abnormal patterns in claim data to identify potential fraud.	Save costs and optimize customer service
Custom service	Customize insurance products and services according to the data of individual customers to meet personalized needs.	Strengthen customer interaction and experience
Real-time data processing	Use real-time data to quickly respond to natural disaster-related claims based on location and weather data.	Improve the emergency response capacity
Products design	Insurance products are designed based on the results of data analysis to better meet the market and consumer needs.	Enhance market competitiveness
Process optimization	Analyze the data collected during the claim process to optimize every link of the claim verification process and reduce the error rate and cost.	Improve the performance of the entire compensation system

Table 3.11 Specific roles of data in compensation automation

Data plays important value in handling automated claims as below,

Value point	Definition
Accurate risk assessment	By using historical claims and user behavior data, the compensation model can accurately assess the risk of new claims, which enables a more accurate prediction of the claim possibility.
Fraud detection enhancement	The application of data science, especially machine learning techniques, has a significant role in detecting irregular patterns of the claims process, especially fraud, thus helping insurance companies to save large amounts of money.
Personalized service	Using detailed data records of customers, insurance companies can design personalized insurance products and services, such as insurance services based on customer behavior or location information, which provides a better experience for customers.
Rapid response ability	The integrated real-time data flow combined with an automated compensation system can enhance the ability of insurance companies to respond quickly to emergency claims and quickly after a natural disaster.
Product development research	Through big data analysis, insurance companies can explore new market opportunities and develop products that more fit customer needs, which can not only meet consumer needs, but also enhance the market adaptability of companies.

Value point	Definition
Improve operational efficiency	Data analysis plays a key role in optimizing the claims process by helping to identify bottlenecks and inefficiencies in the process, making it smoother and reducing processing delays and operational errors.

Table 3.12 Data value in handling automated claims

In the modern insurance industry, the use of data has long gone beyond simple statistical analysis. For mass production of claims data set, policyholder history information, and the depth of risk assessment data learning and analysis, insurance companies can more accurately in the automation assessment risk, more effectively monitor and prevent fraud, and more flexible to adapt to the changes of the market, so not only strengthened the basis of the insurance industry, also provide customers with a higher quality service.

3.9.4 Data processing requirements of the intelligent compensation verification system

“The demand of intelligent compensation system in data processing is mainly reflected in the following key aspects”.

(Ahmed et al., 2023)

Requirement	Specific description
Data sources	Multi-source data, such as sensor data, user behavior information, historical claims records, etc.
Data integration	Probe multi-dimensional data to ensure information integrity to support accurate risk assessment and claims processing ¹² .

Table 3.13 Data value in Intelligent compensation system

(1) Data analysis and processing

Requirement	Specific description
Risk assessment analysis	Use big data and analytical models, such as machine learning algorithms, to detect risk patterns and potential fraud in claims data.
Data privacy and control	Technologies that support data privacy protection to ensure that sensitive data is released on demand and reduce the risk of data abuse.
real-time data processing	To enable real-time or near-real-time data analysis and processing to support rapid response and decision making.

Table 3.14 Data value in Data analysis and processing

(2) System performance and optimization

Requirement	Specific description
High efficiency treatment	Systems must perform efficient data processing to large-scale datasets, especially when rapid response is required.
Automation process	Data processing processes should be as automated as possible, for example, using text mining to speed up the payment process or to automatically classify simple and complex cases.
Extensibility	The compensation system shall be well scalable to meet changing data volumes and analysis requirements.

Table 3.15 Data value in System performance and optimization

(3) User interface and interaction

Requirement	Specific description
User interaction experience	The system shall provide a clear and easy to use interface to support users to efficient data entry, query and review progress.

Table 3.16 User interface and interaction

(4) System security and backup

Requirement	specific description
data security	The compensation system must take strict data security measures, such as encryption and access control, to prevent data leakage or unauthorized access.
Data Backup and Recovery	The system shall regularly back up the data, and be able to quickly recover from any system outage.

Table 3.17 System security and backup

(5) Compliance and standardization

Requirement	Specific description
Compliance with regulations	The system must comply with the requirements of relevant laws and regulations for data processing requirements, including data protection laws and industry standards.
Data standardization	Standardized data formats and protocols are adopted to ensure data compatibility and interoperability and facilitate data exchange within and outside the industry.

Table 3.18 Compliance and standardization

The data processing requirements of the intelligent compensation system are various, covering the collection, integration, processing and analysis of the data, as well as the key links such as ensuring the data security and meeting the compliance requirements. To meet these needs, the system needs to adopt advanced technology and algorithms, while ensuring high efficiency and accuracy, ensuring the rapid response and accurate processing of every claim.

3.10 Types of medical data in China

“In China, the medical data type is extensive and rich, including electronic medical records (EMRs) at the patient center, clinical notes, medical imaging data, clinical trials focused on basic medical research, cohort research, biomics, literature and drug data, as well as medical affairs and medical insurance claims data serving as the center of medical protection information”.

The main types of Chinese medical data are detailed below:

(Zhang Jiannan et al., 2020)

Data category	Example data	Data sources
Electronic Medical Records (EMR)	Patient's clinical information records, diagnosis and treatment process records, the execution of medical orders, etc	hospital information system
Clinical notes	Medical physician records, surgery notes, and other treatment notes	Medical service platform data
Medical imaging data	X-ray, MRI and CT	Medical service platform data
Clinical trial data	Data from basic medical research and clinical trials of new drugs	Clinical medical research data
Cohort study data	Long-term data tracking disease influencing factors and outcomes in specific populations	Public health census data
Bionics data	Genomics, proteomic, and metabolism data	And Genomics and Information Technology
Literature data	Published medical research literature, clinical guidelines, etc	Academic research and publications
Drug data	Drug composition, medication status, and drug response data	Hospital and pharmacy information

Data category	Example data	Data sources
		systems
Medical affairs data	Daily operation and management data of medical institutions	Internal management of medical institutions
Of Medicare claims data	Medical expense reimbursement, insurance claims process data	Medical insurance information system

Table 3.19 Main types of Chinese medical data

China regards medical big data as an important basic strategic resource for the country, emphasizing the importance of medical big data for individualized disease prevention, diagnosis and treatment. With the rapid development of information technology, China's medical data types will continue to expand and deepen, covering more data dimensions and advanced analysis technologies.

3.11 Value of medical data

In the medical field, the value of data is not only reflected in its own information content, but also in its contribution to medical decision-making, clinical practice, health policy making, and scientific research. "Calculating medical data value is a complex task that comprehensively considers factors including data quality, availability, relevance to specific research or application scenarios, and potential economic and social benefits". Here are several ways to estimate the value of the medical data:

(Babhulkar et al., 2019)

- (1) Data quality assessment: Ensuring high data quality is essential to fully leverage the value of medical big data. The principle of "garbage in, garbage out" underscores the critical importance of data quality. Therefore, the data can be systematically scored from

the aspects of accuracy, completeness, consistency, timeliness, and relevance in order to estimate its quality.

- (2) Analytical model building: Estimate the application value of data in specific medical fields by establishing statistical, machine learning or artificial intelligence analysis models. Predictive modeling is an important component of data analysis, as described in Record [2], which uses artificial intelligence, machine learning, and data mining techniques to evaluate past and present information for future predictions.
- (3) Economic benefit analysis: Medical data brings direct economic benefits by improving the scientific nature of management decisions, reducing hospital operating costs, and enhancing the satisfaction of medical services. The value of the data can be quantified through cost-benefit analysis (CBA), cost-utility analysis (CUA), or return on investment (ROI).
- (4) Social benefit assessment: In addition to direct economic benefits, medical data can also contribute to the society by improving the quality of diagnosis and treatment and promoting the healthy and orderly development of the industry 1. The social benefits can be estimated through a social impact assessment (SIA).
- (5) Association analysis of medical events: Through the analysis of medical data, the association system between disease and symptoms, treatment and results can be found, so as to estimate the value of the data in clinical decision support.
- (6) Long-term follow-up and evaluation: Through long-term follow-up and evaluation of medical data, the long-term impact of the data in medical policy making, disease prevention, disease management, and patient health outcomes can be observed and quantified.

Digital value transformation in terms of medical big data sharing is crucial. A decentralized and dedicated scientific research data open platform can provide hetero-dimensional data open to specific groups of people. These data can be transformed into higher value through digitization.

Considering the above methods, calculating the value of medical data is a multi-level and multi-dimensional process, which requires accurate measurement tools and a professional evaluation system for comprehensive estimation. In addition, different evaluation angles and specific application scenarios will lead to different estimates of the value of medical data. Therefore, this difference should be taken into account in practice, and the appropriate evaluation methods and tools should be selected according to the actual needs.

Data types required for medical insurance underwriting and underwriting business Response: Data types required for medical insurance underwriting and underwriting for business.

When automating claims processing, Medicare companies typically collect and process the following types of data:

Data category	Specific data items	Purpose
Personal information data	Patient name, age, gender, contact information, etc	To confirm your identity and communicate with relevant individuals
Medical service data	Diagnosis information, treatment information, medical cost details, etc	Confirm the rationality and necessity of the service and review the compliance of compensation conditions
Claims documentation data	Claims application form, receipt, fee list, etc	Assess claims and execute the compensation process
Policy and coverage data	The content of the insured's policy, the coverage clause, etc	To determine the applicable conditions and scope of compensation

Data category	Specific data items	Purpose
Bank and payment information	Bank account number, payment method, etc	Handle transactions and payment transactions in the compensation process
Information-protection-related data	Encrypts and anonymize the information	Protect patient privacy in compliance with the Health Insurance Privacy and Liability Act and other relevant regulations
Fraud detection data	Historical claims data, abnormal behavior patterns, etc	Avoid insurance fraud and increase the efficiency and accuracy of detecting suspicious claims
Document image classification data	Request-related image data, classification results, etc	Reduce the workload of manual audit and accelerate the automation of the claim process

Table 3.20 Data type in automating claims processing

Automated medical claims processing relies on this data to ensure the accuracy, efficiency, and compliance of the entire process. Data collection and processing need to take into account the data quality, integrity, as well as privacy protection requirements. At the same time, insurance companies need to use technologies such as natural language processing (NLP) and big data analysis to make automated claims processing more efficient and reliable. In this process, how to ensure data security and privacy protection are equally critical, and requires strict compliance with relevant laws and regulations. (Dankar, 2023)

3.12 Pathway of medical data realization

In the current medical industry, the value realization of medical data assets can mainly be realized through the following ways:

- (1) Data analysis services: The amount of medical data is increasing, therefore, providing data analysis services for hospitals or medical institutions is an important way to realize the value. “Combined with AI technology, large amounts of patient feedback data can be analyzed and interpreted to identify areas where the healthcare industry needs to take action, as well as innovative ideas for patients”.(Zhao et al., 2023)
- (2) Health Data Analysis Stack (Healthcare Data Analytics Stack): This integrated system aggregates, integrates, transforms, analyzes, and visualizes health data to provide the necessary infrastructure and tools for knowledge sharing and collaboration to avoid repeating wheels and improve efficiency. Such systems can be either commercial or open-source software solutions.
- (3) The medical convergence framework and the Robin Standard (Healthcare Fusion Framework and Robin Criteria): They efficiently analyze quantified medical data through optimized big data analysis systems, and their results combined with qualitative knowledge can help improve medical outcomes at the individual and group level.
- (4) Policy making and evidence-based decision-making: Policy makers, healthcare providers, government agencies, and pharmaceutical companies can identify many different ways through big data technologies that can significantly improve patient outcomes through policy making and evidence-based decision-making.
- (5) Monetization path hypothesis: The "monetization path" research can provide a deep understanding of the process of economic monetization, including in the medical field. All these paths require compliance considerations to ensure patient privacy and compliance with relevant data protection laws and standards. At the same time, the implementation of these pathways also requires the support of professionals and advanced technologies to ensure the accuracy of the data and the validity of the analysis.

3.13 Literature summary on realizing the value of medical data elements in China

In China, an important issue is how to guide the value of medical data elements through the successful model of information system, with the acceleration of digital medical informatization. The DeLone and McLean models provide us with a rationale for evaluating and optimizing medical information systems successfully.

Dimension	Application interpretation
Mass of system	For China's medical information system, the system quality needs to ensure the stability, security and interoperability of data transmission. This requires the medical data platform to work together with various medical devices and other information systems to ensure the timely and accurate data transmission.
Information quality	The value realization of medical data elements depends on its quality. In China's medical system, on the one hand, it is necessary to strengthen the accuracy and timeliness of data, and on the other hand, attention should be paid to the privacy protection and compliance of data to ensure the confidentiality of patient information.
Quality of service	The quality of service of medical information systems is crucial to users (medical staff and patients). This involves system maintenance, technical support and user training, which should focus on improving user experience and solving problems in the use process.

Dimension	Application interpretation
Condition of service	Significant use indicates that medical information systems can be effectively accepted and used by medical staff and patients. In China, an important indicator to mine the value of medical data elements is the frequency of system use and the depth of data utilization.
User satisfaction	The satisfaction of the medical information system is directly related to its continuous use and the realization of data value. In China's medical industry, the improvement of user satisfaction can start from improving the ease of use of the system, enhancing information feedback and other aspects.
Personal and organizational impact	Personal and organizational impact Considering the positive effects of information systems on the work efficiency and institutional operation of healthcare workers. In China, the realization of medical data needs to assess its contribution to improving the level of diagnosis and treatment, strengthening the management of medical services, and promoting the formulation of health policies.

Table 3.22 Rationale for evaluating and optimizing medical information systems

The following is a summary of how this model framework can be applied to the value realization of medical data elements in China:

Supporting cases for the literature review may include evaluation studies of actual medical information system projects, policy analysis reports, and practice discussions of medical data management and application. For example, the research on system quality may focus on the technical architecture and performance optimization of medical information platform, the research on information quality can start from the standardization of medical data, and the research on service quality should focus on the improvement of customer

service. Studies of usage and user satisfaction are usually based on questionnaires and user feedback, while the analysis of individual and organizational influences favors long-term follow-up studies and economic benefit assessment.

On the basis of comprehensive research, it can be concluded that the application of DeLone and McLean models in the value realization of medical data elements in China reasonably evaluates the success of medical information system, and provides a scientific basis for the optimization of medical data management and utilization. These research results can not only help to promote the effective circulation and application of medical data elements, but also promote the improvement of the overall medical informatization level. Future studies could further explore how to combine the principles of the DeLone and McLean models with specific medical practices in China to achieve greater value for information systems and medical data.

3.14 Why the D&M model stood out

In this paper, several alternative models were explored when discussing information systems (IS) assessment models, but the DeLone & McLean (D&M) model was ultimately chosen. The following section will analyze the reasons why the D&M model stood out in the context of theoretical foundations, service level improvement capabilities, and comprehensive assessment capabilities.

Theoretical Foundations

The D&M model provides a solid theoretical foundation for advancing information technology in the health insurance industry. The model comprehensively assesses the effectiveness of information systems through six core dimensions:

- System Quality
- Information quality
- Quality of Service
- System Usage

- User satisfaction
- Net Benefits

Using these six dimensions, the D&M model achieves a comprehensive assessment of information system success and provides theoretical support for understanding the cause and effect relationships in the dynamic process of information systems.

Service Level Enhancement

The optimized D&M model within the thesis excels in improving the overall service level of medical and health insurance. By incorporating the three core dimensions of system quality, information quality and service quality, the D&M model is able to accurately assess and optimize the impact of these dimensions on overall system performance and user satisfaction. Specifically:

System Quality: Ensure that the information system is stable, secure, and fully functional so as to enhance the user operating experience.

Information quality: Ensure the accuracy, completeness and timeliness of data to meet users' decision-making needs.

Service quality: assesses the responsiveness, professionalism and user support of information system services to enhance user satisfaction.

Comprehensive Assessment Capability

Compared with other models, D&M model stands out with its comprehensive causality framework and dynamic assessment capability. Example:

TAM (Technology Acceptance Model):

Proposed by F. Davis in 1989, it focuses on users' perceived usefulness and ease of use of technology to explain users' acceptance behavior. TAM puts more emphasis on the key role of users' attitudes in technology acceptance, but it focuses on the psychological dimension of users' behavior, and fails to cover the comprehensive assessment of physical dimensions, such as system quality, information quality, and so on.

EAST (Ease of Access, Satisfaction, Trust) model:

Widely used in the field of e-commerce, it emphasizes ease of access, user satisfaction and trust. These three dimensions have a significant impact on the success of an information system, but the EAST model fails to cover key technical indicators such as system and information quality.

The D&M model assesses strengths:

The strengths of the D&M model are its comprehensiveness and dynamism, which are assessed and optimized through the following dimensions:

Causality: It is clear that system quality and information quality directly affect user satisfaction and information system usage, which in turn affects the organization's net benefits.

Assessment tools: Provides standardized assessment tools that help develop standardized models and methods for measuring information system success.

Empirical Analysis: Conducts empirical analysis to validate and optimize the application of the model by comparing predefined success criteria.

Application of D&M Modeling to Healthcare Data Circulation in China

The D&M model is optimized and applied in the context of healthcare data circulation and digital value realization in China:

Model components and dimensions are updated:

System quality, information quality, and service quality are updated as key factors affecting the net benefits of the system.

Causality Reconstruction:

Establishing the interrelationship between system quality and information quality as directly affecting user satisfaction and information system use.

Standardization of assessment tools:

Adoption of standardized assessment tools to promote the standardization of assessment systems.

Case Study

Taking the underwriting and claims processes of commercial insurance in China as an example, the D&M model shows the importance of data in these processes:

Underwriting process: assess eligibility through applicant information, credit scoring to determine financial stability, business history to understand operating conditions, risk data to assess risk levels, and insurance history to review past claims.

Claims process: ensure fast and accurate claims processing through data application.

3.15 D&M model optimization in data circulation and monetization

In the context of the new digital economy, D&M models are optimized by adding new independent variables. These variables include factors such as technological advances, compliance measures, etc., further enriching the framework:

System quality: assessing the performance, reliability and functional richness of information systems.

Information Quality: Ensuring the accuracy, completeness, and timeliness of data.

Service Quality: Improve the response speed and user support level of the information system.

User Satisfaction: Continuously optimize the system and improve user experience through user feedback.

Net Benefit: Measure the enhancement of the information system on organizational performance and user value.

By enriching and optimizing the D&M framework, the D&M model not only remains useful in the information age, but also adapts and guides the realization of data value in the digital age.

Conclusion

In summary, the D&M model stands out among many IS models mainly based on its solid theoretical foundation, comprehensive assessment dimensions, and dynamic causality framework, which is applicable to scenarios such as data circulation and digital value realization in the health insurance industry. With the optimized D&M model, this paper provides a solid academic and practical basis for promoting medical data circulation in China.

3.16 Prospects for future studies in DeLone and McLean information systems

Successful models of DeLone and McLean information systems have been applied and verified in several fields due to their comprehensiveness and applicability. However, as technology development, social changes, and industry-specific needs continue to evolve, future research can deepen and expand the model in the following aspects: (Jakovljević et al., 2023)

- (1) Integrating emerging technologies: Given the rise of technologies such as cloud computing, artificial intelligence, big data analytics, and blockchain, future research can explore how these technologies affect all dimensions of the information system and how they are integrated into the model to evaluate success.
- (2) User behavior and psychological factors play an increasingly important role in the use of information systems. Future research could provide a deeper understanding of how user acceptance, trust, satisfaction, and dependence on technology influence the success of information systems.
- (3) Cross-cultural research: With the deepening of globalization, cross-cultural factors are becoming more and more important in the successful research of information systems. Future studies could explore the universality and adaptability of models in different

cultural contexts, especially how they can be adjusted to maintain their effectiveness in a multicultural setting.

- (4) **Security and Privacy:** Data security and privacy protection are hot issues in the field of information systems. Future studies could incorporate security into the model to analyze the role of security and privacy policies on system quality, user satisfaction, and organizational impact.
- (5) **Sustainability and ethical considerations:** Sustainable development and ethical factors are gradually becoming important dimensions to measure the success of information systems. Research can integrate environmental and social ethical factors into models, especially when assessing long-term effects and effects of the system.
- (6) **Industry-specific applications:** Information systems cover a variety of industries, each with its own specific needs and challenges. Research can explore the applicability of the model in specific industries (e. g., healthcare, education, financial services), and make necessary adjustments to the model to meet specific industry needs.
- (7) **The deepening of empirical research:** Although DeLone and McLean models have been widely used, many empirical studies have focused on specific dimensions or short-term effects. Future studies could allow for more systematic and long-term empirical evaluations to verify the assumptions proposed by the model and the sustainability of the results.
- (8) **Combining qualitative and quantitative studies:** Most studies using DeLone and McLean models use quantitative methods. Future research should consider a combination of qualitative studies such as in-depth interviews and case studies to gain a deeper understanding of the success of information systems.

Through the proposed research directions, future research can continue to extend and improve the DeLone and McLean models to maintain their relevance in new technological environments and social context, providing theoretical support and practical guidance for a broader range of application scenarios.

4 Research methods

4.1 Research framework construction

“In order to build a research framework based on DeLone & McLean model, it is necessary to clearly understand the components and relationships of DeLone and McLean information system (IS) success models”. (DeLone & McLean, 2003)

Here are the steps and key points for establishing the research framework based on this model:

(Pushparaj et al., 2023)

Step 1: Define the research objectives and questions

- (1) Clarify the dimensions of the information system success that the study aims to measure.
- (2) Define the specific environment in which the study is located, such as the IS success measure in the e-commerce environment.

Step 2: Identify the six core dimensions of the model

- (1) System quality (System Quality): refers to the performance of the information system, such as ease of use, reliability, and response time.
- (2) Information quality (Information Quality): involving the accuracy, comprehensibility and usefulness of the information.
- (3) Usage (Use): Reference to the frequency and depth at which the information system is used.
- (4) User satisfaction (User Satisfaction): It reflects the overall satisfaction of users with the information system.

- (5) Individual impact (Individual Impact): measures the impact of information systems on users' work performance.
- (6) Organizational impact (Organizational Impact): Evaluate the effectiveness of the information system at the organizational level.

Step 3: Integrate the service quality dimension

Add a quality of service (Service Quality) dimension, especially when support for information systems is particularly important, such as the e-commerce environment mentioned.

Step 4: Establish the evaluation indicators

- (1) Determine the quantitative indicators for each dimension separately.
- (2) Ensure that each index is metrable and can objectively reflect the quality or effectiveness of relevant dimensions.

Step 5: Design the questionnaire or the experimental scheme

- (1) Design the questionnaire, interview outline or experimental process based on quantitative indicators.
- (2) Ensure that the data collection method can effectively capture the various dimensions specified by the model.

Step 6: Data collection and analysis

- (1) Conduct surveys, interviews or experiments, and collect relevant data.
- (2) Apply appropriate statistical analysis methods, such as factor analysis, structural equation model or regression analysis, to verify the assumptions and measure the influence of each dimension.

Step 7: Explain and validate the research framework

- (1) Explain the data analysis results to verify the relationship between the dimensions.

- (2) To evaluate the effectiveness of the model framework and explore possible room for improvement.

Step 8: Continuous improvement and validation of the framework

Continuous refinement and validation of the model framework, as recommended by Delone and McLean.

Building a research framework based on the DeLone & McLean model requires researchers to have a deep understanding of the concept and composition of the model, and to be able to adapt and apply the model according to the specific context of the study. Through the above steps and key points, researchers can design a clear and feasible research framework to assess the success of a specific information system.

4.2 Data collection and analysis methods

“In the case of analyzing the data flow problem of medical insurance companies, the data collection method and analysis process can be elaborated as follows”:

(Li Gang et al., 2021)

Data collection methods are chosen as below:

- (1) Subject selection and determination:

Medicinsurer data is often derived from payers, i. e., underwriting or private companies, as well as healthcare providers such as hospitals and clinics.

- (2) Data collection route:

- ◆ Electronic medical record (EMR): Patient health data collected and stored by the service provider.
- ◆ Claims and transaction records: record financial transactions and patient treatment during the insurance application process.
- ◆ Oral or written questionnaire: used to obtain qualitative data such as patient satisfaction and quality of services.

(3) Data type and format:

Data may include structured data database records, as well as semi-structured or unstructured data, such as audio, video, and text files.

(4) Privacy and security measures:

Given the sensitivity of medical data, it is important to ensure that data collection is conducted in compliance, while both encryption and access control technologies are applied to protect data security.

(5) Analysis process:

1. Data preprocessing:

-Data cleaning: Remove inconsistent, duplicate, or incomplete data entries to ensure the accuracy of the analysis.

-Transcoding and standardization: convert the data into a unified format to facilitate subsequent processing.

2. Definition of analysis objectives:

Clear analytical purposes, such as optimizing the performance of the healthcare industry or exploring specific health indicators.

3. Application of the analytical methods:

-Descriptive statistics: Basic data overview to provide direction for further data exploration.

-Regression analysis: the correlation and causality between the study variables.

-Risk assessment: Risk analysis of specific clinical indicators with specific exposure and no exposure.

4. Data mining:

-Apply the algorithm to discover the data patterns and trends.

-In particular, conduct in-depth analysis of the selected diagnosis and treatment events to detect problems such as service manipulation and abuse.

5. Verification and interpretation of the results:

-Test the results of statistical analysis to ensure the study objective.

-Explain the data analysis results and suggest practical improvement based on the analysis results.

6. Report preparation and presentation:

Write detailed reports based on the analysis results, and the report format usually includes the research background, methods, results, discussions, and conclusions.

7. Feedback and improvement:

The analysis results are fed back to relevant stakeholders and the analysis process based on the feedback.

Through the above professional decision-making steps, a systematic and standardized medical insurance data circulation and analysis process can be established, with the aim of improving data quality, speeding up data processing speed, and ensuring the accuracy and reliability of the analysis results. The privacy and security issues involved must be strictly followed throughout.

4.3 Selection of quantitative analysis tools

When choosing quantitative analysis tools, there is no unified standard "best", because different tools have different functions and characteristics, suitable for different types of data analysis requirements. I chose some widely recognized and commonly used quantitative analysis tools to compare:

- (1) Excel: Microsoft Excel has a powerful data analysis plug-in such as "data analysis toolkit", which is suitable for basic statistical analysis, data collation, chart generation, etc., especially suitable for beginners and small-scale data processing.

- (2) R: R is an open source programming language and software environment. The rich package ecosystem makes it very powerful in advanced statistical analysis, data visualization, machine learning, and data mining.
- (3) Python: Python is a general programming language, but it is supported by a large number of libraries in the field of data science, such as Pandas, NumPy, SciPy, Scikit-learn, etc. It is suitable for data analysis, data visualization, and machine learning projects.
- (4) MATLAB: MATLAB is a mathematical computing software that provides many built-in tools for mathematical computing, algorithm development, data analysis, and visualization.
- (5) SAS: SAS is business analysis software, widely used in statistical analysis, business intelligence, data management, and analysis work in the fields of finance and medicine.
- (6) SPSSAU: SPSSAU is a powerful statistical analysis software with a user-friendly interface and is suitable for data analysis in the social sciences.
- (7) Stata: Stata is a statistical software suitable for statistical analysis in economics, sociology, political science and other fields.
- (8) Tableau: Tableau emphasizes data visualization and provides a powerful drag-and-drop interface suitable for creating interactive and shareable data charts.
- (9) Power BI: Provided by Microsoft, is a business analysis tool where users can easily create data sets, reports and dashboards.
- (10) QlikView / Qlik Sense: Qlik's product and one of the business intelligence (BI) tools, focusing on data visualization, dashboards and reporting.

When selecting a quantitative analysis tool, the analysis objectives, type and size of data, budget and skill level of the user. For example, data scientists may tend to use R or Python, while business analysts may be more appropriate to use Tableau or Power BI to produce insight reports. For some specific analysis tasks, professional statistical software such as

SAS or SPSS might be the best choice. Therefore, consider your specific situation and analysis needs, choose the most appropriate tool to complete the quantitative analysis task.

Finally SPSSAU is used in this paper because the tool is very easy to be used, it has intuitive UI.

4.4 Analyzing the logic behind healthcare data sources and D&M frameworks

In this paper, we have selected a variety of medical data sources for analysis and research. These data sources include medical records, discussion data from online medical communities, and data from multiple doctoral dissertations and scientific paper abstracts. These different categories of data help form a rich medical knowledge graph, which greatly enhances the credibility and applicability of the data. Next, we analyze these data sources and the logical relationships behind them in the context of the D&M (DeLone and McLean) information system success model.

Classification of healthcare data sources

1. Electronic Medical Record (EMR): The electronic medical record is a core component of a healthcare information system that contains a patient's health record, diagnostic record, and treatment record. Data sources are widely available and mostly structured¹.
2. Online medical community data: including records of patient-doctor interactions, patient self-reported symptoms, and feedback on treatment outcomes. These data are usually unstructured, but can be transformed into useful information through data mining and natural language processing techniques.
3. Academic research and literature data: for example, literature data on multiple myeloma treatment and ancient Chinese medicine treatment. This type of data provides a scientific basis for building a comprehensive medical knowledge graph.

4. Big data platforms: large amounts of data from clinical records, such as those provided by MIMIC-IV, are an important source of data for studying medical decisions and treatment outcomes.

Key elements of the D&M model

Several key elements of the D&M model include information quality, system quality, service quality, utilization, user satisfaction, and net benefits. We will analyze the representation of the above data sources in the D&M model in relation to these elements.

D&M model elements	Medical Data Sources	Specific application
Quality of information	Electronic medical records, online medical community data	Accurate and complete data that effectively reflect patient health status and treatment outcomes
System quality	Medical information management systems (e.g., HIS)	High data processing capacity, excellent system stability and response time
QOS	Medical consultation platform, online community interaction	Great user experience with great consultation and interaction features
Utilization	Hospitals and scientific institutions	Widely used in patient diagnosis, treatment and medical research
Customer satisfaction	Doctors and patients	Provide personalized treatment plans to improve treatment results
Net benefit	Medical management and decision-making	Improving hospital management efficiency and patient health

4.5 The questionnaire and the interviews

When designing a questionnaire to study the combination of China's medical data and the underwriting and compensation process of the medical insurance industry, the core issues we need to pay attention to are improving transparency, trust, data security and shortening the time of claim settlement. The main goal of the questionnaire is to understand the challenges and pain points in the current process, and how to use medical data to optimize these processes to achieve more efficient and precise services.

The following is the questionnaire design for this study, including but not limited to the following parts:

1. The basic information section

Your career orientation is going to be:

Staff of the health insurance company

staff

Managers of medical institutions

Policy-makers

Other (please specify the)_____

Your length of years in the health care or healthcare industry is:

Less than 1 year

1- -5 years

5- - -10 years

More than 10 years

2. Evaluation of the current underwriting and compensation process

Do you think that the current medical insurance underwriting and compensation process has the following problems?(Can be selected more)

Information transparency is not high

Insufficient trust

A claim settlement time is longer

Data security issues 13

Manual audit workload is large: 2

Other (please specify the)_____

What issues do you think are the most critical when medical data is used in public health research or decisions?(Sort them by importance)

Authenticity and accuracy of the data

Data privacy and legitimacy

The ability to acquire the data in real-time time

Data management and analysis capabilities 4

3. Data application and improvement measures

How about improving existing processes to use medical data to be efficiency?(Can be selected more)

Introduce artificial intelligence and big data technology

Establish smart contracts to automate the underwriting and compensation process

Strengthen data sharing across departments and across institutions

Implement more stringent data security measures

Improve the trust of users (policy holders and medical providers) in the system

[] Increased data management training for health insurance staff

In your observations or experience, which types of medical data are the most valuable in the underwriting and compensation process?

[] The diagnostic information of the patient

[] Detailed data on the treatment process

[] Patient's historical medical insurance claims information

[] Quality of service data of medical institutions

4. Future prospects and suggestions

What are your suggestions for improving the transparency and efficiency of the healthcare reimbursement process?(Open-ended questions)

5 Analysis of the key drivers of data monetization

5.1 Policies, regulations and industry standards

“Government policies and industry standards have an important impact on the circulation and utilization of medical data”, which is mainly reflected in the following aspects:

(Duan Yaoqing et al., 2022)

5.1.1 Policy provisions and legal requirements

Data protection regulations, such as the HIPAA Act, specify the collection, processing, storage, and sharing of medical data to ensure the privacy and security of patient data.

Data sharing policy: Government policies established for data sharing can promote cross-institutional and cross-regional data circulation, improve the availability of data and assist policy formulation.

5.1.2 Standardization and interoperability

Information technology standards are emerging efforts to promote the development of global healthcare information standards, but the adoption of these standards is unclear.

Data interoperability: Developing consistent data formats and coding standards can improve the compatibility and liquidity of data between different medical information systems.

5.1.3 Regulation and governance framework

Inconsistent regulatory framework: The legal requirements of various types of data vary according to the use and jurisdiction area, and such differentiated regulatory approaches may hinder the process of data circulation.

The federated data space concept provides a more flexible and adaptable digital service tool and method based on data sovereignty. It involves authorization relationships between

multiple participants, defines the specific boundaries of decision-making authority, and outlines rights, roles, and responsibilities around data processing.

5.1.4 Economic impact and trust issues

Trust issues are critical in medical data sharing, as user trust in data users can determine the success or failure of the process.

Significant role of the economic field: The medical field plays a crucial role in the economy, where data sharing aids in medical diagnostics, biomedical research, and policy development.

5.1.5 To serve the social and public interest

Data sharing demonstrates significant social value during public health events, such as outbreaks, by monitoring the behavior of close contacts and high-risk groups.

5.1.6 To serve the personal interests

Data circulation promotes the convenience of medical services, and reduces the problem of citizens' repeated provision of information when seeking medical treatment, medical insurance settlement and insurance purchase.

Therefore, government policies and industry standards ensure the privacy and security of medical data by defining the rules and methods of data collection, processing and sharing, and promote the effective circulation and utilization of data. However, progress in standardization and consistency of policy are important to achieving these goals and requires a concerted effort to overcome the existing challenges.

5.2 Technical infrastructure and innovation

The driving role of technology infrastructure and technology innovation in the flow of medical data can be summarized as follows: (Qi et al., 2023)

5.2.1 Technical infrastructure construction:

Technical infrastructure provides a solid background system for medical services. Data is a key resource for modern medical services, and the huge technical infrastructure such as electronic medical record systems (EMRs), health information exchange (HIEs), and cloud computing platforms provide the necessary support for the storage, processing and circulation of data. This creates the conditions for achieving seamless docking and instant access to medical information across institutions.

5.2.2 Medical process innovation:

With a strong technology basis, practitioners in healthcare can focus on creating new medical service processes based on various technology configurations.

5.2.3 Medical Systems Engineering Research:

The existence of technical infrastructure provides the basis for researchers in medical systems engineering to conduct empirical evaluation. By applying various application cases, researchers can conduct a meta-analysis to learn which patient-centered processes may be more effective than others, and in what context.

5.2.4 Capture and analyze the data:

Technological innovation has contributed to the generation of various new products / services, and also improved existing medical products / services, improving data accuracy and analysis efficiency through new technologies.

5.2.5 Cross-field technological innovation:

Technological innovations such as artificial intelligence, the Internet of Things (IoT), blockchain, and mobile applications are driving efficiency, quality, and cost in medical services within medical organizations. The application of these technologies is not limited to the information technology industry but penetrates various economic sectors, including the health sector, to improve the efficiency of physicians, nurses, and medical practitioners in delivering medical services.

In conclusion, technology infrastructure and innovation are the key drivers of the flow of medical data. They not only support the storage and exchange of data, but also promote the

innovation of medical service processes and medical system engineering research, and thus improve the overall efficiency and service quality in the healthcare field.

5.3 Governance structure and process management

The governance structure of medical insurance companies has a profound impact on data flow, which is mainly reflected in the following aspects:

5.3.1 Data flow and governance structure construction

The top priority of healthcare insurers in implementing a data-sharing framework is to identify and implement governance structures. Data governance is the backbone of the data access framework, which consists of a set of processes and procedures implemented by health data holders, designed to manage and share their data and ensure protection of data during all development and use stages. A solid data governance structure ensures that all processes comply with laws and regulations and protect data from unauthorized access and abuse.

5.3.2 Data property rights and resource allocation

The control of data utilization and circulation by medical insurance companies largely depends on the ownership definition of the data. In practice, many data of health insurance come from consumers, including private information such as consumers' physical characteristics, health diseases, and behavior tracks. From the perspective of resource utilization efficiency, allocating the ownership of health insurance data to health insurance institutions can better facilitate the sharing and circulation of data recycling. This is because the collection, storage, and utilization of these data are mainly carried out by health insurance institutions.

5.3.3 Digital compliance management system

Health insurance companies need to establish a set of automatic, intelligent and agile enterprise internal digital compliance management system. This system can find out the potential problems such as illegal operations and high-risk transactions in time, and

effectively prevent the risks. The quality of the governance structure directly affects the effectiveness of the corporate governance system and the risk management ability, which also indirectly affects the safe circulation of data.

5.3.4 Regulatory rules and market norms

The stable and efficient operation of the market depends on effective regulation and fair and standardized market rules. In the era of digital economy, data is the core resource of health insurance and one of the most difficult assets to regulate. The cooperation between insurance companies and technology service companies should be carried out within the framework of regulatory rules to ensure that customer data will not be leaked, abused or tampered with, otherwise it will cause serious credit loss and affect the data flow.

To sum up, the governance structure of medical insurance companies directly affects the safety and effective circulation of data by affecting the governance of data, the definition of property rights, the compliance management system and the observance of regulatory rules. A good governance structure is the key to ensuring that the data can be properly shared and used when needed.

5.4 Important factors to establish data governance frameworks

When establishing a data governance structure, health insurers need to focus on the following key elements:

5.4.1 Governance structure and responsibilities: Determine who is responsible for different aspects of medical data, such as data quality, protection, sharing, and the day-to-day operation of the information system.

5.4.2 Data collection, protection, and update are essential aspects of maintaining accurate and reliable data. It is important to establish a clear mechanism for updating and protecting data to prevent it from becoming outdated or being accessed by unauthorized individuals.

5.4.3 Data access processes and policies: Create access control policies that not only protect the data, but also ensure that they can be safely shared and accessed when needed.

5.4.4 Transparency of the public participation process: Throughout the data processing process, involve the public in decision-making, improve the transparency of data management, and strengthen public trust.

5.4.5 User support: Provide adequate support for the end users of the data, including training, guidance and technical support, to ensure that the data can be used correctly and effectively.

5.4.6 Ethics and legal compliance: Work with ethicists and lawyers to ensure that all decisions are consistent with applicable laws, policies, and best practices.

5.4.7 Data account nature and decision-making power: It is important to clarify which individuals or departments are responsible for the management of data and information, and have the decision-making power. This is crucial to ensure the quality of key strategic assets, namely data and information.

5.4.8 Information quality (IQ): As a key element of data governance, ensure the quality of data, including accuracy, completeness and consistency.

5.4.9 Sensitive data identification: Identify which data is sensitive, and establish special access and sharing policies based on these data.

5.4.10 Data Management, Security, and Privacy Responsibilities - Clearly defined roles and responsibilities to manage the security and privacy of data, ensuring that data is properly handled throughout the life cycle.

By following and maintaining the above elements to build and maintain the data governance structure of medical insurance companies, we can improve the application value of data while ensuring compliance, and optimize the efficiency and effect of data management.

5.5 Balance the data security and availability when establishing a data governance structure?

“When establishing a data governance structure, the problem of balancing data security and availability can be considered from the following aspects”:

(Ma yunhe & Xu shuhan, 2023)

5.5.1 Data security strategy

1. Access control mechanism: Implement a robust access control system to ensure that only authorized users can access the data under specific conditions.
2. Communication protocol security: a secure communication protocol is adopted to protect the integrity of the data transmission process and prevent unauthorized interception or tampering.
3. Robust data storage: Apply encryption technology for data in stationary state, implement secure backup and recovery procedures, and regularly review potential security vulnerabilities of data infrastructure.
4. Security policy and regulatory compliance: Implement security policies to ensure compliance with relevant data protection laws and standards within the organization.

5.5.2 Data availability assurance

1. Safety and availability trade-off: When considering meeting the actual needs, it is important to take into account the trade-off between safety and availability. This will help maximize data availability while ensuring safety is maintained.
2. Performance and availability scalability: Make an appropriate trade-off between security and availability based on system performance or scalability requirements for use.

5.5.3 Consideration of the integrated application scenarios

1. Data sensitivity - Different levels of protection measures are designed according to the different levels of data sensitivity. For example, data involving personal privacy or corporate secrets requires more stringent security controls.
2. User awareness education: enhance users' safety awareness and educate them on compliance with data usage to reduce internal risks.

5.5.4 Match the use of the cloud services

1. Cloud storage and computing utilization: For the use of cloud services for data storage or computing, it should be carefully selected and configured according to the security standards and compliance requirements of cloud service providers.

5.5.5 Strengthen high-quality data management

Guaranteeing information quality (IQ) is essential to data governance, as it ensures the accuracy, integrity, and consistency of data. This is the foundation for achieving a balance between data security and availability.

Through the above multi-dimensional strategy, the security and availability of data can be protected when establishing the data governance structure. It should be noted that these measures are not static but should be tailored to technology developments and business needs to maintain the best balance between data security and availability.

5.6 Assess and determine the sensitivity of the different data

“Assessing and determining the sensitivity of different data is a key step in data governance and compliance management.” Accurate determination of the sensitivity to the data usually involves the following steps:

(Naghib et al., 2023)

5.6.1. Data classification and evaluation

Classified data according to their nature and use, organizations categorize information into different types. These data types may include personally identifiable information (PII), financial records, health information, technical or trade secrets, and more. The evaluation process considers the confidentiality, privacy, and value brought to the individual or organization.

5.6.2. Background of analytical data usage

Deeply analyze the context environment of data flow and use, considering the possible loss after the data is accessed or leaked. For example, healthcare data breaches can have a significant impact on personal privacy and are generally considered to be of higher sensitivity.

5.6.3. Review of laws and regulations

Identify which data categories are specifically protected according to applicable laws, industry standards, and internal strategies. For example, HIPAA regulations have strict requirements on the protection of health-related information.

5.6.4. Establishment of the sensitivity assessment model

A sensitivity assessment model is constructed to quantify the sensitivity of the data. This can be performed based on the sensitivity ratio described in ref, which is quantified by assessing the ratio of the effect of data input changes on output change.

5.6.5. Single-parameter and multi-parameter sensitivity analysis

The sensitivity of the model can be evaluated using a single parameter change (Method 1) and a multiple parameter simultaneous change (Method 2), respectively. For example, changing the sensitivity of a data point as a parameter within a certain range, while keeping the other parameters unchanged, and observing the change in the output. Multiparameter sensitivity analysis considers multiple data points simultaneously to more comprehensively assess possible combinations of sensitivity.

5.6.6. Sensitivity analysis

Sensitivity analysis is conducted by observing the changes caused by adjusting the index value to the comprehensive evaluation score. Then, the influence of different weighted indicators on the data sensitivity is evaluated.

5.6.7. Comprehensive consideration and dynamic adjustment

In practice, the global model should be evaluated with deterministic analysis, combining the sensitivity of variables, and dynamically improving the experimental data dependence terms under model parameters and stimulus level. In other words, the accuracy of the sensitivity assessment is constantly corrected by the actual data.

Through the above steps, a detailed sensitivity evaluation of different types of data can be conducted, and then the corresponding protection measures and processing processes can be determined. This is a process that requires continuous supervision and dynamic adaptation,

as new data types and uses may change over time, and the criteria and divisions of sensitivity need to be adjusted accordingly.

5.7 The sensitivity assessment model to quantify the data sensitivity

“The sensitivity assessment model quantified the sensitivity of the data by using quantitative indicators and analysis methods”. These indicators and methods usually include, but are not limited to, the following aspects:

(Roy et al., 2023)

5.7.1 Measurement of data protection:

The degree of protection obtained by the evaluation model after the application of anonymization or deidentification of the data. This measurement is usually performed with the help of data privacy measures, such as differential privacy measures.

5.7.2 Definition of data sensitivity:

Sensitivity refers to the confidentiality level of data associated with privacy protection. It indicates the degree of privacy, personal information, or value that the data is considered to possess, and the need for strengthened protection. At the same time, the sensitivity of the data can be understood from the perspective of personal experience, involving potential exposure risk, especially when the data may reveal personal or financial information, which will make the individual sensitive to such data.

5.7.3. Impact analysis:

The model calculates the extent of the impact of the loss of data items on users. For users, for example, the loss of a credit card number may be more influential than the loss of a birth date. The sensitivity assessment model will capture the sensitivity of the data through this change.

5.7.4. Data Visibility Assessment:

Visibility is described as how widely the data items become visible in the system (i.e., visibility). This metric assesses the number of individuals who could potentially be compromised following a data breach.

5.7.5. Actual background of the use of the data

To evaluate the background of the data in the actual use, such as data sharing, data analysis, and data mining.

Accordingly, the sensitivity assessment model integrates a variety of quantitative and qualitative indicators, and uses relevant analysis methods, such as difference analysis, influence weight analysis and context analysis, to determine the sensitivity of the data and implement corresponding protection measures accordingly. It should be noted that, due to the lack of unified data classification and control standardization, sensitivity assessment is a process that needs to be customized and continuously iterated according to the specific situation. In practice, this process may require a combination of various techniques and methods for continuous optimization.

6 Analysis of the key challenges of data monetization

6.1 Data Privacy and Security

In the process of optimizing data flow, privacy and security challenges mainly include but are not limited to the following aspects:

6.1.1. Balance security and performance requirements: When designing a data platform, it should ensure compatibility with data flow from existing data processing pipelines (such as storage and computing) and meet its strict performance requirements .”The security and performance of each privacy protection method should be thoroughly evaluated, as there is currently no universally established highly secure and comprehensive solution or platform that can meet all the security requirements for various types of data collection, analysis, and sharing”.

(Zahid et al., 2023)

6.1.2. Privacy compliance with data transformation: The platform needs to support a wide range of existing privacy transformations and allow different transformations to be applied to the same underlying data. Conduct privacy-compliant data transformation for encrypted data to maintain data availability.

6.1.3. Privacy transformation of multi-source data: In addition to supporting the privacy transformation of a single source, it also needs to support the transformation of multiple user data, including summarizing private data for release.

6.1.4. Privacy and utility trade-off of data: The privacy protection model needs to ensure that both privacy is protected and the utility of the data structure is maintained, because modifying the input data should not change the numerical properties of the data.

6.1.5. Considerations of trust level: A key factor when optimizing the privacy protection database built by the scheme is the trust level among users. The level of privacy protection should be determined based on the user's level of trust.

6.1.6. Security and privacy risks of cloud services: The adoption of cloud services for data storage and processing will bring new security and privacy risk challenges, and data owners may lose direct control of the data, resulting in the risk of improper exposure and tampering of data 5.

6.1.7. Challenges of data encryption and decryption: When protecting data privacy, encryption and decryption are effective, but they may reduce the original quality of data during the decryption process.

These challenges come down to data optimization during the data flow.

The balance between security and performance, privacy and utility, and trust and control is at the core of this process.

What current technologies can support data transformation while ensuring privacy compliance?

“Ensuring privacy compliance while transforming the data currently relies on the following technologies”:

(Masilela & Nel, 2021)

- (1) Differential Privacy (DP) is a mathematically accurate privacy protection model. It provides ways for applying random noise to a dataset, making it impossible to determine in most cases whether a single record exists in the dataset. Differential privacy provides a trade-off between privacy protection and data utility, which can be controlled by adjusting the noise level.
- (2) Secure multi-party computing (Secure Multi-party Computation, MPC): This technology allows multiple participants to cooperate to calculate the output of a function on the premise of maintaining their own data privacy. The MPC protects the

data through encryption means, and does not expose the private information of either party during the computing process.

- (3) Homomorphic encryption (Homomorphic Encryption, HE): Homomorphic encryption is a technology that allows the specific calculation of encrypted data, and the calculation results remain in the form of encryption. Through dynamic encryption, data transformation and analysis can be performed without accessing the original data, thus protecting data privacy.
- (4) Federated Learning (Federated Learning): This is a distributed machine learning technology that allows models to be trained locally on the user's device, sending only updated model parameters or gradient information back to the central server for aggregation. The advantage of this approach is that the raw data does not need to leave the local device, thus reducing the risk of privacy leakage.
- (5) Use of privacy metadata in process mining: In order to ensure that the data meets the privacy requirements during the processing process, the concept of privacy metadata is introduced. This involves providing the corresponding privacy metadata in the main anonymous operations, which are able to help understand the processed data while maintaining data privacy.
- (6) Process Mining for Privacy Protection (Privacy-Preserving Process Mining): This is a special technology applied in business process analysis that protects the sensitive data of individuals involved in process execution by anonymizing event logs.

In conclusion, these technologies are each applicable to different scenarios and requirements, and the selection of appropriate technologies or technology combinations should be based on the characteristics of the data, the specific requirements for privacy compliance, and the expected data usage. When applying these technologies, we also need to consider the balance between the level of privacy protection they provide and the data utility.

6.2 Data standardization and interoperability

In order to fully understand the impact of the degree of data standardization and the ability to work together between different systems on data flow, it is essential to consider how these factors interact with each other. Data standardization ensures that information is consistent and easily accessible across various systems, while the ability to work together between systems allows for seamless communication and integration of data. When these two components are optimized, data flow can be efficient and effective, leading to improved decision-making and overall organizational performance. “Therefore, it is crucial to prioritize both data standardization and interoperability in order to maximize the benefits of data flow within an organization”.

(Zahid et al., 2023)

The degree of data standardization and the ability to work together between different systems play a crucial role in the flow of data. These factors have significant effects on data flow.

6.2.1. Data exchange and compatibility: Data standardization ensures the consistency of data format and semantics in different systems, thus reducing the difficulty of data exchange caused by format mismatch. Standardization of data exchange is crucial to improving the ability to work together between systems, helping to ensure that information flows seamlessly through different information systems.

6.2.2. System interoperability: Interoperability between different systems needs to rely on common data and communication standards. At the platform interoperability level, standardized software packages, metadata, and identifiers allow individuals and applications to explore, access, integrate, and analyze data on a single platform, driving the flexibility of the system.

6.2.3. Designing high-level standards and promoting standardization: Implementing high-level data standards is crucial for establishing universal standards. The lack of high-level design will affect the construction of interactive interfaces and communication with external systems, which will have a negative impact on the subsequent stages of simulation and

management. Restricted by the inconsistency of internationalization and localization standards, the goal of interoperability is difficult to achieve.

6.2.4. Data richness - Data standards and interoperability are the foundation of powerful data richness processes. Data richness process The pooling of different data sources and formats depends on the principle of standardization and interoperability, which helps to improve the quality and integrity of data.

6.2.5. The principle of openness: The principle of openness advocates the unimpeded accessibility and availability of data, which is often reflected by complying with the open standards. Improving the standardization of data and enhancing the ability for systems to collaborate contribute to the creation of a collaborative environment. This environment not only promotes standardized and collaborative data work, but also reflects the principle of data openness in practice.

From the above analysis, data standardization and interoperability between systems directly affect the efficiency and effect of data circulation. In the modern information technology and business environment, realizing a high degree of data standardization and strong inter-system collaboration ability is the basic condition to promote flexible and efficient data circulation.

6.3 The common inconsistencies and solutions when integrating multi-source data

‘When integrating multi-source data, it is common to encounter various inconsistency issues. The table below outlines some typical inconsistencies and their respective solutions’:

(liu Qi, 2021)

Inconsistencies	Description	Solution
Data format is	Different data sources use	Implement the data conversion and

Inconsistencies	Description	Solution
inconsistent	different data representations, such as the format of date and time, the representation of numbers and currency, etc.	standardization process, establish the general data format standards, and use the conversion tools or writing scripts to unify the data format.
Repeating data	The same entity is recorded multiple times in different data sources and may contain contradictory information.	Apply data DE-weight techniques such as record links (record linkage) and entity resolution (entity resolution) to identify and merge records representing the same entity.
Missing data	Different data sources often have different information integrity, resulting in missing fields with some data.	Data interpolation techniques such as statistical interpolation, regression, time series analysis or machine learning methods are adopted to speculate and fill in the missing data.
Semantic inconsistency	Even if the data format is the same, different data sources may have different interpretations or meanings for the whiskers' integrated data.	Build ontologies or use control word lists and knowledge maps to resolve differences in meaning with semantic mapping.
Quality of data	Data from different sources may have reliability and accuracy problems, such as some data	Evaluate and score data sources, establish data quality indicators and continuous data cleaning process,

Inconsistencies	Description	Solution
	sources may contain large amounts of error or noise information.	and identify and correct wrong data.
Difference in data update frequency	Different data sources update at an inconsistent frequency, and the integrated information may not be synchronized.	Set the data update policy and timestamp mechanism, identify the data version differences, and update the historical data according to the latest data.
Permissions and Privacy restrictions	Due to regulations and privacy policies, some data may have use restrictions and cannot be merged with other data sources.	Ensure that the data management process complies with legal and regulatory requirements and achieve compliance integration. If necessary, use data desensitization method to protect privacy data.
The field is not clear	Different data sources may use different field names, making it difficult to accurately match the data during integration.	Through metadata management and data governance, a unified field mapping table and data dictionary are established to eliminate ambiguity.

Table 6.1 Rationale for evaluating and optimizing medical information systems

When using the above methods, we usually need to rely on a series of data integration tools and systems, such as data warehouse, data lake, and professional data integration platform. It should be noted that different business scenarios and data features may require different strategies and tools, so before developing specific solutions, the problem should be analyzed

in detail, and the organization's business needs and technical capabilities are adapted and adapted.

7 Data Infrastructure system and capacity building

7.1 Separation of the three data rights

“In the field of data management, the separation of the three data rights is an important governance mechanism. It aims to clarify the ownership, access, and control of the data”. Specifically, this involves the following three aspects:

(Li Gang et al., 2021)

7.1.1. Ownership: refers to the ownership of the data, clarifying which subject (individual, organization, or entity) has legal rights to the data and can license or transfer it.

7.1.2. Right of Use (Usage Rights): determining which person or entity is entitled to use specific data, as well as the purpose and scope of the data usage. This is typically defined in a license agreement that specifies the conditions under which the user can utilize the data.

7.1.3. Control right (Control Rights): refers to the management and decision-making power of data, including data quality, security, storage, processing, and distribution, etc. The control unit is tasked with developing and executing appropriate data policies and procedures to guarantee the uniformity of data governance.

The establishment of the three-rights data separation mechanism helps to handle the relationship between data owners and data users, and solve the problems in privacy protection, data security and data value realization that may occur in the process of data circulation. At the same time, this mechanism promotes transparency and trust in data assets, creating synergies and commercial value for protecting data.

From the perspective of practical application, the separation of the three data rights can create a more balanced and more compliant data sharing model between customers and

insurance service providers. Through rational allocation of logical and physical resources, this is conducive to the establishment of a smooth data flow mechanism and provide high-quality data for accurate risk assessment and decision support system. Especially in the face of technological progress, such as the increasingly widespread application of big data and artificial intelligence in the field of medical insurance, the appropriate data three-rights governance structure can effectively ensure the transparent flow of data, while protecting data privacy and security.

In establishing the governance mechanism of the three rights of data, medical insurance companies need to formulate detailed data policies based on legal, technical and management considerations, and more, covering information security, data privacy protection and compliance requirements. This will ensure the effective implementation of the automated dual-core process, in turn improving the efficiency and service quality of the entire health insurance system.

The implementation of the governance mechanism of data separation in medical insurance companies needs to comprehensively consider multiple aspects such as law, technology and management process. The specific steps can include but are not limited to the following contents:

(1) Analyze the existing laws and policies

First, the existing policies and regulations, such as the HIPAA guidelines, are analyzed to understand the requirements and regulations for the protection of personal health care data. We confirm whether the company's data management method meets the requirements and provide a legal basis for the separation of the three rights.

(2) Define the data rights and interests

According to the description of relevant research results, the rights and interests of personal health and medical information, including the right to know, the right to self-determination, and the right to consult/inquire, are clarified to ensure that these basic rights and interests of users are protected in the process of the separation of the three rights.

(3) Use of advanced technology

Establish a secure, decentralized data management system by utilizing technologies such as blockchain and Privacy computing. The system can effectively prevent unauthorized access, ensure the privacy and credibility of the data, and support a flexible response to multiple use cases.

(4) Formulate detailed authority management rules

According to the HIPAA privacy requirements, it is important to set different access levels for different authorized entities. In addition, it is crucial to establish clear and detailed data access control protocols and usage specifications to ensure compliance with the regulations.

(5) Establish a governance structure

Establish a unified governance structure and responsibility distribution mechanism, clearly stipulate which department or individual assumes ownership, use rights, and control of the data, and define the operational authority and restrictions they have on the data.

(6) Strengthen the compliance of data sharing

To ensure data sharing is conducted ethically, it is crucial to always obtain clear informed consent from the patient, in accordance with their right to know and self-determination.

(7) Integrate data quality management

Implement comprehensive data quality management, focusing on the accuracy, completeness, and timeliness of the data. This includes building strong data collection, storage, processing, and updating processes.

(8) Provide continuous training and support

Provide necessary training and technical support for the employees involved in data processing, so that they can understand the importance and operational specifications of the separation of data rights and three rights.

(9) Regular audits and assessments

Establish a regular audit mechanism to evaluate the effectiveness of the data governance process and ensure that the data separation mechanism can continue to adapt to changes in regulations, technology and business.

Through the above comprehensive strategy, medical insurance companies can better establish the separation governance mechanism of the three data rights, which not only promotes the compliance, transparency and credibility of data, but also provides high-quality data support for decision-making, thus improving the efficiency and effect of the overall business.

When implementing data separation governance mechanisms, medical insurance companies must adhere to specific laws and policies.

- (1) Personal information protection laws stipulate that, for example, the HIPAA Act (Health Insurance Circulation and Liability Act) requires medical insurance companies to ensure privacy protection and data security when processing personal health information.
- (2) Data security legal requirements for data collection, storage, transaction, transmission, reuse, and other links should ensure that data management runs through the entire data life cycle to guarantee stable and orderly data circulation.
- (3) Regulations on privacy protection: When formulating data sharing and opening strategies, it is necessary to protect the privacy rights of the insured, and a privacy risk assessment mechanism should be established according to law, so as to make a systematic and comprehensive assessment of the sharing and opening of medical insurance data and its impact on privacy.
- (4) Data sharing platform standards: establish a data sharing platform that meets the requirements of internal coordination and supervision mechanisms, unifies the data format, and adheres to data sharing and open standards to ensure the efficient and safe circulation of data among all parties.
- (5) Restrictions on the use of third-party data should be implemented by making good use of the protocol restriction mechanism. This will ensure that third-party enterprises

adhere to industry self-discipline when sharing and opening data, and they should not disclose or abuse private data.

- (6) Intelligent supervision and audit: strengthen the comprehensive and dynamic supervision of medical institutions and the insured, improve the application of the intelligent audit system for medical insurance, ensure the use of scientific and reasonable payment methods, and promote the modernization of medical insurance.
- (7) Strengthening of legislative operation: Consider the privacy protection legislation in the context of big data, including special legislation in medical care, medical insurance and other related fields, and make special provisions on the privacy legal issues of data sharing and opening.
- (8) Improvement of judicial protection channels: When the right to privacy is violated, the insured should clearly apply for the channels of judicial protection, so as to enhance the judicial credibility and support the protection of the legitimate rights and interests of the victims.

When implementing the governance mechanism of the three rights of data, medical insurance companies should internalize these laws and policies into the standards and procedures of the company's operation to ensure compliance, efficiency of data utilization, and the security of data privacy.

To ensure that health insurers are in practice complying with the requirements of the HIPAA (Health Insurance Circulation and Liability Act) Act, the following steps may be taken:

1 Development and update of policies and procedures:

- ◆ Develop and maintain comprehensive HIPAA compliance policies and procedures.
- ◆ Ensure that the policy covers all aspects of the HIPAA privacy and security rule requirements.

2 Regular review of policies and procedures is essential to counter changes in technology and regulations. This ongoing process ensures that organizations remain compliant and up-

to-date with the latest advancements in their industry. By regularly assessing and updating policies, businesses can effectively adapt to new challenges and opportunities that arise.

3 Staff training:

- ◆ Provide necessary HIPAA training to all employees, especially those who will process Protected Health Information (PHI).
- ◆ The training includes basic HIPAA requirements, company policies, and how to protect patient information in employees' daily work.

4 Risk assessment and management:

- ◆ Regular security risk assessments are essential to detect potential security vulnerabilities and events that do not meet HIPAA requirements. These assessments help organizations identify and address any weaknesses in their security measures, ensuring compliance with HIPAA regulations and protecting sensitive patient information.
- ◆ Develop corrective measures immediately after risks are identified, assess the potential impact of each risk, and supervise the implementation process to ensure effectiveness.

5 Data access control:

- ◆ Limits access to PHI data, ensuring that only authorized personnel have access to sensitive information.
- ◆ Strong authentication and access management mechanisms.
- ◆ Implementation of information security measures:
- ◆ Implement appropriate physical and technical security measures to prevent unauthorized access, use, or disclosure of PHI.
- ◆ Such as data encryption, firewalls, intrusion monitoring systems, etc.
- ◆ Contract and Business Partner Agreement (BAAs):

It is important to sign business partner agreements with any external service provider that requires access to PHI in order to ensure the protection and confidentiality of sensitive patient information. This agreement outlines the responsibilities and obligations of both parties, including how PHI will be handled, stored, and secured. By having a signed agreement in place, it helps to establish clear guidelines and expectations for how PHI should be managed, reducing the risk of unauthorized access or breaches.

- ◆ Ensure that business partners also comply with HIPAA regulations.
- ◆ Privacy and Security event response plan:
 - ◆ Establish and execute a privacy and security event response plan.
 - ◆ Immediate action must be taken to mitigate losses in the event of an information breach or security incidents and to meet HIPAA reporting requirements.
- ◆ Protection of patient rights:
 - ◆ Protecting patients' rights, such as accessing their own health information, requesting revision information, and receiving instructions on how to share their information.

6 Document preservation and record management:

- ◆ Maintain good management of all HIPAA-related documentation and records to support evidence of compliance.
- ◆ Including training records, policy and procedure documentation, and risk assessment reports.
- ◆ Internal audit and compliance supervision:
 - ◆ There is a dedicated compliance officer or team to oversee HIPAA compliance efforts.
 - ◆ -Regular internal audits to monitor compliance.

In conclusion, health insurers need to establish a multi-faceted HIPAA compliance protection system that constantly evaluates and optimizes various strategies and practices to ensure consistent compliance in a changing business and regulatory environment.

7.2 Multi-level data trading system

“The construction of a multi-level data trading system aims to address the growing complexity of data processing needs and achieve effective management and full utilization of data resources.” The specific reasons for this are as follows:

(Zhang Jiannan et al., 2020)

7.2.1. Support the fusion and integration of multi-source data:

In multi-source heterogeneous data environments, different data sources often contain structured, semi-structured, and unstructured data, which differ in format, standards, and semantics. The multi-level data trading system can provide a unified platform to realize the effective collection and integration of multiple data sources.

7.2.2. Provide data representation with different precision and abstraction levels:

To meet the needs of different users and applications, we need to formulate multiple levels of detail within the same data model, allowing various models and simulation paradigms to coexist. Such a multi-level architecture provides flexibility for users to choose the appropriate model.

7.2.3. Promote data flexibility and innovation in its application:

Multi-level data system can not only improve the utilization of data, but also promote the flexible application of data and service innovation³. The integration of multi-source heterogeneous data is one of the key technologies in the construction of smart cities.

7.2.4. Strengthen data analysis capability and decision support:

By effectively integrating data of different levels, it can provide a more comprehensive and in-depth information basis for complex data analysis and decision support. This is

particularly important in areas such as health insurance, where precise risk assessment and decision-making are key.

7.2.5. Improve the efficiency and quality of data trading:

In the multi-level data trading system, differentiated trading strategies can be designed and implemented for different categories of data according to the sensitivity, quality and usage requirements of the data. This helps to improve the efficiency and quality of data transactions.

7.2.6. Data Security and Privacy Protection:

Considering the different levels of data security and privacy protection requirements, the multi-level data system can better realize data protection and compliance management. For example, different access and authorization policies can be set up for different levels of data to ensure data security.

7.2.7. Support for data governance and compliance requirements:

The governance mechanism of three rights of data needs to clarify the ownership, use right and control of data at different levels. The multi-level data trading system helps to implement this governance mechanism, in line with the requirements of continuously developing laws, regulations and policies.

In short, the construction of a multi-level data trading system is a response to the diversity of data resources, the increasingly refined data application, and strict data governance. This helps to realize sustainable development and maximize the value of data.

The structure of a multi-level data trading system usually includes the following key levels:

1 Data source layer

2 Raw data layer: This layer contains a variety of raw data sources, including internal enterprise databases, data collected by Internet of Things devices, third-party data providers, and data in cloud storage.

Data cleaning and preprocessing involve preliminary processing of raw data, including cleaning, conversion, and integration, so that the data can be used at subsequent levels.

3 Data integration layer

Data warehouse / lake: It stores cleaned and transformed structured and unstructured data to provide a unified storage solution for analysis and transactions.

In order to conduct deeper data integration, possibly including data desensitization and processing, and to form a data mart that provides standardized data products for the market, the data center needs to be optimized.

4 Trading layer

- ◆ Market mechanism: It provides a platform so that buyers and sellers can trade based on data products and services, possibly including auction, bidding and fixed prices.
- ◆ Transaction supervision: ensure the legality and compliance of data transactions, and monitor data quality and transaction security.

5 Application service layer

- ◆ Data commodification: Packaging data into data products suitable for specific industries or scenarios, such as analysis reports or prediction models in finance, healthcare, marketing and other fields.
- ◆ Data application development: Develop data-driven commercial applications, including analytical tools, decision support systems, etc.

6 User interface layer

- ◆ Portal / application * *: Provide an interface for users to access and purchase data products, as well as provide feedback on their experience.
- ◆ API services allow machines and systems to interact with and access data products, facilitating automation and efficiency.

7 Management and supervision layer

- ◆ Data governance is essential for managing and reviewing the entire data trading system, including aspects such as data quality, data security, and privacy protection.
- ◆ Policy and compliance: Ensure that the data trading system complies with relevant laws and regulations and implements policies to guide the rational use of data.

On the whole, the multi-level data trading system connects the sources, processing, transaction, application, and management of data through a clear hierarchical division, forming a set of complete architecture. In this architecture, all levels depend on, support, and complement each other to ensure the efficient operation of the data value chain and the smooth data flow.

7.3: Data infrastructure construction

‘The infrastructure construction methods and paths of data circulation and transaction need to be closely combined with the requirements of current technological progress and laws and regulations’. Here are the detailed methods and paths:

(LiuJiajing &zheng jianming, 2022)

7.3.1. Legislative guarantee and system design:

- ◆ Formulate and improve the laws and regulations required for data circulation exchanges, such as referring to the Cyber Security Law of the People's Republic of China, the Data Safety Law and the Personal Information Protection Law.
- ◆ Legislative limitations and institutional designs for addressing privacy and security issues that may arise during the circulation and transaction of data.

7.3.2. Development of technical standards and specifications:

Develop uniform data standards and technical specifications to promote connectivity between facilities of different owners. This will ensure seamless communication and interoperability, ultimately improving efficiency and collaboration across the industry.

Customize the technical specifications for data classification, encryption, storage, and transmission based on the nature of the data to ensure optimal security measures are in place.

3. Data management system construction:

- ◆ Build a data trading platform with functions for data compliance, dealmaking, trading regulation, asset pricing, and dispute arbitration.
- ◆ Deploy a modern data management system to ensure the quality and traceability of data during circulation and transaction.

7.3.4. Construction of technical facilities:

The construction of software and software facilities for efficient data collection, storage, transmission, and processing is essential for modern businesses to stay competitive in today's digital landscape. By implementing robust software solutions, organizations can streamline their operations, improve decision-making processes, and enhance overall productivity. Additionally, these tools enable companies to effectively manage and analyze large volumes of data, leading to valuable insights and strategic advantages. In conclusion, investing in software development is crucial for companies looking to thrive in the digital age.

Continuously upgrade and maintain facilities to maintain efficient data processing and rapid response to new requirements is essential for staying competitive in today's fast-paced business environment. By investing in the latest technology and regularly updating our systems, we can ensure that we are able to adapt quickly to changing demands and provide the best possible service to our customers.

7.3.5. Data security and privacy protection measures:

- ◆ Implement strict data access and control strategies, and establish corresponding security protection measures for different levels of data.
- ◆ Develop and utilize advanced privacy protection technologies, such as anonymization and controllable sharing technologies, to ensure the security of privacy data in transactions.

7.3.6. The improvement of the Internet infrastructure:

- ◆ Strengthen the construction of network infrastructure and increase the capacity for big data transmission and processing.
- ◆ Optimize the geographical distribution and interconnection structure of data centers to achieve more efficient data trading and circulation.

7.3.7. Funds and policy support:

- ◆ Use the leverage of policy and funds to encourage and guide the construction and optimization of data infrastructure.
- ◆ Explore a variety of financing models to ensure ongoing financial support for the development of data infrastructure.

7.3.8. Professional talent training:

Develop skilled professionals with expertise in data governance, data analysis, and system maintenance.

To strengthen the professional ethics and legal responsibility education of employees is essential in order to improve the professional service level of the whole industry. This will ensure that employees are aware of their ethical obligations and legal responsibilities, ultimately leading to a higher standard of service delivery across the industry.

7.3.9. Attempt and innovation of market operation:

- ◆ Explore the operation mode of data circulation and transaction monetization while ensuring compliance and security.
- ◆ Encourage companies to conduct data leases to protect ownership of original data from infringement.

Through the above paths and methods, combined with the means of legislative guarantee, system construction, technological innovation and market operation, it can lay a solid infrastructure for data circulation and transaction, and ensure the reliability and security of

data in the transaction process. This can not only promote the overall circulation of data in society, but also stimulate the maximum value of data.

The infrastructure construction methods and paths of data circulation and transaction need to be closely combined with the requirements of current technological progress and laws and regulations.

Here are the detailed methods and paths:

1. Legislative guarantee and system design:

- ◆ Formulate and improve the laws and regulations required for data circulation exchanges, such as referring to the Cyber Security Law of the People's Republic of China, the Data Safety Law and the Personal Information Protection Law.
- ◆ Legislative limitations and institutional designs for addressing privacy and security issues that may arise during the circulation and transaction of data.

2. Development of technical standards and specifications:

Develop uniform data standards and technical specifications to promote connectivity between facilities of different owners. This will ensure seamless communication and interoperability, ultimately improving efficiency and collaboration across the industry.

Customize the technical specifications for data classification, encryption, storage, and transmission based on the nature of the data to ensure optimal security measures are in place.

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- ◆ Develop and utilize advanced privacy protection technologies, such as anonymization and controllable sharing technologies, to ensure the security of privacy data in transactions.

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- ◆ Strengthen the construction of network infrastructure and increase the capacity for big data transmission and processing.
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- ◆ Use the leverage of policy and funds to encourage and guide the construction and optimization of data infrastructure.
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To strengthen the professional ethics and legal responsibility education of employees is essential in order to improve the professional service level of the whole industry. This will ensure that employees are aware of their ethical obligations and legal responsibilities, ultimately leading to a higher standard of service delivery across the industry.

9. Attempt and innovation of market operation:

- ◆ On the premise of ensuring compliance and security, explore the operation mode of data circulation and transaction marketization.
- ◆ Encourage companies to conduct data leases to protect ownership of original data from infringement.

Through the above paths and methods, combined with the means of legislative guarantee, system construction, technological innovation and market operation, it can lay a solid infrastructure for data circulation and transaction, and ensure the reliability and security of data in the transaction process. This can not only promote the overall circulation of data in society, but also stimulate the maximum value of data.

The challenges of implementing the legislative guarantees of data circulation and transactions mainly include:

- ◆ Deficiencies of legal provisions: The current legal regulation system of data transaction is not perfect. The legislation is blank, the content is vague, or too abstract, which cannot solve the multiple value conflicts behind data transaction and restricts the in-depth development of the market.
- ◆ Basic principles of rights protection: An important issue in current legislation is how to construct legal rules of data transaction in line with the protection of human rights, especially to adhere to the personal dignity and privacy rights of individuals in the information society.
- ◆ Challenges in establishing data security regulations include: the new legislative environment making it more difficult to collect and share data between institutions,

especially when sensitive data is involved. This will force the data to exist in isolated data islands maintained by the data owners.

- ◆ Unclear trading platforms and rules: Domestic established data exchanges have problems such as unclear platform positioning, excessive rules, lack of unified standards, and insufficient legal status and safeguard measures. These issues lead to operational difficulties.
- ◆ Insufficient interpretation of laws and regulations: Although there are major transaction categories such as data ownership, use right, and usufruct, laws and regulations do not further explain these transaction categories, which cannot provide normative support for data transactions.
- ◆ Unclear object and quality standards: The data transaction object and its quality standards are not clear. This leads to the generalized transaction of data that do not meet technical standards, threatening personal privacy, trade secrets, and national security.
- ◆ Complexity and incentive mechanism of data pricing: Solving the difficult problem of reasonably pricing, distributing the interests of all participants in the transaction process, and forming a long-term incentive mechanism.

The legal status of data exchanges has not been officially recognized. The lack of formal recognition of the legal status of big data exchanges results in the low and repetitive construction of the exchange level, chaotic order, and the failure of the role of self-supervision.

As mentioned above, the implementation of data circulation and transaction legislation guarantee needs to be coordinated from the system, technology, management and other aspects, to establish a data governance system in line with international standards, and to create a corresponding legal framework and market environment.

Under the current legislative environment, the strategies to solve the problem of data pricing and distribution and promote the enthusiasm of market participants can be started from the following aspects: (Taipalus et al., 2023)

1. Clear data ownership:

Determine the ownership of the data, clarify the data ownership, and provide a legal basis for the data transactions. This helps to protect the interests of data providers and increase their willingness to participate in data market transactions.

2. Institutionalized data pricing mechanism:

Establish an officially recognized data pricing mechanism to ensure the rationality and fairness of data pricing, ensure the market subjects' right to know the data content and transaction subject, and form the market price on the basis of risk and benefit measurement.

3. Construction of incentive pricing mechanism:

By utilizing model pricing mechanisms, such as model contribution-based pricing (Dealer), data owners can receive reasonable returns based on their data contribution to the model. This approach aims to motivate more data contribution.

4. Market-oriented operation:

Adopt market mechanisms such as the auction model, allow market participants to independently evaluate the value of data, submit corresponding bids, and establish data prices through free market competition.

5. Transparent trading platform:

Build an open and transparent data trading platform, provide visualization of the transaction process, open trading rules, ensure fair and transparent trading, and enhance market activity.

Considering the above measures, a reasonable and efficient data pricing and distribution mechanism is constructed through the combination of policy guidance and market self-discipline, which can effectively enhance the participation enthusiasm of market subjects and promote the healthy development of the data circulation and trading market.

7.4 Data Convergence

In the convergence of data from different sources, the common challenges and the corresponding solutions can be summarized as follows, (Mayunhe & Xushuhan, 2023)

Challenges	Solution
Data access and abstract modeling	The data is extracted from established data sources by providing functions of abstraction and data operations.
Data quality is inconsistent with the format	Design automatic data conversion methods, promote the research of mode matching, entity resolution and other technologies, and reduce the infeasibility of manual conversion and integration.
Entity recognition and linking	Investigate the entity resolution problem, which identifies and links to multiple data records corresponding to the same entity.
Data fusion and weight	Adopt efficient data fusion technology to ensure that data is not repeated and improve the accuracy and availability of data.
Technology evolution and update	With the evolution of the technology, the modern mathematical logic and computational model are applied to solve the challenges in the data integration problem space one by one.
Data security and privacy protection	Establish strict data access and control strategies, and apply encryption technology to protect the security of data during transmission and storage.
Large-scale data processing	Use cloud computing and distributed technologies to improve data processing capabilities and address the challenges of large capacity and complex databases.

Table 7.1 Challenges and the corresponding solutions in Data Convergence

Specifically, to address the challenges of data access and abstract modeling, interfaces and middleware that are compatible with various data sources are developed to ensure that data

can be integrated smoothly. Problems arising from data quality differences usually rely on data cleaning, format standardization, data completion or interpolation techniques.

The solution to entity resolution problems requires a combination of technologies, including but not limited to natural language processing, semantic analysis, machine learning, and other methods to identify and associate entities.

Technically speaking, with the improvement of computing power and the development of new algorithms, data processing can be more automated and intelligent. In addition, it is also crucial to keep the technology updated and follow the latest research trends.

Data security and privacy protection are crucial aspects of data convergence. Strict policies, technical solutions, and legal regulations are implemented to ensure the compliance and security of data. In terms of large-scale data processing, it focuses more on the scalability and stability of systems and platforms. Through the above measures, the effective circulation and reasonable and safe use of data can be promoted under the existing legislative environment.

When dealing with formatting inconsistencies from different data sources, we can take the following steps:

7.4.1. Data abstraction and preprocessing:

First, we need to abstract the data, including extracting the data into a certain unified form of intermediate representation. At this stage, various preprocessing methods such as data cleaning, unified coding standards, time zone conversion, and unit conversion can be applied to reduce the impact of inconsistent data formats.

7.4.2. Mode matching and integration:

Due to the different structures and formats of different data sources, pattern matching is needed to determine the correspondence between the same entities or concepts in different data sources. On this basis, integration schemes are designed to merge or fuse these data, dealing with problems such as name space incompatibility, inconsistency and uncertainty that may occur from the data incorporated into the same framework.

7.4.3. Build a unified data model:

In some cases, there may be no clear pattern (schema) for data from different sources, and a standardized or universal data model needs to be built to accommodate these data and ensure that all data can be represented and stored in a consistent format.

7.4.4. High-quality data assurance:

In order to ensure the quality of integrated data, it is necessary to check and process data consistency and identify and eliminate duplicate data. After completing these steps, the data will be presented in a more consistent and understandable pattern for easy analysis and application.

7.4.5. Application of the query system:

For large-scale data resources, query-based systems can be used to provide targeted data extraction in the integration process, so as to avoid overall data compression or transformation. This approach helps analysts or scientists to extract only subsets of data related to their specific problems, while greatly reducing time consumption and operational complexity.

7.4.6. Transformation of data form:

Different data sources may provide different forms of information. For example, individual data is raw data at the individual level, while others consist of analyzed aggregated data. In this case, it is necessary to flexibly choose the integration methods suitable for different data forms, and to guide the subsequent reasoning and analysis work according to these methods.

In general, the progress of algorithms and tools provides a practical technical means to handle the problem of inconsistent formats of data from different sources while promoting the effective circulation and rational and safe utilization of data in the existing legislative environment. Through the above steps, we can strengthen the integration and collaboration between different data sources to improve the quality of data integration and support advanced data-based analysis and decision making.

7.5 Data Circulation

To build an efficient data element flow system, the main steps are as follows:

(LiuJiajing &zheng jianming, 2022)

7.5.1. Establishment of the right confirmation mechanism:

Clarify the ownership and function of data elements, including ownership, use right, right of users, and management right. This is essential for facilitating data circulation and transactions. The establishment of the right confirmation mechanism is the basis of building the data circulation system, and provides legal guarantee for the subsequent value evaluation, transaction and distribution.

7.5.2. Data pricing system:

Price formulation, change, management, and supervision of data should be done scientifically and reasonably. The pricing mechanism needs to be scientifically evaluated in multiple dimensions, such as data scarcity, practicability, generating cost, and potential value. Reasonable data pricing is the key link to activate the data value and promote the circulation of data elements.

7.5.3. Data trading mechanism:

Establish and improve the data trading mechanism from the dimensions of laws and regulations, mechanism design, platform construction and operation management. It includes ensuring the compliance of data transactions, making them transparent trading processes, and developing clear trading rules and standards to facilitate the effective flow and trading of data.

7.5.4. Data circulation management system:

By establishing data circulation access principles, implementing a data element circulation management system, identifying data element circulation, setting cross-border circulation rules for data elements, data sources can ensure legal data, privacy protection, adherence to circulation and transaction norms, and promote efficient data element circulation.

7.5.5. Interoperability standards and industry specifications:

To achieve seamless data interoperability, it is essential to develop unified standards encompassing API technology architecture, data format, encryption, and authentication.

These standards will help minimize discrepancies among various data sources and facilitate easier data sharing. Furthermore, industry norms should be established to ensure that market entities adhere to unified operating procedures and standards.

7.5.6. Data security governance system:

To improve data supervision, establish a data security subsystem, maintain data security, and enhance privacy protection measures. This should involve implementing data encryption, access control, monitoring data, and preventing leaks.

7.5.7. Platform construction of data circulation and trading:

We need to build a special data circulation and trading platform as an intermediary for data asset exchange between buyers and sellers. An excellent platform should provide data asset directory, deal making, online payment, digital contract signing and other functions, and ensure the security and convenience of the transaction process.

The above steps also need to be closely coordinated to form a systematic solution, in order to realize the efficient operation of the data element circulation and trading system in reality, and actively support the development of the digital economy on this basis.

7.6 Data application

The construction steps of the data application system include:

(Rezig et al., 2021)

7.6.1 Determine the data application objectives and requirements:

First of all, the business objectives and user needs of the data application system construction should be clearly defined, which is the starting point of the whole construction.

7.6.2 Selection of data sources:

In the initial stage of construction, appropriate data sources should be selected to ensure the contribution of data quality and quantity to the final goal.

7.6.3 Data warehouse construction:

Build a data warehouse according to the capabilities. This step includes data collection, storage and management, as well as ensuring the security and privacy of the data.

7.6.4 Data cleaning and preprocessing:

Preprocessing operations such as cleaning, standardization and conversion of raw data to improve data quality and provide preparation for analysis and application.

7.6.5 Definition of data integration and analysis model:

Integrate data from different sources across systems, and define a reasonable analysis model suitable for mining algorithm.

7.6.6 Data mining and algorithm selection:

Mine out useful information from the converted data and find a suitable data mining algorithm.

7.6.7 Visualization of analysis results:

Use visualization technology to analyze data mining results to help users understand data patterns and trends.

7.6.8 Knowledge integration and process adjustment:

Integrate the knowledge of the analysis results into each application scenarios of the enterprise, adjust the workflow, product quality traceability and business system, and realize the comprehensive value of data.

In conclusion, the construction of the data application system is a circular feedback process starting from the data source to the end of the application integration, which needs to be constantly adjusted and optimized to ensure that the data can provide strong support for decision-making. In the theoretical research and practical operation, each step needs to be carefully handled, to ensure the efficiency and accuracy of the data application.

7.7 Data Operation

In the construction of the public data operation system, the steps need to be systematic and specific to the implementation level. The building steps listed below are detailed planning at all levels, from macro-policy formulation to micro-implementation:

Step	Content
Establishment of a data collection system	A public data collection system based on data supply shall be established, which includes the collection, storage, classification, registration and quality management.
Construction of the operation management and supervision system	Formulate operation management supervision system and data security guarantee system, focusing on solving the problems of operation subject attributes, operation procedure design, boundary demarcation and business boundaries, distribution of obligation rights and responsibilities, and safety management.
Data requirements delivery management system	Build the management system of data demand delivery, focusing on the rules of data value evaluation, data product delivery and income distribution, to promote the circulation of data transactions.
The establishment of the effect evaluation system	The evaluation system of public data operation effect is constructed by the competent department of public data operation to evaluate the effectiveness of data operation.
Construction of data open utilization system	Create an open utilization system that includes open utilization environment, data open subject, public data open utilization platform (data management, data service layer, communication and interaction layer), target data users, public value evaluation and other elements.
Stratification of the authorized operating	The data authorization model of hierarchical classification is proposed, which includes many aspects, such as how to authorize,

Step	Content
mechanism	the scope of authorization and the supervision after authorization. ³
Data source activation mechanism	Establish a continuous rolling data source activation mechanism to ensure the real-time nature and effectiveness of the data.
Data pooling mechanism	Design a cross-level and cross-region data coordination mechanism to ensure the effectiveness of data sharing and collaboration.
Data revenue distribution mechanism	Implement the data income distribution mechanism of comprehensive regulation to ensure the reasonable distribution of benefits among all participants.
Data operation supervision mechanism	Implement the data operation supervision mechanism of collaborative governance, maintain the market order, and ensure the safe, fair and public welfare use of the data.

Table 7.2 Data Operation

The above steps constitute the basic framework of the construction of the public data operation system. Each step requires specific policy support, technical implementation and management operations to ensure that the data operation system can operate in an orderly and efficient manner, and continuously optimize and improve in this process, so as to finally realize the maximum value of the public data.

In order to ensure the balance and reasonable distribution of the interests of all participants in the public data operation system, it is necessary to build a comprehensive management system and mechanism, and clarify the rights, obligations and interests of all parties.

Specific measures include:

7.7.1. Clear rights and responsibilities

The "rights, responsibilities and interests" of each subject, such as the data provider, the data operator, the data user, and the government data authorization operation and management agency, should be clearly defined. Standardize the management rights, the scope and standards of data provision, and the avoidance of problems such as excessive data management, so as to clarify the rights and responsibilities of all parties and protect the legitimate interests.

7.7.2. Equity principle

Ensure fair access to public data and prevent unfair kidnapping and reliance on data source units 2. Establish a reasonable data authorization and license to ensure the fair flow of data among different subjects.

7.7.3. Reasonable pricing and sharing

Data pricing and revenue distribution through the market mechanism to ensure that the use value of the data is reasonably returned. For the public data, the income distribution mechanism should take into account the public interest.

7.7.4. Transparent operation

By establishing relevant systems such as the data demand delivery management system and the effect evaluation system, the transparency of data operation is increased. This provides an institutional guarantee for fairness.

7.7.5. Data authorization mechanism

Establish a hierarchical data authorization model with different levels of data to accommodate sensitivity and usage requirements, and ensure that post-authorization supervision is in place.

7.7.6. Safety assurance

Drawing on the existing model for defining data property rights, we can enhance security, fairness, and public welfare protection of data. This will help in fostering a standardized market for public data elements.

7.7.7. Cross-border Collaboration

Promote the cross-level and cross-regional data coordination mechanism to ensure efficient collaboration and data sharing among different subjects. This will help promote global optimization and resource integration.

7.7.8. Regulatory mechanism

Design and implement the data operation supervision mechanism for collaborative governance, ensuring the order of the data operation market, balancing the rights and interests of all parties, and promoting the healthy development of data resources.

To sum up, it is a systematic project to ensure the balance and reasonable distribution of the rights and interests of all participants in the public data operation system. It involves many areas, from policy, regulation formulation to technology and management implementation. Through the collaborative work at all levels, it can protect individual interests while serving the public good, and promote the efficient utilization and sustainable development of public data resources.

7.8 Data Security

It is essential to implement system engineering to establish a data security strategy in data operations. This strategy should be built on a framework that considers both technology and management aspects. The primary objective of a data security policy is to guarantee that data is adequately safeguarded throughout its life cycle, thereby preventing unauthorized access and data leakage. (Zahid et al., 2023)

Here are specific measures for the data security policy:

Step	Control measures	Specify
Risk analysis	Regular comprehensive analysis of the security risks of data, covering data collection, transmission, storage, use, sharing and destruction of all	Identify potential risks to provide the basis for subsequent technical and management measures.

Step	Control measures	Specify
	links.	
Access control	Implement strong access control mechanisms that precisely define who can access the data under what conditions.	Controls the obtaining and modifying privileges of the data to prevent unauthorized access.
Security transmission protocol	Use a secure communication protocol for data transmission to ensure data integrity and protection against unauthorized interception or tampering.	Encrypt data transmission to make the data movement process safe and reliable.
Data encryption	Use encryption techniques for both static and transmitted data.	Protect the data from being read or tampered with by the unauthorized visitors.
Data Backup and Recovery	Implement secure data backup and recovery procedures.	The guarantee is that the data can be quickly recovered after loss or damage.
Security audit	Regular audits of the data infrastructure and checks for potential security vulnerabilities.	Find and fix security issues in the system.
Security policy implementation	Develop and enforce security policies and regulations within the organization to ensure compliance with relevant data protection laws and standards.	Ensure that the data processing activities within the organization comply with the regulations.

Step	Control measures	Specify
Data sensitivity classification	Combined with different data sensitivity levels for classification management, to achieve the use of authority control of sensitive data.	Different levels of protection were used for different data, ensuring on-demand desensitization.
Data monitoring and auditing	Establish mechanisms for data monitoring, data audit, and risk assessment.	Monitor the data security through a combination of routine and irregular methods.
Data security management system	Develop an integrated data security management system that combines data account management, access control, data storage, and security audit.	Realize the actual workflow of data security management, and ensure the overall management consistency.
Data exchange control	Exchange control and ownership identification are used in the data exchange stage.	Maintain the legitimacy and integrity of high security level data and core value data.

Table 7.3 Specific measures for the data security policy

Considering the above measures, the safety management of the data operation process can be realized, including the prevention of existing risks and response to post-accidents. These strategies should be based on the value and risk of data, target data security at multiple levels, and be updated in accordance with current legal provisions and standards. Through this multi-dimensional and dynamic management method, we can effectively respond to and manage the possible security threats in the data operation.

8 Data Asset Valuation and Value Realization

Data assets refer to the process in which the data assets that meet the conditions of asset recognition are accounted for in accordance with certain accounting standards, and are presented and disclosed in the financial statements of the enterprise. The steps of data assets can be summarized in the following stages: (Tan et al., 2022)

Identification and evaluation of data resources: First of all, enterprises need to identify the data resources they have and evaluate whether they have the conditions to become data assets. This includes a comprehensive assessment of data quality, value, availability, and relevance. If the enterprise has not yet established the information system, then the conditions of data assets are not mature, and the information construction must be completed firstly.

Establishment of data governance and management system: After confirming that data resources have the potential to become data assets, enterprises need to establish or improve the data governance and management system to ensure the effective management and utilization of data. DCMM (Data Management Maturity Model) and DAMA (Data Asset Management Framework) can be used to evaluate and improve data management capabilities.

Assets are initially recorded in the table. Next, data resources that comply with accounting standards can be added to the table as original assets. This step is crucial in managing data assets, ensuring they are reported and disclosed using the actual cost method as outlined in the Interim Provisions.

Formation of intangible asset income: With the use and transaction of data assets, it can bring intangible asset income to enterprises. These revenues reflect the economic value of the data assets in the market.

Formation of stock assets: Finally, data assets, as the stock assets of enterprises, need to be continuously tracked and managed in the financial statements. This includes accounts

receivable, other receivables and intangible assets, which are all important parts of the stock assets of enterprises.

Through the above steps, enterprises can transform data resources into assets in the accounting sense, so as to reflect their value in the financial statements, and bring potential economic benefits to the enterprise. In the whole process, enterprises need to pay attention to the key links such as the evaluation, management and accounting processing of data assets to ensure the effective use and compliance of data assets.

8.1 Strategy for Introducing Data Assets into the Table

In order to realize the embodiment of data assets in accounting and finance, it is essential to first identify the relevant data sources and ensure their accuracy and reliability. Once the data sources have been established, it is important to analyze and interpret the data to extract valuable insights that can inform decision-making processes. Additionally, implementing data governance practices and utilizing advanced technologies such as data analytics and artificial intelligence can help optimize the management and utilization of data assets in accounting and finance. By integrating data assets effectively into financial reporting and analysis, organizations can enhance their strategic planning and performance evaluation capabilities. (Laval et al., 2023)

The data assets included in the table represent the data resources of the enterprise that are reflected in the financial statements to show the input and income of the enterprise in the data elements. In order for enterprises to incorporate the data assets into the table, they must meet certain conditions and follow a specific path.

We are committed to adding value to state-owned data assets through our extensive experience in data exploration over nearly 20 years. We have summarized the data assets using a method called the 'Six entry table'.

Validation of data assets: Enterprises must organize and validate their data resources, clearly identifying which data meet the criteria to be considered assets. This encompasses data produced internally by the enterprise as well as data acquired from external sources.

Understand the asset definition: Companies must demonstrate ownership or control over data resources in order to include them in their financial statements and anticipate deriving economic benefits from them for a specific period in the future. This may require demonstrating control rights and the right to use the data through contracts, authorizations, etc.

Determine the measurement method of data assets. The enterprise needs to determine the appropriate measurement method according to the characteristics of the data and the economic benefits brought to the enterprise. This may include the original cost method, depreciation method, fair value method, etc.

Formulate accounting policies: Enterprises need to formulate corresponding accounting policies to standardize the accounting treatment methods of data assets. This includes initial recognition, subsequent measurement, impairment testing, and termination recognition of data assets.

Preparation of financial statements: Enterprises need to incorporate data assets into their financial statements according to accounting policies and relevant standards. They must properly classify and measure these assets along with other assets, liabilities, and equity items. This process may include preparing financial statements like the balance sheet, income statement, and cash flow statement.

Disclosure of related information: Enterprises need to disclose information related to data assets in their financial statements, including the category, quantity, value, source of data assets and the impact on the business performance of enterprises, etc. This will help to improve the transparency and comparability of the financial statements.

In short, the inclusion of data assets is a complex process, which requires enterprises to fully understand their own data resources, meet the definition of assets, and carry out appropriate accounting treatment in accordance with accounting standards and policies. This will help improve the quality and transparency of corporate financial statements, and provide stronger support for corporate financing and investor decision-making.

By building a big data asset circulation and trading service platform, we can promote the development of China's big data industry and maximize the value of data. Through the data assets entry path described above, we can assist enterprises in conducting data governance

to transform data resources into data products and prepare data assets for entry into the market.

8.2 Data Asset Ownership Confirmation

(Liu Qi, 2021)

To build an efficient data element flow system, the main steps are as follows:

8.2.1. Establishment of the right confirmation mechanism

Clarify the ownership and function of the ownership, use right, right of access, and management right of data elements. This is the primary premise of data circulation and transaction. The establishment of the right confirmation mechanism is the basis of building the data circulation system, and provides legal guarantee for the subsequent value evaluation, transaction and distribution.

8.2.2. Data pricing system

Price formulation, change, management, and supervision of data should be done scientifically and reasonably. The pricing mechanism needs to be scientifically evaluated in multiple dimensions, such as data scarcity, practicability, generating cost, and potential value. Reasonable data pricing is the key link to activate the data value and promote the circulation of data elements.

8.2.3. Data trading mechanism

Establish and improve the data trading mechanism from the dimensions of laws and regulations, mechanism design, platform construction and operation management. It includes ensuring the compliance of data transactions, making them transparent trading processes, and developing clear trading rules and standards to facilitate the effective flow and trading of data.

8.2.4. Data circulation management system

By establishing data circulation access principles, implementing a data element circulation management system, identifying data element circulation, setting cross-border circulation

rules for data elements, data sources can ensure legal data, privacy protection, adherence to circulation and transaction norms, and facilitate the efficient circulation of data elements.

8.2.5. Interoperability standards and industry specifications:

To achieve this goal, it is essential to develop unified data interoperability standards that encompass API technology architecture, data format, encryption, and authentication. These standards will help reduce discrepancies between various data sources and facilitate seamless data sharing. Furthermore, industry norms should be established to ensure that market entities adhere to unified operating procedures and standards.

8.2.6. Data security governance system:

To improve data supervision, establish a data security subsystem, maintain data security, and enhance privacy protection measures. This should involve implementing data encryption, access control, data monitoring, and leak prevention.

8.2.7. Platform construction of data circulation and trading:

We need to build a special data circulation and trading platform as an intermediary for data asset exchange between buyers and sellers. An excellent platform should provide data asset directory, deal-making, online payment, digital contract signing and other functions, and ensure the security and convenience of the transaction process.

The above steps also need to be closely coordinated to form a systematic solution, in order to realize the efficient operation of the data element circulation and trading system in reality, and actively support the development of the digital economy on this basis.

8.3 Data Asset Valuation Model

“In designing a data asset value evaluation model suitable for medical insurance companies, the key elements that usually need to be considered include data use frequency, breadth, shared circulation range, data consistency, standardization and integrity”. Based on the characteristics and needs of medical insurance companies, it is recommended to use the following model for the value evaluation of data assets:

(LiuJiajing &zheng jianming, 2022)

8.3.1. Income method

The income method is an evaluation method based on the principle of expectation. It estimates the contribution of data assets to future cash flow and is applicable to scenario 2. In this scenario, the health insurance industry expects data assets to bring clear returns. Specifically, expected returns can be estimated by analyzing the contribution of different decision data sources (such as electronic health records, drug consumption records, etc.) to decision-making process improvement, risk control, and customer service improvement. The value of data assets can be evaluated based on this analysis.

8.3.2. Cost method

When the expected benefit is difficult to specify, the cost method can be used. This method evaluates the cost of reset data assets and corrects it for the expected use period and recovery of cost investments 2. Health insurance companies can consider the direct and indirect expenditures resulting from data acquisition, cleaning, storage, and analysis as the value of data assets.

8.3.3. Market law

Market law assumes that similar assets can be traded in an open market and uses such transactions as a value reference. In the health insurance sector, the market price of similar data products may be used as the basis for valuation.

Based on the above approach, the following is an example of a simplified model:

8.3.4 Income method:

- ◆ Determine the expected cash flow from data assets.
- ◆ Analyze the potential risks and uncertainties associated with the data assets.
- ◆ Choose the right discount rate.
- ◆ Calculate the net present value of the data assets.

8.3.5 Cost method:

- ◆ Estimate the cost of resetting data assets.

- ◆ Consider the value of the reduction due to loss of use.
- ◆ Add the influence factor to modify the asset value.

8.3.5 Market method:

Involves the analysis of similar data assets in the market transaction prices. This helps in determining the value of the asset in question. Adjust for data asset specificity factors when determining the pricing of data assets.

In practical application, the above three evaluation methods can be combined to weigh according to the specific situation, so as to ensure the accuracy and rationality of the data asset value evaluation. In addition, factors including data scarcity, quality and uniqueness of data can also be considered to correct the final valuation results.

When using the cost method to estimate the cost of reset data assets, the following steps should be taken to ensure the accuracy of the assessment:

1. Determine the replacement cost

Reset cost is the current cost needed to rebuild the data asset from scratch. All direct and indirect costs associated with the establishment of new data assets at the same level should be considered. It specifically includes the cost of data acquisition, data processing, and data mining.

2. Calculate the construction cost

Including depreciation and amortization expenses for data collection, data processing, software development, and hardware purchase, etc.

3. Operation and maintenance costs:

Determine the operational and maintenance expenses needed to sustain the data asset's operation for the upcoming period. Operating costs encompass data storage, data maintenance, and other related expenses.

4. Management cost

Including labor costs and indirect costs such as management salaries, equipment depreciation, and office facilities.

5. Depreciation and depreciation

Deduct depreciation due to use and technology obsolescence. The depreciation can be calculated based on the corresponding depreciation method and life expectancy.

6. Use of premium considerations

If an existing data asset exceeds the general market value due to some unique value, the expected use premium may need to be added to the replacement cost.

7. Return on investment and data utility

The expected return on investment (R) and utility of data (U) need to be estimated and included in the total cost to correct the asset value.

8. Select the cost summary period

Compare the length of time based on the revenue statements of the relevant assets between the period from the data business to the appraisal and the 5 years following the appraisal. Select the shorter period as the cost summary period.

9. Final valuation

Add the costs from the above steps to obtain the total cost of replacing the data asset. The final valuation may also take into account the impact of market demand, technological advances, and other macroeconomic factors.

Through such a detailed and systematic calculation process, the cost of reset data assets can be estimated more accurately, and provide a more reliable basis for the value evaluation of data assets. In practical application, it is necessary to hire professional appraisers to refine and adjust the evaluation model according to the specific situation.

8.4 Strategies to maximize data value

This paper proposes optimization measures based on the DeLone & McLean model to maximize the value of data assets.

In the context of the DeLone & McLean model, the following aspects can be considered for optimizing measures to maximize the value of data assets:

8.4.1. Information quality

Improving the quality of data assets is the basis for ensuring their maximum value. Information quality includes the accuracy, completeness, timeliness, and relevance of the data. In order to ensure timely data updates that are closely aligned with business objectives, it is essential to constantly review and improve the accuracy of stored data.

8.4.2. System quality

Ensure the reliability, ease of use, and adaptability of the system. The high quality of the system can improve user satisfaction and enhance the value of data assets. If necessary, the system should be upgraded and maintained to ensure its high efficiency and high performance in providing data services.

8.4.3. Service quality

The paragraph lacks a clear connection between the two sentences. It would be more effective to add a sentence that explains how providing user support and service assurance leads to the improvement of data asset value. For example: "By offering user support and service assurance, organizations can ensure that users are able to effectively utilize data assets, ultimately increasing the overall value of the data." This addition helps to bridge the gap between the two ideas and provides a more cohesive flow to the paragraph.

8.4.4. Data use

Optimize the data utilization process, provide more analysis tools and applications that meet the needs of users, and ensure that data is not only collected and stored, but also actively queried, analyzed, and value extracted.

8.4.5. User satisfaction

User satisfaction is a key measure of the value of data assets. Conduct regular user satisfaction surveys and collect feedback, adjust the data service and product provision direction according to user needs, and continuously improve user satisfaction.

8.4.6. Individual influence

Assess the impact of data assets on individual work performance, especially in improving work efficiency and decision-making quality. Identify how data assets can help users save time, reduce costs, and increase productivity by providing valuable insights and information that can streamline processes and enhance overall performance.

8.4.7. Organizational impact

Consider the contribution of the data assets to the strategic objectives and final business performance across the organization. Show the important role of data assets in improving organizational operation efficiency, optimizing management decisions, and exploring new market opportunities through actual cases.

By applying the above proposed optimization measures to the six dimensions of the DeLone & McLean model, a set of comprehensive improvement strategies can be formed to ensure the effective use of data assets and enhance their overall value. Through continuous improvement and optimization, data assets can be expected to provide a solid foundation for future new requirements and applications, while also meeting current business needs.

9 Data Quantitative Analysis

9.1 The guiding ideology by Chinese government on the circulation of data elements

The Chinese government has published on various policy about the impact of data on the Chinese economy.

Adhere to the application scenario as the guidance, these policies focus on the whole life cycle of data elements governance, and promote compliance and efficient circulation of data elements.

- (1) Establish access rules for the circulation of data elements.
- (2) Accelerate the improvement of the data circulation and trading system by implementing new technologies and streamlining processes to enhance efficiency and accessibility for all stakeholders involved. Efficient circulation and transaction is an important prerequisite for data to effectively support production or consumption.
- (3) Developing a digital economy with data as the central element is the primary driving force behind unlocking the value of data. From the perspective of system construction, the rapid development and change in the data field requires the combination of top-level design and practical exploration.
- (4) Fully releasing the value of data elements, leading digital development, and driving digital development are the internal requirements and important focus of building a digital China. We will vigorously promote the reform of market-based allocation of data factors, promote the efficient circulation and utilization of data, and take the development of digital China to a new level.
- (5) Promote the adjustment and optimization of the supply of data factors, and improve the quantity and quality of data factor supply. Establish a trusted data circulation system to enhance the level of availability, credibility, circulation and traceability of data. Realize

the dynamic management of the whole process of data circulation, and activate the data value in the use of compliance circulation.

At present, China's data factor market system needs to be further improved, and problems such as unclear data use and rights and interests, data monopoly and unfair competition still exist.

9.2 Data quantification and analysis

Through more than 100 different seminars and interviews, we collected the feedback of couples of CIOs from Chinese famous hospitals for data quality, response time and other factors, and the following data are collected:

IO	Customer Survey	Response Time	Availability	Data Security	Data Integrity	QA	User Ownership	Data Source	Data Asset	Data Value
	Peking Union Medical College Hospital	60	95	95	85	82	72	77	86	74
	East China Hospital	65	90	95	91	70	66	75	87	75
	Sun Yat-sen University Hospital	80	89	100	80	70	64	72	90	81
	Peking University People's Hospital	62	88	94	90	80	63	62	85	72
	Renji Hospital, Shanghai Jiao Tong University School of Medicine	65	92	99	88	80	62	72	84	73
	West China Hospital, Sichuan University	69	93	98	87	70	62	72	87	80
	Zhongnan Hospital of Wuhan University	70	82	98	88	60	72	82	85	72
	Tianjin Medical University General Hospital	65	90	91	87	80	81	60	84	72
	Affiliated Hospital of Harbin Medical University	60	90	99	88	70	66	76	82	73
	Xiangya Hospital, Central South University	80	85	92	85	71	78	67	90	85
	Affiliated Hospital of Anhui Medical University	86	95	92	86	80	55	65	83	72
	Peking University Third Hospital	60	90	92	92	78	65	75	84	82
	Yinzhou People's Hospital, Ningbo	75	89	94	88	77	64	70	83	82
	Bethune International Peace Hospital, Jilin University	60	88	91	86	80	63	66	80	72
	Nanfang Hospital, Southern Medical University	76	92	98	88	82	62	72	79	72
	Henan Provincial People's Hospital	60	93	98	92	70	62	72	91	82
	Wenzhou People's Hospital	76	82	96	82	65	70	80	85	75
	Wuhan Central Hospital	60	90	96	92	80	66	65	84	75
	Shanghai Sixth People's Hospital	60	90	95	84	70	65	72	85	75
	Southwest Hospital	80	85	94	80	75	90	92	98	89
	Northwest Women's and Children's Hospital	60	95	95	83	80	72	66	80	75
	Shanghai Children's Hospital	90	90	96	92	72	66	70	88	81

Sichuan Provincial Cancer Hospital	80	89	87	88	70	65	70	86	80
Shaoxing People's Hospital	88	88	96	93	80	64	60	79	75
Jiangsu Provincial Hospital of Traditional Chinese Medicine	65	92	94	92	80	65	72	78	75
Zhejiang Provincial Cancer Hospital	65	93	93	83	72	69	70	85	82
PLA General Hospital	77	82	92	82	62	66	80	80	75
Nanjing Second Hospital	60	90	91	90	80	68	68	79	76
Fujian Provincial People's Hospital	60	90	96	80	72	61	72	78	78
Yueyang First Hospital	80	85	92	86	86	60	65	79	79
Ganzhou People's Hospital	65	95	95	82	82	71	60	80	71
Affiliated Hospital of Jiamusi University	65	90	98	92	70	66	72	86	82
Gansu Provincial People's Hospital	76	89	98	82	72	62	72	86	82
Dalian City Hospital	67	88	98	88	80	66	68	82	70
Fujian Provincial People's Hospital	76	92	100	88	82	62	72	85	77
Jilin Provincial People's Hospital	66	93	99	82	72	61	72	88	80
Qilu Hospital, Shandong University	78	82	98	82	62	66	80	82	75
Shanghai Ninth People's Hospital	80	90	97	92	80	66	66	80	71
Affiliated Hospital of Bengbu Medical College	80	90	96	77	72	65	70	80	72
Hubei Provincial Maternity and Child Health Care Hospital	80	85	95	76	78	66	75	86	79
The Second Affiliated Hospital of Xi'an Jiaotong University	65	95	95	89	80	70	63	82	75
Liuzhou People's Hospital	69	90	95	92	75	65	76	90	80
Xinjiang Uygur Autonomous Region People's Hospital	72	89	97	84	70	64	76	79	69
Guiyang People's Hospital	60	88	92	87	82	62	66	86	78
General Hospital of Jinan Military Region	60	92	96	97	85	62	72	80	68
Liaoning Provincial People's Hospital	60	93	96	92	72	62	72	89	80
Zhongnan Hospital of Wuhan University	70	82	97	88	60	66	80	94	88
Tianjin Medical University General Hospital	66	90	98	92	80	77	65	84	70
Qiqihar First Hospital	88	90	95	86	70	62	72	70	66
Jiangsu Provincial Hospital of Traditional Chinese Medicine	80	85	94	77	82	64	74	95	85
Hebei Provincial People's Hospital	75	82	95	80	60	71	80	80	75
Zhejiang Provincial Cancer Hospital	90	90	92	92	80	65	60	82	76

Table 9.1 Collected interview data from 50+ different hospitals

The regression analysis, conducted through IBM SPSSAU software, aims to analyze the causal relationship between the data and the dependent variables.

From the analysis results, all the independent variables have a direct impact on the results of the data value.

But the ownership of the data plays a very critical role to determine the value of data.

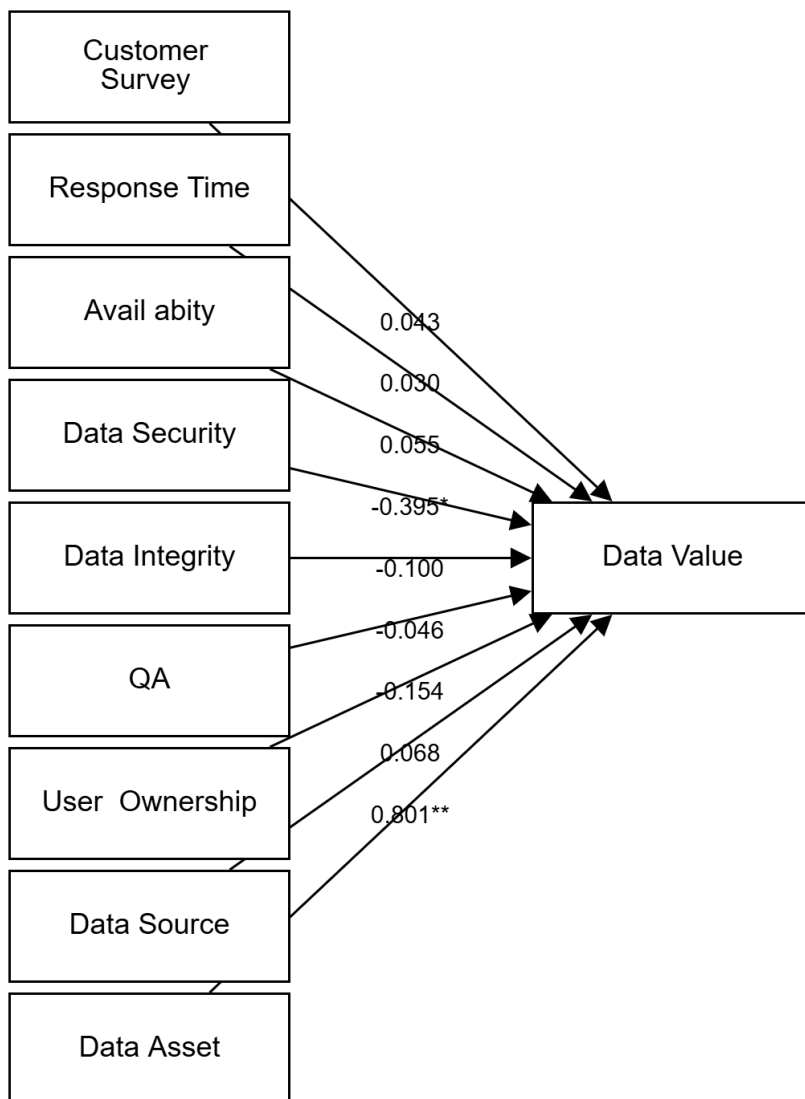


Figure 9.1 Relationship between data attributes and data value

Parameter Estimates (Summary)

	Coefficients	95% CI	Covariance diagnosis	
			VIF	容忍度
Constant	56.161* (2.060)	2.731 ~ 109.591-	-	-
Customer Survey	0.043 (1.117)	-0.032 ~ 0.118	1.392	0.718
Response Time	0.030 (0.534)	-0.079 ~ 0.138	1.287	0.777

Availability	0.055 (0.325)	-0.277 ~ 0.387	1.87	0.535
Data Security	-0.395* (-2.134)	-0.757 ~ -0.032	1.214	0.824
Data Integrity	-0.100 (-0.920)	-0.312 ~ 0.113	1.295	0.772
QA	-0.046 (-0.487)	-0.229 ~ 0.138	1.937	0.516
User Ownership	-0.154 (-1.642)	-0.338 ~ 0.030	1.386	0.721
Data Source	0.068 (0.637)	-0.141 ~ 0.276	2.179	0.459
Data Asset	0.801** (7.709)	0.598 ~ 1.005	1.236	0.809
n	52			
R ²	0.659			
Adj. R ²	0.586			
F Value	F (9,42)=9.018,p=0.000			
备注: Dependent Variable=Data Value				
D-W=1.645				
* p<0.05 ** p<0.01 t statistics in parentheses				

Table 9.2 Parameters of different data attributes

The value of regression coefficient for Customer Survey is 0.043 ($t=1.117$, $p=0.271>0.05$), implying that Customer Survey does not have an impact relationship on Data Value.

The regression coefficient value of Response Time is 0.030 ($t=0.534$, $p=0.596>0.05$), which means that Response Time does not have an impact relationship on Data Value.

The regression coefficient value of Availability is 0.055 ($t=0.325$, $p=0.747>0.05$), which means that Availability does not have an impact relationship on Data Value.

The regression coefficient value of Data Security is -0.395 ($t=-2.134$, $p=0.039<0.05$), implying that Data Security will have a significant negative impact relationship on Data Value.

The regression coefficient value of Data Integrity is -0.100 ($t=-0.920$, $p=0.363>0.05$), implying that Data Integrity does not have an impact relationship on Data Value.

The regression coefficient value of QA is -0.046 ($t=-0.487$, $p=0.629>0.05$), which means that QA does not have an impact on Data Value.

The regression coefficient value of User Ownership is -0.154 ($t=-1.642$, $p=0.108>0.05$), which means that User Ownership does not have an impact relationship on Data Value.

The value of regression coefficient for Data Source is 0.068 ($t=0.637$, $p=0.527>0.05$), which means that Data Source does not have an impact relationship on Data Value.

The regression coefficient value of Data Asset is 0.801 ($t=7.709$, $p=0.000<0.01$), which means that Data Asset will have a significant positive impact relationship on Data Value.

To summarize the analysis, it can be seen that Data Asset will have a significant positive influence on Data Value. And Data Security has a significant negative effect on Data Value. However, Customer Survey, Response Time, Availability, Data Integrity, QA, User Ownership, Data Source do not have a significant impact on Data Value.

Model Summary

R	R 2	Adj. R 2	RMSE	D-W	AIC	BIC
0.812	0.659	0.586	2.937	1.645	279.605	299.118

Table 9.3 Model Summary

9.3 Chinese government policies on the circulation of data factors

The main documents regarding the data factor policy in China are as follows:

1. Considering the "separation" of data property rights promotes the healthy development of the data factor market and protects the rights and interests of data owners, data processors, and data users. [[1]]

(https://www.digitalchina.gov.cn/2022/szzg/zcfb/202212/t20221220_4573086.htm)

"Data 20" is the initial national special policy document that outlines the release of data elements related to production factors. It has a unique policy design and aims to solve the

basic problems related to the release of data elements within the basic system. [[2]] (<http://finance.people.com.cn/n1/2022/1221/c1004-32591014.html>)

In order to promote the construction of a data factor market, China encourages industry associations and other social forces to actively participate in the development of security technology, related security research, and services for data circulation. They are also encouraged to establish a credit system for the data factor market.

China is also exploring the construction of a national integrated data element registration and certification platform, promoting the development of an innovation platform in the field of data elements, advancing the "east number and west calculation" project in a three-dimensional way, and forming a data industry ecosystem that combines "computing power" and "data".[[3]] (https://www.digitalchina.gov.cn/2022/szzg/zcfb/202212/t20221220_4573086.htm)

In addition, China also selects typical cases for the application of data elements, relying on the Digital China Construction Summit and various conferences, forums, and activities related to data elements. It actively releases typical cases to promote experience sharing, exchange, and cooperation.

10 Conclusions and recommendations

10.1 Summary of the main studies and findings

With the rapid development of big data and artificial intelligence technology, the collection, processing and analysis of medical data are becoming more and more important. China's medical industry is in a critical period of information transformation. As the core of the transformation, medical data circulation and operation, and their efficiency and security have been widely concerned. However, data flow and operation are faced with many drivers and challenges, including technological progress, policies and regulations, economic incentives, privacy protection, and so on. This study takes the success model of DeLone & McLean information system as the analytical framework to discuss the current situation of medical data circulation and operation in China, aiming to reveal the main driving forces and challenges it faces, and analyze its value to process automation and intelligence in the medical insurance industry.

The purpose of this study is to sort out and identify the key factors affecting the circulation and operation of medical data in China, and then evaluate the promotion effect of these factors on the process automation and intelligence in the medical insurance industry. By analyzing the current situation and challenges of medical data circulation, this study aims to propose improvement strategies to promote the rational utilization of medical data resources, improve the quality of medical services, reduce operating costs, and provide theoretical support and practical guidance for policy making. For the medical insurance industry, the significance of this study lies in realizing the precision of policy implementation and efficient service response through the intelligent transformation of the existing processes, so as to provide better medical security services for the masses.

In the course of the research, this paper uses various research methods such as literature review, case analysis and expert interview. By collecting and analyzing the relevant

literature on the circulation and operation of medical data at home and abroad, and combined with the actual situation of China's medical industry, I comprehensively understand and evaluate the dynamic changes of medical data circulation and the logic behind it. In addition, this study also uses case analysis to deeply analyze the successful cases, and existing problems of automation and intelligence in the medical insurance process, as well as the challenges and solutions encountered in practice. Finally, expert interviews will be conducted to collect opinions and suggestions from industry insiders to make the research results more practical.

The key findings of this study indicate that the factors driving medical data flow and operations consist of policy advocacy, technological advancements, market needs, and management requirements. On the other hand, the obstacles primarily revolve around issues such as data security, privacy safeguarding, inter-departmental cooperation, and technical standards. Drawing from the insights presented in this paper, a set of specific strategies and recommendations have been compiled to enhance the efficient exchange of medical data and improve operational management. At the same time, the research found that through the use of advanced information technology, it can significantly improve the automation and intelligence level of the medical insurance industry process, reduce labor costs, and improve work efficiency and service quality.

Although this study has made some contributions in analyzing the current situation and influencing factors of medical data circulation and operation in China, there are still some limitations. For example, the special circumstances of some regions and units may not be fully considered; the limited number of cases and interviews used may not fully reflect the full picture of the industry. Future studies can further broaden the data sources, increase the sample size, and improve the universality and depth of the studies.

The distinctive aspect of this study lies in its utilization of the DeLone & McLean model as a theoretical framework for examining the flow and management of medical data. It also presents tailored strategies and recommendations that are rooted in the specific context of the Chinese medical industry. Furthermore, the paper conducts a detailed analysis of the benefits of process automation and intelligence in the medical insurance sector, offering a theoretical foundation and practical guidance for enhancing operational efficiency. The results of this study not only help to promote the efficient circulation and operation

management of medical data in China, but also are of great significance to promote the information construction of the medical treatment and medical insurance industry, improve the overall service level of the industry, and guarantee the public health.

Future research should continue to pay attention to the policy environment, technological progress and process optimization of the circulation of medical data, explore more effective operation models, and contribute to the sustainable development of China's medical industry and medical insurance industry.

10.2 Suggestions on the circulation of data elements in China

To promote data circulation in China, the following suggestions will be proposed,

Firstly, Build a unified data sharing platform

The government is recommended to set up policies and build a unified data sharing and exchange platform to reduce the barriers to data sharing. Such a platform can provide standardized and unified data resources and services, helping to reduce data redundancy, and ensure data quality and security.

Secondly, Improve the data sharing regulations

In the development of the data element market, we need to improve the laws and regulations on data sharing, establish a legal system that includes intellectual property rights, data sharing agreements, and scene sharing agreements, and protect the legitimate rights and interests of data providers and users.

Thirdly, Promoting government data sharing

According to the Opinions of the CPC Central Committee and The State Council on Building a More Perfect System and Mechanism of Market Allocation of factors, accelerating the sharing and opening of government data, promoting the integration of data resources, and strengthening the security and protection measures of data resources are important measures for the marketization of data elements.

Finally, Improve data quality

To improve the efficiency of data factor circulation, the key is to improve the data quality.

Suggestions on the circulation of medical data elements in China include implementing standardized formats for data exchange, ensuring data security and privacy measures are in place, promoting interoperability among different healthcare systems, and establishing clear guidelines for data sharing and consent. Additionally, creating a centralized database for medical data storage and streamlining the process for accessing and sharing data can help improve efficiency and accuracy in healthcare delivery.

For circulating medical data elements in China, the following are some specific suggestions:

(1) Improvement of the legal framework

According to the Data Security Law, Network Security Law, Personal Information Protection Law and other legal bases, the responsible subjects and their rights and obligations in the circulation of medical data are further clarified, and the standards for data security and personal privacy protection are established.

(2) Establishment of a data-sharing mechanism

Establish an efficient medical data sharing platform to promote data integration and analysis among different institutions, while ensuring security and compliance in the data sharing process.

(3) Construction of a data governance system

A data security review committee shall be established under the legal framework to be responsible for the supervision and review of data collection, use, disclosure, cross-border transmission and other links to ensure the compliance and standardized sharing and utilization of medical data.

(4) Protection of the Public interest

On the premise of ensuring the protection of personal privacy, the role of medical data in public health event response, national security and public interests.

(5) The profit distribution mechanism is clear

Solve the problems of privacy security, unclear data ownership and unclear profit distribution in medical data sharing, and establish a reasonable profit distribution mechanism between data providers and data users.

Through the implementation of the above suggestions and measures, it is expected to promote the smooth circulation of medical data elements in China, maximize the value of medical data, and ensure the effective protection of data security and personal privacy.

10.3 The measurement to improve the intelligence level of China's medical insurance industry

When considering how China's medical insurance industry can use data elements to improve intelligence levels, several suggestions can be put forward. These suggestions are designed to enhance operational efficiency, improve service quality, and make the industry more suitable for today's medical and health service requirements. (Jakovljevic et al., 2023)

Propose	Measurement
1. Strengthen the application of data analysis	Big data analysis technologies, such as machine learning and artificial intelligence, are used to conduct in-depth analysis of medical insurance claims data and the use of medical services to optimize resource allocation.
2. Intelligent precision medicine	Develop personalized treatment programs to promote the practice of personalized medicine and precision medicine by analyzing large amounts of patient data.
3. Risk prediction and	Construct the disease prediction model to predict the

Propose	Measurement
management	epidemic trend of high incidence in advance, and provide scientific basis for medical insurance fund management.
4. Strengthen the audit and cost control function of medical insurance	Using big data analysis technology to improve the automatic audit ability of medical insurance claims, to prevent excessive diagnosis and treatment and fraud.
5. Improve the user service experience	Big data tools are used to intelligently identify patients' needs and provide more accurate and convenient medical and health services.
6. Interdisciplinary talent training	Innovate the talent training mode and strengthen the application of talents in interdisciplinary fields, such as artificial intelligence and big data in the medical insurance industry.
7. Data privacy and security protection	Planning and implementing advanced data privacy protection measures and security management strategies to ensure compliance when processing sensitive Medicare data.

Table 10.1 The measurement to improve the intelligence level

Here are some specific suggestions:

Through the implementation of the suggestions mentioned in the above table, China's medical insurance industry can ensure the data security and privacy protection while improving the level of intelligence, so as to achieve the goals of optimizing resource

allocation, improving risk management ability and enhancing user service experience, and promote the more sustainable and efficient development of the industry.

10.4 Summary of the key drivers on the road to the realization of data value in China

When summarizing the key drivers of data value realization or Data Monetization in China, we can investigate the technology application, market demand, policy support, and other perspectives. Here is a detailed overview of these drivers and their specific impact on realizing the value of data assets:

Driving factors	Influence
1. The development of the applicable technologies	With the rapid development of information technology, such as big data analysis, cloud computing, artificial intelligence, etc., it provides technical support for the mining and application of data value, and promotes the development of digital therapy and other fields
2. Market demand is driven	Modern enterprises rely on data-driven analysis for marketing, modeling, decision optimization, and customer positioning, which promotes the formation of data markets and enables enterprises to buy and sell valuable data
3. Digital economy drive	Since 2010, the digital economy has become a key driver of China's growth and development, especially in promoting technology-based activities and the e-commerce economy
4. Globalization	The trend of globalization and the prediction of the current and

Driving factors	Influence
trends and forecasts	future impact of the health industry show that with the deepening of globalization, the demand and utilization of data in the health industry will continue to increase
5. Development of Internet finance	With the globalization of Internet finance, China's Internet budget is constantly evolving, which affects the credit problems in financial transactions and the new characteristics of financial and credit risks
6. Activity of data as an important data source	In the context of the rapid development of the digital society and the exponential growth of data, data production activities have become an important data source, which becomes extremely important to ensure security and increase the protection and management of data

Table 10.2 Key drivers to the realization of data value

Combined with the above table, we can see that on the road to realizing data value in China, a variety of factors complement each other to promote the development of this process. Technological advances provide the possibility to process and analyze large amounts of complex data, market demand provides the direction for the commercialization of data, and the development of the digital economy expands the scope and influence of realizing data value. At the same time, the development of Internet finance also provides new perspectives and challenges for data trading.

On this basis, Chinese policy makers should continue to create a good environment for data application, protect data security, promote the rational and efficient circulation and use of data, and realize the maximum value of data assets.

10.5 Summary of the key challenges on the road to data monetization

In China, the key challenges on the road to realizing the value of data are mainly focused on the following aspects:

Challenging factors	Actions
1. Data privacy and security issues	In the process of data value realization, privacy computing, multi-party security computing and other technologies need to be further developed and popularized to ensure that data is available and privacy is protected. These technologies have not yet been applied on a large scale.
2. Imperfect laws and regulations	There are bottlenecks in the data right confirmation and registration, asset pricing, product supply, technological innovation and other aspects, which restrict the maturity and standardized development of the data factor market.
3. Difficulties in assessing data value	Due to numerous data sources, different collection methods, and large differences in format and content, it leads to greater difficulty in data value evaluation. Uniform or widely accepted criteria for assessing data values are currently lacking.
4. Lack of data pricing mechanism	Data pricing faces challenges, especially the lack of effective pricing mechanism in data trading, including the immaturity of pricing technology and the lack of a unified market mechanism.
5. Lack of technology application and	At present, data desensitization, data security protection and other technologies need to be further applied and innovated in the practice of data trading to meet the market demand.

Challenging factors	Actions
innovation	
6. Challenges of sustainable development	Among the problems to deal with in the development process of the data factor market are how to establish a sustainable and stable market environment for development, and how to deal with the relationship between innovation and regulation.

Table 10.3 Key challenges on the road to realizing the value of data

The above challenges cover multiple aspects of technology, law, market and strategy, and the importance in the further development and realization of data value is self-evident. In the future, we should strengthen technology research and development, build a more perfect legal and regulatory system, establish a clear data value evaluation and pricing mechanism, and promote the construction of a sustainable development environment, so as to cope with these challenges and comprehensively promote the healthy growth of China's data factor market.

10.6 Summary of the Thesis

EDBA learning has lasted for more than three years, and the thesis has also been on my mind for more than three years. I have been working in the IT industry for more than 30 years and especially expect to look for a chance to summarize my own ideas and opinions.

In recent years, the emerging data circulation has been the finishing touch of China's data economy.

Through systematic research of the policies, technologies and theories, through continuous refinement, I believe this paper will play an important role in the circulation of data elements and value realization in China.

(1) Research background and current situation

With the rapid development of information technology, the level of medical informatization in China is also constantly improving. The effective circulation of medical data has a crucial impact on the diagnosis and treatment of diseases, the rational allocation of medical resources, and improving the response speed of public health services. However, in the process of medical informatization, the problems of data privacy protection and data security are increasingly prominent, and the restrictions of policies and regulations also cause some obstacles to the effective use of data. In addition, the imbalance between technology and resources is also an important factor restricting the development of medical informatization. This paper thoroughly examines the advancement of medical informatization in China, focusing on the significance of medical data sharing and its utilization in the medical insurance industry.

(2) Study purpose and significance

This study aims to explore how to automate insurance underwriting and compensation processes by optimizing the data flow of medical insurance companies. This will improve the efficiency of insurance management, strengthen fraud detection, promote product innovation, and enhance the quality of decision support. The significance of the research lies in transforming the potential value of data into actual value through the evaluation of data assets and value realization. This will better serve the development of the health insurance industry. At the same time, this study has important theoretical and practical significance for promoting the flow of medical data, ensuring data security and privacy protection, and adapting to the changes of medical informatization in terms of policies and regulations, technological progress and market demand.

(3) Research methods and procedures

This study takes an interdisciplinary research approach, forming a team of data scientists, medical experts and insurance business experts to work together to face changing laws and regulations, technological advances and changing market needs. The research first analyzes the current situation and existing challenges of data application in the medical insurance industry, then discusses how to improve the automation level of medical insurance business by optimizing data circulation, and finally puts forward a series of suggestions on technology and process optimization. In the process of research, we pay attention to the

research of the evaluation methods of data assets, and comprehensively explore the ways to realize the value of data assets through case analysis, model construction and empirical research.

(4) Study findings and conclusions

The main findings of this study include optimizing the data flow of medical insurance companies to effectively improve the efficiency of automated underwriting and compensation processes, the cooperation of interdisciplinary teams to explore the potential value of data in their respective fields, and the importance of improving the data asset evaluation method for realizing data value. The conclusion highlights that the medical insurance industry can not only enhance work efficiency but also play a significant role in product innovation and decision support. It is important to promote medical informatization while also ensuring data security, privacy protection, and adapting to changes in policies, regulations, technological progress, and market demand.

10.7 Future research direction and application prospects

Looking forward to the future, the development of medical informatization will tend to be more in-depth and extensive, and the circulation and application of medical data will become the key factor to promote the development of the medical insurance industry. This paper proposes that future research should focus on innovations in data privacy and security technologies to accommodate increasingly stringent regulatory requirements. At the same time, we should continue to deepen the research on data asset evaluation methods and explore more ways to realize data value. In addition, with the continuous progress of artificial intelligence and big data technologies, research on how to effectively use these technologies in the health insurance industry will be an important direction in the future research. Ultimately, the results of this study are expected to provide decision support for medical insurance companies, promote the healthy development of medical informatization, and provide higher quality services for patients.

10.8 Optimized D&M Models in the Age of Artificial Intelligence era

In China's medical data circulation, combined with the advantages of artificial intelligence, the D&M (DeLone and McLean) information system success model has been optimized to better suit the needs of the modern medical environment. Next, we will analyze the optimized D&M model in detail and discuss its application in Chinese medical data circulation.

10.8.1 Quality of information

Information quality is fundamental in an optimized D&M model. The accuracy, completeness and timeliness of data are key criteria for measuring information quality. With the development of artificial intelligence and big data technology, the ability to acquire, store and process medical data has increased dramatically, which lays the foundation for the provision of high-quality information.

- Patient consultation data collected through electronic medical record (EMR) systems and online medical consultation platforms can be updated in real time to ensure the timeliness and accuracy of the data¹.
- Data mining and deep learning techniques play an important role in information extraction, classification and correlation analysis, resulting in higher quality data¹.

10.8.2 System quality

System quality refers to the effectiveness, ease of use and responsiveness of a healthcare information system. A high quality system should have strong processing power and good user experience.

- The architecture of big data-based healthcare platforms not only improves the processing speed of the system, but also enables effective dynamic and refined management¹.
- The technological model of human-computer collaboration makes healthcare information systems more intelligent, such as image recognition, intelligent querying, and automated health management to improve the effectiveness of the system³.

10.8.3 QOS

In the optimized D&M model, service quality emphasizes personalization and responsiveness of healthcare services. Artificial intelligence technology can help provide efficient and personalized healthcare services.

- Interactive platforms for online healthcare communities are able to respond quickly and accurately to patient questions and meet user needs through natural language processing technology.
- Medical AI systems play an important role in diagnostic and therapeutic decision-making, improving the quality of healthcare delivery⁴.

10.8.4 Utilization

Usage is equally emphasized in the model optimization process, referring to the frequency and breadth of use of the system in practice. The optimized healthcare data system promotes deeper application of the system based on convenience and efficiency.

- Hospitals and research organizations have achieved efficient use of clinical decision-making and research analysis through large-scale application of AI technology⁵⁶.
- The active introduction of blockchain technology for data security makes the flow of data between different organizations smoother and more secure⁹.

Customer satisfaction

In the optimized model, user satisfaction is an important criterion to measure the success of the system. Efficient, safe and intelligent healthcare information systems can greatly enhance user satisfaction.

- Ensure the security of users' data through a comprehensive data privacy protection mechanism, thus winning users' trust and satisfaction⁷¹³.
- Actively respond to and address ethical issues in the application of healthcare data to enhance user satisfaction ⁷¹⁶.

10.8.5 Net benefit

Net benefits measure the overall value delivered by the system. The optimized D&M model maximizes the benefits of healthcare delivery and management through the application of artificial intelligence technology.

- Refined management and intelligent diagnosis and treatment have significantly improved the operational efficiency of hospitals and the health of patients¹³.
- The use of AI technology for healthcare data analysis and prediction can help advance medical decisions and reduce treatment costs²⁰.

D&M model elements	Descriptive	Application Cases
Quality of information	Accuracy, completeness and timeliness of data	Real-time updating of electronic medical records
System quality	System processing power and user experience	Human-computer collaborative healthcare information system
QOS	Personalization and responsiveness of health care	Online interactive platforms and natural language processing
Utilization	Wide range of applications of the system in practice	Applications in hospitals and research institutes
Customer satisfaction	User trust and evaluation of the system	Data privacy protection and ethical problem solving
Net benefit	Overall medical benefits from the system	Improve operational efficiency and patient health

10.9 Summary of managerial contributions and innovations

This paper brings the following management contributions and innovations to the healthcare industry by combining the optimized DeLone & McLean model for data flow research in the Chinese health insurance industry:

- Enhancing the overall value of data strategy
- Closed-loop data management:

The thesis proposes to highlight the key role of data in improving productivity through a full closed-loop process management from data collection to final analysis. This innovative approach aims to leverage data to drive China's digital transformation and industrialization process, maximizing the overall value of data.

- Improving data flow in the health insurance industry
- Data asset value realization:

By analyzing the current status and challenges of medical data application in health insurance underwriting and claims business, the article adopts the DeLone & McLean model as a research framework and proposes solutions to improve the efficiency of medical data circulation and maximize the value of data. This helps to improve the operational efficiency of health insurance companies, reduce operational costs, enhance service quality, and reduce the risk of fraud.

- Technology and Compliance Measures:

The article emphasizes improving the use of medical data in health insurance underwriting and compliance processes through technological advances and compliance measures, increasing automation and intelligence, and improving the value of data utilization.

- data standardization and building of sharing mechanisms
- Data standardization:

The thesis notes that the establishment of data standardization and sharing mechanisms and the application of advanced data analytics can significantly improve the efficiency and value of

healthcare data utilization, thereby driving health insurance companies to more effectively respond to market changes and control risks and costs. This measure provides a more solid foundation for various healthcare data exchanges.

- Data Governance and Privacy Protection
- Data governance capabilities:

The article emphasizes that improving data governance capabilities plays a key role in ensuring the effective

Summary of academic contributions and innovations

The academic contributions and innovations of this paper are summarized in the following areas:

Optimizing the DeLone & McLean model

This paper revisits and optimizes the traditional DeLone & McLean information system success model to make it more applicable to the study of healthcare data flow in the context of the data economy era.

Theoretical Model Improvement:

The optimized DeLone & McLean model provides a theoretical basis for addressing key challenges and barriers in data circulation and value realization.

Application Expansion:

The new applications of the model are not limited to traditional information systems research, but are also applicable to the evaluation of emerging information technology systems such as artificial intelligence and big data analytics, especially in the field of health insurance.

2. Enhancing the application value of medical data in the health insurance industry

Data asset value evaluation:

Through empirical research, a research framework for data asset value evaluation and value realization is established. This helps to deeply understand the current situation and challenges of the application of medical data in automated underwriting and claims business, and enhance the application value of medical data in the health insurance industry.

Business Process Optimization:

This paper analyzes in detail the impact of key factors such as data quality, data sharing, system integration and interoperability on business efficiency and effectiveness, and proposes corresponding optimization strategies. Thus, it enhances the operational efficiency of health insurance companies, reduces operational costs and improves service quality.

Strengthening medical data standardization and sharing mechanism

Data standardization and sharing:

This paper highlights the key role of data standardization and sharing mechanisms in significantly enhancing the efficiency and value of medical data utilization. This provides theoretical support and empirical evidence for various medical data exchanges, and helps to promote the wide application of medical data.

- Advanced data analysis applications:

The article further points out that by applying advanced data analytics to medical data, the efficiency of decision support can be greatly improved, the risk of fraud can be reduced, and resource allocation can be optimized.

Rationale for Improving Data Governance and Privacy Protection

Data governance capacity:

This paper proposes specific strategies to enhance data governance capabilities to ensure that data are secure and effective in circulation. Through in-depth analysis, this paper provides a theoretical basis for enhancing healthcare data privacy protection and data governance capabilities.

5 Industry-specific applications of emerging information technologies

Artificial Intelligence and Machine Learning:

The article suggests that future research should focus on advances in medical data processing technologies based on artificial intelligence and machine learning to improve the intelligence of health insurance underwriting and claims processing operations. This provides an important direction for research in related fields.

Automation and Intelligence:

To further promote the application of information technology in the health insurance industry in order to reduce labor costs and improve efficiency and service quality.

In-depth Understanding of Data Economy and Information Society

Theoretical expansion of data economy:

By examining actual cases of healthcare data circulation, this paper provides a deeper understanding of the fields of data economy, data governance and information society.

Combination of commercial and academic value:

The research not only has practical value in business, but also expands the understanding of data economy in academia, providing a solid theoretical foundation for future research.

Optimization Strategies for the Digital Age

Addressing Challenges and Obstacles:

In the context of the digital economy, this paper provides strategies to address key challenges and barriers in data circulation and monetization by optimizing the DeLone & McLean model.

Digital Transformation in the Health Insurance Industry:

The study suggests that with technological advances and improved policy environment, the ability to collect, process, and analyze healthcare data will be further enhanced, bringing more innovation possibilities to the health insurance industry.

Conclusion.

In summary, the academic contributions and innovations of this paper are not only in optimizing the theoretical model, enhancing the value of healthcare data applications, and strengthening data governance capabilities, but also in promoting the application of emerging information technologies in the healthcare industry, as well as advancing the in-depth understanding of the theory of data economy and information society. These academic contributions provide rich theoretical and empirical support for future research and practice, and lay a solid foundation for the digital transformation of China's medical data circulation and health insurance industry.

10.10 Managerial implication

This thesis brings the following management contributions and innovations to the healthcare industry by applying and optimizing the DeLone & McLean (D&M) model in a data flow study of the Chinese health insurance industry:

Firstly we must build the strategy to improve the efficiency of medical data circulation in China and realize the monetization of data value.

In the management of medical data in China, improving the efficiency of data circulation and realizing the monetization of data value are key goals to optimize medical services and promote the development of the medical industry.

Based on existing research and data, this thesis proposes specific steps from four aspects:

- Data standardization and Normalization
- Construction of data sharing platforms
- Data analysis and mining
- Security and privacy protection,

And finally we will discuss solutions to key obstacles and the work that managers need to undertake.

1 Data Standardization and Normalization

Key Milestones:

- Develop and implement unified data standards: Establish national unified data standards and metadata management specifications to ensure the consistency and operability of data in various medical institutions.
- Promote data interoperability: Introduce international standards such as FHIR to enable data exchange between different systems.

Specific measures:

Data standardization work: Governments at all levels work together with medical institutions to develop and implement unified data standards, and conduct comprehensive data cleaning and formatting.

Training and promotion: Organize training related to data standardization, enhance medical staff's awareness of standardized operations, and increase their cognition through promotion.

2 Data sharing platform construction

Key Milestones:

Establish provincial and national-level data sharing platforms: based on blockchain technology, ensuring the secure, transparent, and efficient circulation of data.

Implement the mechanism of user informed consent: ensure user privacy and data security during the data sharing process.

Specific measures:

Design and implementation of data sharing platform: Ensure the standardized construction of data sharing platforms in various regions and promote their national interconnection to achieve data interoperability.

Permission management and data protection: Introducing blockchain technology to ensure the security and privacy of data, and achieve trusted data sharing.

3 Data Analysis and Value Discovery

Key Milestones:

Build an intelligent analysis platform: Use machine learning and deep learning technologies to conduct in-depth analysis of massive medical data and explore the potential value of the data.

Establish a data visualization system: Use data visualization tools to transform analysis results into intuitive decision support reports.

Specific measures:

Development and application of data analysis tools: Develop and deploy advanced data analysis tools for real-time monitoring and analysis of medical data.

Data application scenario promotion: Promote the results of data analysis in various fields such as clinical decision-making, health management, and disease prediction to enhance the level of medical services.

4. Safety and Privacy Protection

Key Milestones:

Develop data security and privacy protection policies: Refer to international excellent practices and develop medical data security management policies suitable for the Chinese context.

Implement encryption and identity authentication technologies: Ensure the security of data during transmission and sharing.

Specific measures:

Data security management mechanism: Protect the security and privacy of medical data through techniques such as privacy-preserving computation and dynamic data masking.

Data auditing and tracing system: establish an auditing system for data usage and operations, ensuring traceability of every data operation.

Specific tasks for managers.

- Establish uniform policies and standards:
- In cooperation with the National Health and Health Department, formulate unified medical data standards and data management policies to ensure national data consistency.
- Driving platform construction and operation.
- Supervise and oversee the construction and daily operation of the medical data sharing platform to ensure its compatibility and scalability.
- Strengthen training and promotion:

- Promote the importance of data standardization and data security both inside and outside medical institutions, and enhance the data management capabilities of staff through training and exercises.
- Regulation and Enforcement:
- Establish strict regulatory policies to ensure the implementation of data management policies and standards, and to seriously deal with violators.
- Interdepartmental coordination and cooperation:
- Organize cross-departmental work teams, hold regular coordination meetings, and strengthen data cooperation and communication among departments.

Summary:

Optimize the D&M model to achieve the goal of enhancing data circulation and monetization.

To improve the efficiency of medical data circulation and monetize the value of data, the DeLone and McLean (D&M) model can be optimized to meet the modern requirements of data management.

In this optimization, the key elements of information quality, system quality, service quality, data usage, and user satisfaction should be given special attention.

- Data quality: Ensure the accuracy and integrity of data through standardization and normalization.
- System quality: Building an efficient and reliable national data sharing platform to ensure the stability and usability of the system.
- Service quality: Provide high-quality service support to ensure the timeliness and accuracy of data services.
- Data usage: Promote data analysis applications to ensure the full utilization of data in clinical decision-making and health management.
- User Satisfaction: Enhancing user trust in data management systems through security and privacy protection, to increase user satisfaction.

Key operational steps and Milestone Summary

Step	Key Milestone	Detailed Description	Duration	Cost	Resources
Data Standardization and Normalization	Establish uniform data standards	Integrate standardized data from various regions to improve consistency	2-3 months	2-3 Million US\$ per project	Data engineers/Data scientists
Construction of Data Sharing Platform	Establish provincial and national platforms	Utilize blockchain technology to ensure data security	6-12 months	5-10 million US\$ per platform	System engineer, DBA, Networking, Data engineer
Data Analysis and Value Exploration	Build intelligent analysis platform	Utilize advanced analytics techniques to explore data value	3-4 months	2-10 million US\$	Data analysts, Data scientists
Security and Privacy Protection	Develop data security policies	Implement encryption, data auditing, and other measures	1-2 months	1-2 million US\$	Security and networking engineer

By applying and optimizing the DeLone & McLean model, this thesis provides a solid theoretical foundation and practical guidance for medical data flow in the Chinese health insurance industry. The thesis not only bridges the gap between theory and practice, but also

proposes specific management strategies and innovations in data governance, data standardization, and privacy protection. These management implications not only help to improve the operational efficiency of the health insurance industry, but also promote the overall digital and intelligent development of the industry, laying a solid foundation for the future development of China's health insurance industry.

11 Annexes

11.1 Questionnaire

Questionnaire and Scoring Sheet for Hospital CIOs Influencing Key Elements of Data Value Realization.

The questionnaire for hospital CIOs (CIO) focuses on the application of data elements in the medical and financial industries, especially the availability, security, integrity, etc. of data, and how these factors affect the realization of data value. This questionnaire is designed to evaluate the role of data elements in improving industry efficiency and quality of service.

Finally, please fill in the form to include Industry, Availability, Data Security, Data Integrity, QA, User Ownership, Data Source, Response Time, Data Asset as an independent variable, and Data Value as the dependent variable. The data range from 0 to 100, and you fill in the data according to your own understanding.

Questionnaire title: Data element value assessment questionnaire for healthcare and banking industry

Questionnaire description:

This questionnaire aims to understand the practice and challenges in data management, especially in improving the value of data. Your valuable comments will be critical to optimizing data usage strategies and improving industry efficiency. Please answer the questions based on the actual situation of your organization.

Essential information

1. Organization type

- [] Hospital

- bank

2. Your position

- CIO (Chief Information Officer)

- Others (please specify the) _____

Data management and circulation

3. Diversity of data sources

- Please list the main sources of your institutional data (at least three items) for medical records, insurance companies, and banks

4. Data integration and standardization

- How do you evaluate the efficiency and challenges of current data integration?

- High efficiency, unified standards

- There is integration difficulty and different standards

- Facing major challenges, standard confusion

5. Data security measures

- What data security measures has your organization take?(multiple choice)

- Encrypted transmission

- Access control

- Regular security audit

- Data backup and recovery plan

- Other, please specify the _____

6. Data integrity and quality

- How do you monitor the data integrity and accuracy? Verify in the business scenario

(Open question, ask for a short description)

7. Response time and availability

-What is the average response time for data access?

- <1 second

And- 1-5 sec

- 5-30 seconds

- > For about 30 sec

8. Management of data as assets

-Please evaluate the strategic importance of data asset management in your institution.

- Very high

- higher

- same as

- lower

9. Data value realization

-What factors do you think can best promote the value of the data?(multiple choice)

- Data analysis and insight

- Real-time decision support

- Customer service optimization

- Internal process automation

- Other, please specify the _____

10. Challenges faced

-Please list the major challenges encountered in achieving the value of your data.(Open-ended questions)

Data rights confirmation, data islands, and data security issues.

11. Please help fill out the following form, according to your understanding, the numbers range from 0 to 100. As shown in the following:

CIO	Customer Survey	Response Time	Availability	Data Security	Data Integrity	QA	User Ownership	Data Source	Data Asset	Data Value

11.2 Collected data summary

CIO	Customer Survey	Response Time	Availability	Data Security	Data Integrity	QA	User Ownership	Data Source	Data Asset	Data Value
Wang	Peking Union Medical College Hospital	60	95	95	85	82	72	77	86	74
Zhang	East China Hospital	65	90	95	91	70	66	75	87	75
Sun	Sun Yat-sen University Hospital	80	89	100	80	70	64	72	90	81
Guo	Peking University People's Hospital	62	88	94	90	80	63	62	85	72
Wang	Renji Hospital, Shanghai Jiao Tong University School of Medicine	65	92	99	88	80	62	72	84	73
Zhang	West China Hospital, Sichuan University	69	93	98	87	70	62	72	87	80

Jiang	Zhongnan Hospital of Wuhan University	70	82	98	88	60	72	82	85	72
Qin	Tianjin Medical University General Hospital	65	90	91	87	80	81	60	84	72
Wang	Affiliated Hospital of Harbin Medical University	60	90	99	88	70	66	76	82	73
Zhang	Xiangya Hospital, Central South University	80	85	92	85	71	78	67	90	85
Jiang	Affiliated Hospital of Anhui Medical University	86	95	92	86	80	55	65	83	72
Zhu	Peking University Third Hospital	60	90	92	92	78	65	75	84	82
An	Yinzhou People's Hospital, Ningbo	75	89	94	88	77	64	70	83	82
Zheng	Bethune International Peace Hospital, Jilin University	60	88	91	86	80	63	66	80	72
Guo	Nanfang Hospital, Southern Medical University	76	92	98	88	82	62	72	79	72
Zheng	Henan Provincial People's Hospital	60	93	98	92	70	62	72	91	82
Wen	Wenzhou People's Hospital	76	82	96	82	65	70	80	85	75
Wu	Wuhan Central Hospital	60	90	96	92	80	66	65	84	75
Hu	Shanghai Sixth People's Hospital	60	90	95	84	70	65	72	85	75
Nan	Southwest Hospital	80	85	94	80	75	90	92	98	89

Lan	Northwest Women's and Children's Hospital	60	95	95	83	80	72	66	80	75
Guo	Shanghai Children's Hospital	90	90	96	92	72	66	70	88	81
Han	Sichuan Provincial Cancer Hospital	80	89	87	88	70	65	70	86	80
Guo	Shaoxing People's Hospital	88	88	96	93	80	64	60	79	75
Zheng	Jiangsu Provincial Hospital of Traditional Chinese Medicine	65	92	94	92	80	65	72	78	75
Guo	Zhejiang Provincial Cancer Hospital	65	93	93	83	72	69	70	85	82
Zhang	PLA General Hospital	77	82	92	82	62	66	80	80	75
Lan	Nanjing Second Hospital	60	90	91	90	80	68	68	79	76
Fu	Fujian Provincial People's Hospital	60	90	96	80	72	61	72	78	78
Yue	Yueyang First Hospital	80	85	92	86	86	60	65	79	79
Yu	Ganzhou People's Hospital	65	95	95	82	82	71	60	80	71
Wang	Affiliated Hospital of Jiamusi University	65	90	98	92	70	66	72	86	82
Zhang	Gansu Provincial People's Hospital	76	89	98	82	72	62	72	86	82
Guo	Dalian City Hospital	67	88	98	88	80	66	68	82	70
Fu	Fujian Provincial People's Hospital	76	92	100	88	82	62	72	85	77
Lin	Jilin Provincial People's Hospital	66	93	99	82	72	61	72	88	80

Qi	Qilu Hospital, Shandong University	78	82	98	82	62	66	80	82	75
Ha	Shanghai Ninth People's Hospital	80	90	97	92	80	66	66	80	71
Ren	Affiliated Hospital of Bengbu Medical College	80	90	96	77	72	65	70	80	72
he	Hubei Provincial Maternity and Child Health Care Hospital	80	85	95	76	78	66	75	86	79
Hu	The Second Affiliated Hospital of Xi'an Jiaotong University	65	95	95	89	80	70	63	82	75
Zhao	Liuzhou People's Hospital	69	90	95	92	75	65	76	90	80
Hu	Xinjiang Uygur Autonomous Region People's Hospital	72	89	97	84	70	64	76	79	69
Wang	Guiyang People's Hospital	60	88	92	87	82	62	66	86	78
Hu	General Hospital of Jinan Military Region	60	92	96	97	85	62	72	80	68
Qin	Liaoning Provincial People's Hospital	60	93	96	92	72	62	72	89	80
Shen	Zhongnan Hospital of Wuhan University	70	82	97	88	60	66	80	94	88
Du	Tianjin Medical University General Hospital	66	90	98	92	80	77	65	84	70
Guo	Qiqihar First Hospital	88	90	95	86	70	62	72	70	66
Bao	Jiangsu Provincial Hospital of Traditional	80	85	94	77	82	64	74	95	85

	Chinese Medicine									
Zhang	Hebei Provincial People's Hospital	75	82	95	80	60	71	80	80	75
Li	Zhejiang Provincial Cancer Hospital	90	90	92	92	80	65	60	82	76

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Abstract

1: Introduction and Background

The purpose of this thesis is to study the realization of data value in the process of data factor flow, and analyze the various favorable and unfavorable factors that promote or hinder the realization of data value.

The reason for choosing this topic is that China and even the whole world expects the flow of data elements, but in practice, there are many factors such as policy, technology, process and law that make it difficult to carry out this work, so it is necessary to systematically analyze the root causes and propose solutions.

2: Issues

In the process of data value realization, there are many favorable and hindering factors, and it is necessary to find a suitable theoretical framework to systematically sort out the relationship between various factors and quantify them, so as to persuade various decision makers and theoretical researchers in the ecological chain of data element circulation to design the correct policy and legal framework, finally to recognize and solve the problems from the top.

The DeLone and McLean model has not been used in the existing literature to analyze and solve the problems in the flow of data elements and AI automation process.

3: Objectives and Contributions

The goal of this dissertation is to use the DeLone and McLean model as a theoretical framework to investigate which elements of policy, law, technology, and process in the flow of data elements play the most significant or decisive role in determining the value of data.

In the process of analysis, the DeLone and McLean model is very systematic and valuable, but this model was invented in the era of information technology, and it needs to be enriched and optimized in the digital era to adapt to the era of digitization and artificial intelligence, which is also the academic value of this thesis.

4: Methodology

The research methodology used in this paper includes a combination of seminars, questionnaires, qualitative analysis and quantitative analysis.

5: Main Results

When using DeLone and McLean model to analyze and sort out all the key elements affecting the process of realizing the value of data, through the interviews with CIOs of more than 50 hospitals and health care institutions, it was found that the key role in the assessment of the value of data is the treatment of data ownership, and the paper proposes to replace the treatment of ownership with the right to use, the right to process and the right to benefit from the data, which can solve the legal problems. This would solve the legal issues and thus simplify the problem, which is a managerial contribution.

Meanwhile, the DeLone and McLean model is optimized and many new elements are added to make the D&M model continue to play a greater role in the digital era.

6: Implications

The value of this thesis to policy makers and theoretical researchers in the field of data elements is that it identifies the key problems in China's data domain, especially in healthcare industry, finally the solutions are provided.

The total solution is systematic, comprehensive, high level and deep, and very actionable.

7: Conclusion and Outlook

The main conclusion of the thesis is that the road to realize the value of data element circulation is very long, but after systematic analysis, the risk and difficulties in the journey have been identified.

Recognized and valued by China's data management authorities, and also reached a consensus with many theoreticians, the biggest contribution of this thesis to the Chinese industry is the thesis draw a whole picture of data circulation in China.

The next step is to extend this theoretical research framework to other fields besides the healthcare industry, so that the research methodology and conclusions can be generalized into a universal model.

Keywords:

Data, Artificial Intelligence, D&M Model, Data ownership, Data ownership, Data usage rights, Insurance claims process, Data value, Data value realization

Résumé

1 : Introduction et contexte

L'objectif de cette thèse est d'étudier la réalisation de la valeur des données dans le flux d'éléments de données et d'analyser les différents facteurs favorables et défavorables qui favorisent ou entravent la réalisation de la valeur des données.

La raison du choix de ce sujet est que la Chine et même le monde entier attendent le flux d'éléments de données, mais dans la pratique, de nombreux facteurs tels que la politique, la technologie, le processus et la loi rendent difficile la réalisation de ce travail, et il est donc nécessaire d'analyser systématiquement les causes profondes et de proposer des solutions.

2 : Problèmes

Dans le processus de valorisation des données, il existe de nombreux facteurs favorables et défavorables, et il est nécessaire de trouver un cadre théorique approprié pour trier systématiquement la relation entre les différents facteurs et les quantifier, afin de persuader les différents décideurs et chercheurs théoriques dans la chaîne écologique de la circulation des éléments de données de concevoir les cadres politiques et juridiques corrects, et de comprendre et de résoudre les problèmes à partir du sommet.

Le modèle de DeLone et McLean n'a pas été utilisé dans la littérature pour analyser et résoudre les problèmes liés à la circulation des éléments de données et aux processus d'automatisation de l'IA.

3 : Objectifs et contributions

L'objectif de cette thèse est d'utiliser le modèle de DeLone et McLean comme cadre théorique pour étudier, parmi les différents éléments politiques, juridiques, technologiques et de processus des flux de facteurs de données, ceux qui jouent le rôle le plus important ou décisif dans la détermination de la valeur des données.

Dans le processus d'analyse, le modèle de DeLone et McLean est très systématique et précieux, mais ce modèle a été inventé à l'ère de l'information, et il doit être enrichi et optimisé à l'ère du numérique pour l'adapter à l'ère du numérique et de l'intelligence artificielle, ce qui est également la valeur académique de cette thèse.

4 : Méthodologie

La méthodologie de recherche utilisée dans ce document comprend une combinaison de séminaires, de questionnaires et d'analyses qualitatives et quantitatives.

5 : Principaux résultats

En utilisant le modèle de DeLone et McLean pour analyser et trier tous les éléments clés affectant le processus de réalisation de la valeur des données, par le biais d'entretiens avec plus de 50 DSI d'hôpitaux et d'organisations de soins de santé, il a été constaté que ce qui joue un rôle clé dans l'évaluation de la valeur des données est le traitement de la propriété des données, et le document propose d'utiliser le droit d'utilisation, le droit de traitement et le droit de bénéficier des données, etc. au lieu du traitement de la propriété, qui peut résoudre les problèmes juridiques. au lieu de traiter la propriété, ce qui peut résoudre les problèmes juridiques. Cela résoudrait les questions juridiques et simplifierait donc le problème, ce qui est une contribution à la gestion.

Dans le même temps, le modèle DeLone et McLean est optimisé et de nombreux nouveaux éléments sont ajoutés pour que le modèle D&M continue à jouer un rôle plus important à l'ère numérique.

6 : Implications

La valeur de cette thèse pour les décideurs politiques et les chercheurs théoriques dans le domaine des éléments de données réside dans le fait qu'elle identifie des problèmes clés dans le domaine des données chinoises, en particulier dans les soins de santé, et qu'elle fournit des solutions ciblées.

Il s'agit d'une étude systématique et complète des problèmes, avec un degré élevé de sophistication et de profondeur, et elle est très utile.

7 : Conclusion et Perspectives

La principale conclusion de cette thèse est que la route vers la réalisation de la valeur de la circulation des éléments de données est très longue, mais après une analyse systématique, les points de risque et les difficultés du voyage ont été identifiés, et ont été reconnus et appréciés par les autorités chinoises de gestion des données, et un consensus a été atteint avec de nombreux théoriciens, ce qui est la plus grande contribution de cette thèse à l'industrie chinoise.

La prochaine étape consistera à étendre ce cadre de recherche théorique à d'autres domaines que l'industrie des soins de santé, afin que la méthodologie et les conclusions de la recherche puissent être généralisées dans un modèle générique.

Mots clés : données, intelligence artificielle, modèle D&M, propriété des données, droits de traitement des données, droits d'utilisation des données, processus d'indemnisation des assurances, valeur des données, réalisation de la valeur des données