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Article

Research on the Optimization of Digital Transformation of Social Assistance Based on Entropy Change Theory

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Abstract: With the development of digitalization in China, the social assistance environment has also undergone tremendous changes in the digital era, which requires social managers to achieve high-quality and efficient assistance through digital transformation. The research introduces the theory of entropy change, constructs a two-dimensional quadrant method, and demonstrates that the orderly digital transformation of social assistance is achieved by negative entropy reduction offsetting positive entropy increase. Based on the current situation and case study of the digital transformation of social assistance in China, the entropy change of social assistance system has the characteristics of variability, uncertainty and complexity. Based on these three characteristics, the optimization path of the digital transformation of the social assistance system is proposed from the perspectives of negative entropy increase and positive entropy flow.

Keywords: Social Assistance; Digital Transformation; Positive Entropy Increase; Negative Entropy Flow

1. Introduction

The construction of digital China has become an important engine to promote Chinese modernization in the digital age, which is of great significance to the transformation of production, life and governance. In the "Guiding Opinions of the State Council on Strengthening the Construction of Digital Government" issued in June 2022, it is proposed that "strengthening the construction of digital government is to adapt to the new round of scientific and technological revolution and industrial transformation... It is an important measure to innovate the concept and mode of government governance, form a new pattern of digital governance, and promote the modernization of national governance system and governance capacity [1].

Digitization and informatization are important engines for leaping-over economic development. Data are the foundation of the digital government and digital social assistance system. The classified management, efficient sharing and orderly development and utilization of data would directly determine the efficiency and final effect of digital government construction. Therefore, the collection, statistics, revision and classification management of social assistance data could be implemented in accordance with the standards of digital government construction, which links up social assistance

data sharing and provide basic information support for further strengthening the orderly development and utilization of big data.

The environment of social assistance has undergone tremendous changes in the digital era. The traditional, isolated and decentralized social assistance mechanism in the past has also undergone drastic changes. The previous social assistance system no longer meets the development needs of the modernization of national governance. The examination paper of the era of digital empowerment and the reform route of transformation and upgrading put forward new requirements for the high-quality development of China's social assistance system.

The digital transformation of social assistance is also one of the hot areas studied by scholars in many countries. Wu and Guan [1] summarizes 10 typical cases of digital transformation of social assistance in China and found that the digital transformation of social assistance had many advantages over traditional social assistance. Japan, Korea, Singapore, and Thailand are in the top ten rankings in terms of information and communication technology development within the Asia Pacific. Region, Mulati Nadila et al. [2] discussed the starting time, development process, achievements and future of digitization and health promotion in these four countries under the background of healthy aging and digitization.

As countries are still in the early stages of digital implementation, digitization has hindered the progress of social assistance in the specific implementation process. Frennert Susanne [3] thinks that Swiss municipal pension institutions faced challenges due to changes in the objectives of digital transformation and the development of welfare technologies. Alistair Sheldrick [4] believes that the digitization of the British welfare system deprives digitally excluded citizens of their rights and prevents them from meaningfully participating in their welfare requirements. Like the previous point of view. Through interviews with people with intellectual disabilities and city service workers in Melbourne, Australia, Ellen van Holstein et al. [5] learned that digitalization creates new opportunities for some people with intellectual disabilities, but also creates new obstacles for them.

In addition, digital transformation must face the problem of the diversity of social assistance needs [6]. Karl Kristian Larsson [7] studied the automated system for granting child benefits in Norway and found that although the system enables most recipients to obtain benefits automatically, there are still omissions and manual applications are needed to assist. According to Buchert Ulla et al. [8]'s research, the digitization of social assistance may contribute to social exclusion, the realization of social rights of people with lower socio-economic status, poor local language skills, and no Finnish education.

In general, the application of big data in the field of social assistance is still lagging. It is necessary to strengthen the strategy of big data mining and application of social assistance and innovate the service mode of social assistance [9, 10].

The digital transformation of social assistance involves the coordinated driving of multiple dimensions such as value concept, technological innovation, practice mode, and institutional norms. Therefore, the social assistance system is a complex system, and how to improve the basic living standards of the rescued group through digital empowerment transformation and realize high-quality and efficient assistance has become the focus of the research.

Based on the current situation and case study of the digital transformation of social assistance in China, the paper would introduce the theory of entropy change and construct a two-dimensional

quadrant method to get the optimization path of the digital transformation of the social assistance system from the perspectives of negative entropy increase and positive entropy flow.

2. Entropy Change Theory

Entropy change is an important concept in thermodynamics, which describes the change of the disorder degree of the system in the thermodynamic process. The reasons why the rescued groups need assistance are complex. The individuals who need assistance have chaotic characteristics and change to the degree of disorder, which is like the entropy in thermodynamics. So, the principle of entropy change can be applied to the research of social assistance system. The orderly progress of social assistance would be realized by entropy reduction neutralize the disorder or chaos caused by entropy increase.

2.1. principle of Entropy Change

Statistical physics considers entropy as a measure of the degree of disorder among microscopic particles in a reaction system. Systems are classified into isolated, closed, and open systems by energy exchange between system and surroundings. According to the second law of thermodynamics, the isolated system is changing in the direction of entropy increase, which is the principle of entropy increase. The principle means that the isolated system eventually forms the most chaotic disorder.

In practice, there are a lot of processes contrary to the above situation. That is, some reactions spontaneously proceed towards ordered direction. The reactions are due to the environmental participation of the system in the entropy increase process. While the system's entropy increases, the environmental entropy decreases. The phenomenon is known as the flow of negative entropy. Negative entropy is the reverse process in the increase of entropy and add negative quantity to the entropy change. Therefore, the final change in the system, whether disorder or order, depends on the comparison between the entropy increase and the flow of negative entropy in the system.

Therefore, entropy change has the following characteristics.

1) The positive and negative of entropy change: according to the calculation formula of entropy change, the entropy becomes positive when the system absorbs heat, while entropy becomes negative when the system releases heat.

2) The additivity of entropy change: the total entropy change is equal to the algebraic sum of the entropy changes of each system in independent systems.

3) The directionality of entropy change: the process of entropy reduction is irreversible, while the process of entropy increase is reversible.

According to the property of entropy change, let dS represent the total entropy change of the system, diS represents the entropy increase, and deS represents the negative entropy flow of the environment, then dS=deS+diS, where diS changes in the direction of increase and deS changes in the direction of decrease.

2.2. The Application of Entropy Change in Social Assistance

The research takes the social assistance system as a whole system, and the improvement of the assistance level is also determined by the internal and external factors of the system. The goal pursued by the whole system is that the social assistance system is carried out in an orderly direction, namely the direction of negative entropy flow.

The internal factors of the assistance system are set as the rescued group, and the external factors of the assistance system are set as the relief management. The total entropy change determined by the role of the internal factors of the system and the participation of the external environment.

Assumed:

diS represents the rescued group. Without the influence of the external environment or ineffective management, the rescued group cannot solve their own predicament, and diS would lead to disorder.

deS represents the social assistance management. Through effective management of social assistance, the entire rescued group would move towards orderly state, so deS would make the entire system tend to be orderly.

dS represent the social assistance system, and the formula can be expressed as follows:

$$\begin{cases} dS = d_i S + d_e S \\ dS < 0 \end{cases} \tag{1}$$

Set dS<0, and the system is in an orderly state, and the entire social assistance system are more efficient.

3. Analysis of Entropy Change Characteristics of Social Assistance

3.1. Two-dimensional Quadrant Construction of Entropy Change

Two-dimensional quadrant method makes an intuitive explanation through the two important levels of events or things and obtain the basis of classification analysis. The horizontal axis is the rescued group, showing the development direction from uncontrollable to controllable; The vertical axis is relief management, showing the development process from traditional management without digitization to digital management. As shown in Figure 1:

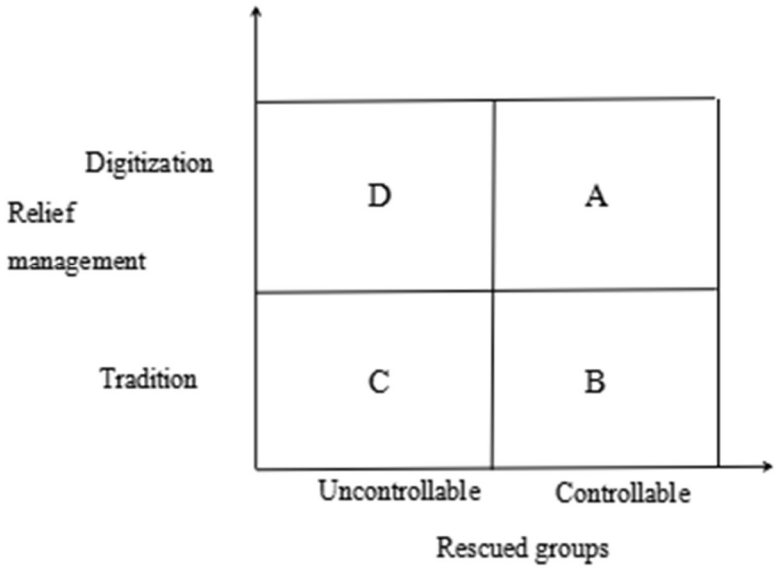

Figure 1. The development process from traditional management without digitization to digital management.

In Fig. 1, area A is the state of digital management and controlled; area B is the state of traditional management and controlled; area C is the state of traditional management and uncontrolled; area D is a state digital management and uncontrolled

Among:

1) Area AB, diS<deS, indicating that the realization of social assistance controllable state, traditional and digital could be achieved, but the degree and the way to achieve different.

2) Area CD, diS>deS, indicating that there is also an uncontrollable state of assistance in the traditional and digital implementation process.

To achieve a negative total entropy value dS, it is necessary to reduce the positive entropy increase diS and increase the negative entropy flow deS, only by deeply analyzing the characteristics of positive and negative entropy flows.

3.2. Characteristics Analysis of Positive Entropy Increase (diS)

Positive entropy increase guides the rescued group to the uncontrollable direction. Therefore, the rescued group have the characteristics of volatility, uncertainty, and complexity.

1) Volatility, which is mainly the characteristics of social assistance groups in the emergency state. Specifically, it includes temporary assistance, vagrants and beggars without living assistance, and emergency assistance for people with difficulties in public emergencies such as major epidemics. For example, the risk of COVID-19 epidemic has caused some specific marginalized groups to be unable to obtain relief policies and application processes in time, such as homeless people, disabled people, lonely and widowed elderly people, and other groups to fall into poverty.

2) Uncertainty, which is mainly the characteristics of assistance groups in basic livelihood protection state. It included the minimum living security and poor assistance support. Due to the lack of positioning technology, it is impossible to accurately identify unstable groups hovering at the poverty line.

3) Complexity, which is mainly the characteristics of social assistance groups in special assistance. In China, special assistance includes medical assistance, education assistance, housing assistance, employment assistance, disaster assistance, and other assistance. Among them, other assistance includes legal aid, judicial assistance, rehabilitation assistance for disabled children, living allowance for disabled people with difficulties, nursing allowance for severely disabled people, basic living guarantee for orphans, and relief of basic funeral service fees for people with death difficulties. In summary, the data of assistance groups is diversity and complexity, which are difficult to aim at the target center resident.

3.3. Characteristics Analysis of the Negative Entropy Flow (deS)

Negative entropy flow is to make the relief work develop to a controllable state through relief management. Corresponding to the positive entropy flow, the negative entropy flow also has the same characteristics of volatility, uncertainty and complexity.

1) Volatility. The volatility of emergency social assistance groups makes social assistance involving different authorities and social organizations. With the implementation of the relief work, different departments and social organizations would join or withdraw. So that, assistance organizations have variability.

2) Uncertainty. To help basic living assistance groups, China 's social assistance works are led by the civil affairs ministry and coordinated by the relevant ministries. As the contents of assistance are more focused on medical care, education, security, etc., Service-oriented social assistance produce inevitably repeated assistance and assistance blind spots. Uncertainty brings waste and mismatch of relief resources.

The main reasons are the rescue information blocked. In the current social assistance work, the lack of the digital assistance platform result in the information not smooth among the assistance ministries and the departments. The data information barrier has not been completely eliminated, which objectively leads to the phenomenon that the people who ask for help run repeatedly.

At the same time, the dissemination of assistance policy information is not effectively disseminated. The low transparency of the relief policy makes the public question the fairness of the relief and think that there are good friends and black-box operations in the relief, which leads to the occurrence of related petition incidents.

3) Complexity. The complexity of special social assistance determines the complexity of relief management. There are several reasons for the formation of this complexity.

The first is the dispersion of relief resources. It is difficult to integrate resources to form a rescue force, which leads to the inability to actively discover the information of the rescued group seeking help and the inability to implement accurate assistance. At the same time, there are phenomena such as slow transfer of assistance, low efficiency of assistance, repeated assistance, multiple assistance, and fragmented assistance.

The second social assistance network isn`t perfect. Four-level assistance network system has been established in China. There are cities, districts and counties, streets (towns), and villages (communities). The network lacks effective linkage and has not yet fully demonstrated overall strength.

The third social assistance lacks unified management mechanism and couldn`t co-ordinate the problem of multi-ministries and cross-regional. Different rescuers have different operating mechanisms, and the cooperative action mechanism between different subjects also has problems of technical failure, system failure or unimpeded operation.

The fourth social assistance force is not meet assistance need. In practice, charitable assistance is faced with the problem that the “charity cake” is not big enough, and the number of charitable organizations and the total amount of charitable donations need to be improved. Although social workers and voluntary service organizations have achieved remarkable results in participating in the assistance, the lack of participation ways have limited their force

4. The Digital Transformation of Social Assistance Entropy Change

4.1. Research on the Current Situation of Digital Transformation

With the continuous maturity of digital technology, the application of digital technology has become a new direction for the development of social assistance innovation. Some regions are promoting the construction of social assistance informatization and have made some effective attempts to solve the volatility, uncertainty and complexity.

1) Research on transformation mode

The social assistance digital transformation is roughly divided into two ways in China. One is to emphasize technological innovation. It is combined traditional social assistance with information technology, big data, Internet, 5G technology, block-chain, artificial intelligence, etc., which strengthens the reform of the social assistance model of deep integration of online and offline services through the electronic information platform. The other is to emphasize service precision. The digital transformation of social assistance is to make the policy benefits more equal to the disadvantaged groups in the society who cannot maintain their basic life. The use of digital technology and Internet government platform to provide more convenient and efficient, more intelligent and accurate, more high-quality, more humane relief services for vulnerable groups.

2) Transformation case analysis

Wu and Guan [1] collected and arranged cases provided by network platforms, including the official website of the Ministry of Civil Affairs, the official website of local governments and the official WeChat public account, and summarized typical cases as shown in Table 1.

Table 1. Typical cases of digital transformation of social assistance and their functional advantages.

No.	Typical case	Main function or advantage
1	Huayang Road, Changning District, Shanghai, "Community cloud + precise help" pilot street	(1) the number of wisdoms leading, "accurate" locking efficiency is high. (2) the system enables, "forward-looking" intervention initiative is strong. (3) linking resources, "targeted" service response is accurate.
2	Beijing Chongwen District Social Assistance Information Platform (now Dongcheng District)	(1) the information integration function. (2) the function of resource allocation. (3) business approval function. (4) fourth, intelligent rescue function.
3	Huainan City, Anhui Province Social Assistance Integrated Service Information Platform	(1) through information sharing to achieve effective and rational allocation of resources. (2) fully integrating rescue resources and unblock rescue ways.
4	Zhejiang Province's ' one database, one network, one platform ' low-income population wisdom assistance system	(1) multi-channel convergence of low-income population base database. (2) multi-dimensional monitoring of low-income groups security protection network. (3) multi-agent assistance to create a low-income population intelligent rescue service consortium.
5	Inner Mongolia Autonomous Region Xing 'an League Civil Affairs Bureau social assistance information management system construction project	(1) self-help application. (2) online accounting. (3) online publicity. (4) setting up an exclusive two-dimensional code to establish a citizen understanding card. (5) the survival authentication system. (6) complaint reporting feedback.
6	The " five modernizations " intelligent rescue system of Changzhou intelligent rescue platform in Jiangsu Province	(1) integrated integration, rescue more convenient and efficient. (2) intelligent research and judgment, more accurate rescue coverage.
7	Jiangsu Suzhou Industrial Park 'Save So Do 'social assistance service platform	(1) the policy to find people. (2) monitoring and early warning. (3) a one-key bid. (4) mobilizing social forces to participate in social assistance.

8	Dezhou Leling City, Shandong Province 's ' Dejiu ' WeChat Mini Program	(1) establishing a "network coverage, whole-chain management" care service system for people in extreme poverty. (2) people with difficulties have realized the transformation from "receiving assistance" to "self-help" and then to "helping others".
9	Taian Feicheng City, Shandong Province, "a door to accept collaborative management" comprehensive rescue window	(1) achieving information exchange. (2) the assistance is more accurate. (3) improving the efficiency of staff. (4) realizing the integration of rescue resources and maximize the benefits. (5) creating a comprehensive evaluation system for difficult families.
10	Shandong Zibo Boshan District ' Boshan e Rescue ' WeChat Mini Program	(1) using a Netcom, so that the data run more, the masses run less errand. (2) taking the initiative to discover, from "people looking for policy" to "policy looking for people". (3) Integration resource to create a new model of "material + service +e".

It can be seen from Table 1:

1) Various types of government APPs and applets, government service websites, government official microblogs and WeChat public accounts are the carriers of digital social assistance, which indicates that digital platforms based on information and communication technologies can achieve digital transformation.

2) The digital construction in various places is carried out from the perspectives of positive entropy increase and negative entropy flow. For the positive entropy increase, it is convenient for the rescuers to actively seek assistance through the information platform. Compared with the positive entropy increase, the digital application is more to increase the negative entropy flow, and it is convenient to the relief manager for the management of the rescuers through the digital platform.

4.2. The Dilemma of Digital Transformation

A series of achievements has been made in the digital transformation of social assistance. However, most of them remain at the level of traditional offline assistance in the actual implementation process, and the degree of digitization is low. The reasons are still analyzed from the characteristics of volatility, uncertainty and complexity.

1) Volatility.

The technical support is not enough in the digital transformation of social assistance. The basic levels assistance management has fewer people and more things, and often face the embarrassing situation of less technical training and lack of resources, which leads to difficulties in system implementation. At the same time, digitalization requires the construction of corresponding infrastructure. The lack of funds, talents and technologies leads to the difficulty of related infrastructure construction and the difficulty of promoting the digital transformation of social assistance.

2) Uncertainty

It is difficult to integrate the data of government, non-profit organizations or charities and form comprehensive and accurate rescue data when the social assistance system platform is embedded with diversified rescue subjects. Due to the poor information communication between government

departments, there are cracks in the transmission of information, and the civil affairs department audits the insufficient information of poor households, resulting in the anomie of digital governance behavior.

In addition, the social assistance service presents the diversification and personalization of the group's needs. The traditional "equal treatment" service has been difficult to meet its personalized needs.

3) Complexity

In theory, in the process of digital transformation of social assistance, the responsible subject of business handling use comprehensively the intelligent office digital system of government departments, collect the basic data of residents mastered by various departments for measurement and analysis, effectively break the business information barriers between various departments, and achieve the goal of "one thing to handle". However, in some areas, there are a phenomenon that data sharing is not smooth in the process of building a social assistance information platform. Although there is a linkage and collaborative operation mechanism between departments, the databases of some administrative departments are not compatible, which makes it difficult to exchange data. As a result, the social assistance platform unable to fully obtain sufficient data, making it difficult for relevant departments to deeply understand the needs and characteristics of the recipients, and it is also difficult to adjust the relief policy in a refined and effective manner.

From the three aspects of volatility, uncertainty and complexity, the application of big data in the field of social assistance is still lagging, and there is still much room for improvement.

5. Discussion on Optimization Path

5.1. Positive Entropy Increase Digital Transformation Optimization

1) Incorporate into the grid management system

Grid management is a model that relies on a digital network platform or unified urban management. Grid management divides the city into several jurisdictions and sets up management units through certain standards. Grid management teams are established and provide management services to the grid residents of the community. The teams conduct refined management by collecting relevant data to know the resident's status.

The role of community grid members is given full release. In line with the principle of "not losing one household, not missing one person", grid members propagandize the content and use of social assistance policies though going into villages and households, which enhance residents the awareness and understanding of assistance services.

2) Use the social assistance platform

The characteristics of their own needs is analyzed, including age, gender, income level, family status, clear interests, hobbies, consumption habits, etc. The interested services or policies are searched and shared on the social assistance platform. By compared different services or policies, residents' policies or services are chosen. Big data are expediently analyzed for managers and become decision-making basis, which improves service effect [9].

5.2. Negative Entropy Flow Digital Transformation Optimization

1) Enhance population dynamic monitoring and early warning information.

In October 2023, the Ministry of Civil Affairs and other 10 ministries and commissions jointly issued the "Opinions on Strengthening the Dynamic Monitoring of Low-income Populations and Doing a Good Job in Hierarchical and Classified Social Assistance" in China. The document stipulates normalized assistance is provided and used hierarchy according to dynamic monitoring and early warning information of low-income population and difficulty level and difficulty type of low-income population. The integration of social assistance data resources has entered a new stage of development [11].

2) Broaden the ways for expressing the interests and opinions of the rescuers.

The digitization of social assistance broadens the ways for recipients to express their interests and opinions, so that relevant departments can understand the needs of the rescued group more clearly and incorporate the real demands of the rescued group into the decision-making category, so as to further improve the social assistance mechanism.

3) Combine digital technology with institutional reform

The transparency and openness of the system are promoted by the combination of digital technology and institutional reform. The implementation of a network office, a window office, a window office and other models, and the use of electronic licenses, electronic signatures, electronic signatures and other technologies, to provide convenient and efficient social assistance services for the masses, saving the use of service time.

The digital transformation of social assistance has changed the traditional situation of social assistance, shortening working time and improving service experience of social assistance present the innovative paradigm of social assistance service. Public service spirit of service-oriented government would be better demonstrated.

6. Conclusion

In China, the digital transformation of social assistance is underway, and some achievements have been made, which has improved the traditional assistance ability. The social assistance system is a complex system, and there are still various problems in the transition period.

The research introduces entropy change theory into social assistance. The whole social assistance system is taken as a system. In the system, when absence of external environmental impact or ineffective management, the rescued group couldn`t solve their own difficulties, and the social assistance system as a system diS only go to disorder state. The entropy flows deS represents the management of social assistance. Through the effective management of social assistance, the whole rescuers would be in an orderly state, so deS makes the whole system tend to be orderly.

Set the rescued group as the horizontal axis and the relief management as the vertical axis. A two-dimensional quadrant of the entropy of the social assistance system is formed. It shows that both traditional assistance and digital transformation assistance can realize the orderly development of the rescued group, but the degree and way of realization is different. However, if there are problems in the implementation process, there is also a state of uncontrollable rescue. It is necessary to promote the digital transformation and optimization of social assistance and improve the efficiency of social assistance.

Social assistance system has the characteristics of volatility, uncertainty and complexity by the characteristics analysis of positive entropy increase and negative entropy flow. At the same time,

digital transformation is also faced with problems of variability, uncertainty and complexity through the existing model and case analysis.

To solve the problems of volatility, uncertainty and complexity, the research puts forward digital transformation way of social assistance system from the perspectives of negative entropy increase and positive entropy flow.

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