The Transforming Bridge Method of Urban Comprehensive Disaster Prevention Plan Strategy Generation

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Abstract: The urban comprehensive disaster prevention plan is frequently incapable of sufficiently achieving balance between the synthesis goals of ordinary disasters and severe disasters. This paper draws support from the transforming bridge method to propose reasoning and methodologies for the development of urban disaster prevention plan strategies. It is focused on resolving the synthesis problem in urban comprehensive disaster prevention plans. Furthermore, it steps closer to providing the conceptual construction of a transforming bridge strategy generating system. It calls for a computational aid in the production of a smart urban comprehensive disaster prevention strategy and provides a theoretical basis for the technological support.

Keywords: Urban comprehensive disaster prevention plan; Transforming bridge; Strategy generating system

1. Introduction

The urban comprehensive disaster prevention plan includes land use, spatial layout, and other disaster prevention works related to urban disaster security. It includes space and facilities to carry out comprehensive deployment and management of specific arrangements [1]. Synthesisshould be the plan’s largest feature, principally for combining each type of disaster and disaster defense plan as well as coordinating with the overall urban plan [2]. ShioriShimokawa of the school of environmental engineering, Kitakyushu University studied the application of urban planning information system in large-scale disaster prevention of rainstorm and flood [3]. The virtual permission framework(VP) developed by MouloudMessaoudi of the University of Florida can solve the current problems related to the post disaster reconstruction work and save resources and time [4]. Through the case study of bantour earthquake, Ineke K. Haryana, etc. of GadjahMada University in Yogyakarta, proposed the application of remote sensing and geographic information system based on Disaster Reduction [5]. Augustine o. esogbue, Georgia Institute of technology, uses the modeling and optimization technology based on the fuzzy set theory to control or reduce the impact of disasters [6]. Alejandro Quintero of the higher vocational and Technical College of Montreal, set up an intelligent decision support system for coordinated management of urban infrastructure to improve urban infrastructure management [7]. Liu Qingrong of the State Oceanic Administration have developed a storm surge disaster risk assessment numerical model based on numerical model and remote sensing [8]. Satoru Iizuka of Nagoya University predicted the urban thermal environment of Nagoya metropolitan area in the future, and introduced three disaster reduction urban structure models for the future prediction [9]. Bernard manyena of the University of Northumbria, UK, etc. put forward a new method of disaster resistance called comprehensive transformation framework of disaster resistance[10]. Nuhaetinay, South Bank Universityimprove urban resilience by integrating UN Habitat urban system model methods, and develop disaster risk reduction management (DRM) [11]. The idea behind the transforming bridge method is that each actor does what it thinks is correct, and each will be sufficiently provided, the opposing two sides create a transformation that enables coexistence [12]. This paper puts forward procedures and methods to generate an urban comprehensive disaster prevention plan via the transforming bridge strategy.

2. Problem Generation

In the problem generation section, it is most important to subdivide the problem into constituent collections of data. Figure 1 shows the important link between model expression and automatic generation.

2.1. Problem collection

This paper demonstrates disaster response plan synthesis to solve the crucial problem of dividing and combining the problem with more simultaneous problems. Based on temporal factors, the normal disaster connection problem can be divided into connection problems during normal operation and disaster connection problems. Furthermore, based on disaster type, simultaneous disaster damage can be divided into primary damage and secondary damage caused by the simultaneous problems.

2.2. Expressing the problem model

In the field of Extenics, disaster response synthesis problems can be classified as problems with many conflicting goals. The antithetical problem model $(G_1 \wedge G_2) \uparrow L$ and Extenics symbols can be used to evaluate the expression.

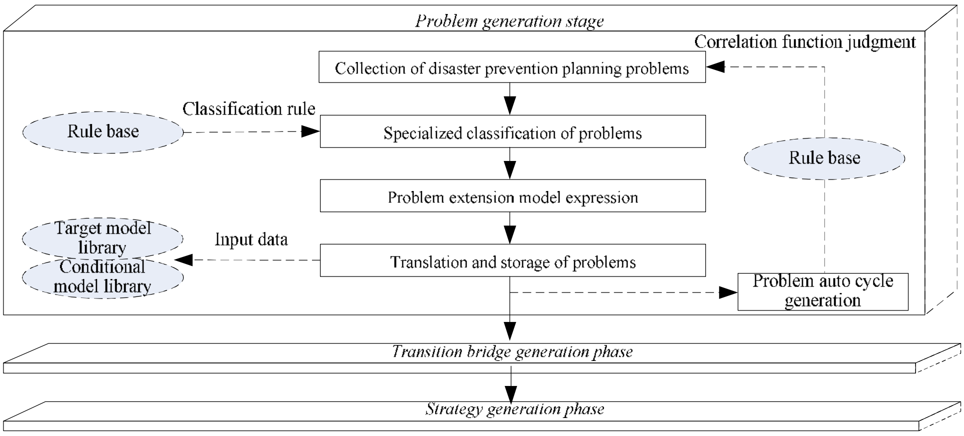

Figure 1. Problem generation process

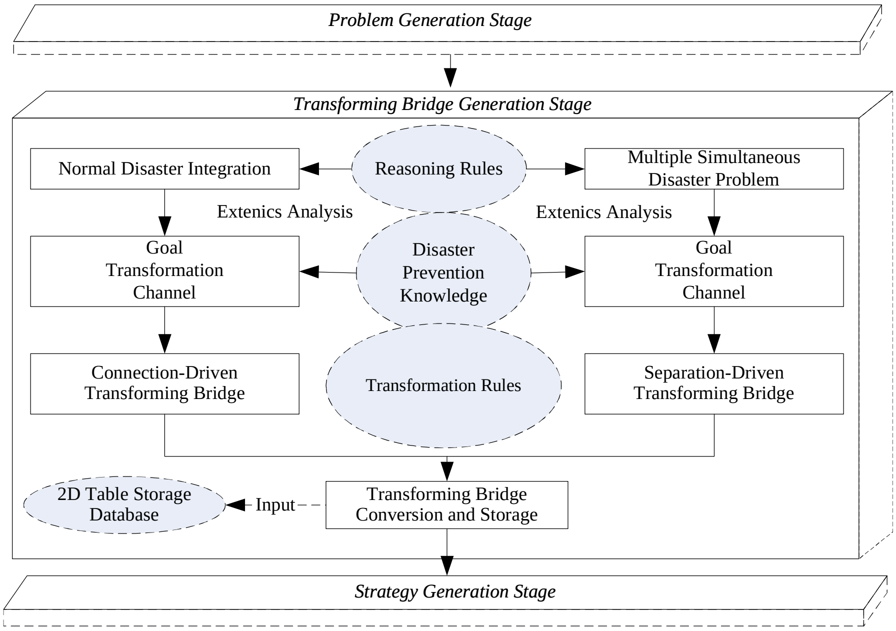

Figure 2. Transforming bridge generation process

3. Transforming Bridge Generation

The transforming bridge method aims for the 'win-win' plan, which completes the main disaster prevention goal while achieving other secondary objectives. This study aims to utilize the transforming bridge idea to improve the extension strategy generation system, and create transforming a bridge generating program (Figure 2)to undertake the problem generation stage and lead to the strategy generation stage. The transforming Bridge strategy generation system, not only utilizes the traditional rule base of storage extension deduction and transformation, but also the added knowledge base and transforming bridge base of comprehensive disaster prevention, making it more suitable for solving the multifaceted problems in disaster prevention planning. The solutions for transforming bridge can be separated into two categories: connection-driven and separation-driven. Separation-driven method is more suitable for solving multiple simultaneous disasters while connection-driven is more suitable for solving a single large disaster.

4. Transforming Bridge Method

4.1. Separation driven transforming bridge method

The separation driven transforming bridge is made up of separation-driven shifts in events and condition changes. In a large system, the antithetical problem can be expressed as a decomposition T using Z to decompose S into S1 and S2. In the solution to the antithetical problem, Z is called S's separated pivot point, referred to as $TS=S_1|Z|S_2$ [12]. The process to create the separated pivot point is created through the decomposition of T. Once the separated pivot point is generated it can judge the link between strategy creation and the degree of coexistence. In the transforming bridge method the creation of the separated pivot point provides for more types of functional components. If the Extenics rule set is dispersed, it contains and performs conjugate analysis on other Extinics inferences to serve as a prerequisite to carry out analysis.

The separation-driven transforming bridge method can be used to solve a comprehensive disaster response plan in the event of multiple simultaneous disasters. Its advantages lie in its abilities to allow Extenics analysis to be performed on the conditions of a disaster response plan. Finding the separated pivot point divides the focus of the problem allowing for temporal separation, spatial separation, functional separation, and morphological separation. This method should be beneficial to implement disaster response specific land and facilities before a disaster occurs, provide help during the disaster, and help with reconstruction functionality after the disaster. It can improve the vector of disaster response for dissimilar damage categories and provide comprehensive defense against secondary damage. It can also enhance the rescue effectiveness when faced with damage from a sudden, unexpected disaster.

4.2. Separation driven transforming bridge case analysis

The Tianjin city government plans to construct the Tianjin Port Eco-Park above the ruins of the disaster site (Figure 3) Its importance comes from the three different uses of this land which will include a park, a community supporting space, and public management location. The park's construction goal should not be to limit or remove the influence of the explosion, but rather to help prevent future potential disasters and improve the port area's comprehensive disaster prevention ability. However, due to the limited area and lingering materials left over from the explosion, the park's ecology should attempt to restore the design goal of a place to take refuge.

$$G_1=\begin{bmatrix} \text{First Goal}, & \text{Content}, & \text{Ecological Restoration} \oplus \text{Commemoration} \\ \Delta & \text{Strategy}, & \text{Ecological Area} \oplus \text{Landscape Design} \\ \Delta & \text{Landform}, & \text{Depression} \end{bmatrix}$$

$$G_2=\begin{bmatrix} \text{Second Goal}, & \text{Content}, & \text{Disaster Prevention} \oplus \text{Safet Refuge} \\ \Delta & \text{Strategy}, & \text{Disaster Prevention Space} \oplus \text{Disaster Prevention Facilities} \\ \Delta & \text{Landform}, & \text{Level} \end{bmatrix}$$

The goal of the ecological refuge is to eliminate the influences of the explosion and reflect and commemorate the event. The goal of disaster prevention refuge is to provide space for comprehensive disaster prevention capabilities. It is required to provide citizens with security, a level evacuation grounds, and a refuge area. Thus within the area's design goal there exists an obvious contradiction, namely $(G_1 \wedge G_2)\uparrow L$.

$$L=\begin{bmatrix} \text{Area A}, & \text{Land Area}, & 48\ \text{Hectares} \\ \Delta & \text{Components}, & \text{Northern Area} \oplus \text{Southern Area} \\ \Delta & \text{Internal Roads}, & \text{Jiyun Primary Road} \oplus \text{Jiyun Secondary Road} \end{bmatrix}$$

$$L=L_{it}\oplus L_{ap}=\begin{bmatrix} \text{Area } A_1, & \text{Land Area}, & 40\ \text{Hectares} \\ \Delta & \text{Position}, & \text{Explosion Surroundings} \\ \Delta & \text{Pollution Level}, & \text{Slight} \end{bmatrix} \oplus \begin{bmatrix} \text{Area } A_2, & \text{Land Area}, & 8\ \text{Hectares} \\ \Delta & \text{Position}, & \text{Explosion Site} \\ \Delta & \text{Pollution Level}, & \text{Critical} \end{bmatrix}$$

$$L' = TL = L'_1 \oplus L'_2$$

$$L'_1=L_{it}/Z/=\begin{bmatrix} \text{Disaster Response Park}, & \text{Components}, & \text{Many Types of Land} \oplus \text{Many Types of Facilities} \\ \Delta & \text{Location}, & \text{Park Surroundings} \\ \Delta & \text{Functionality}, & \text{Damage Prevention} \oplus \text{Security Refuge} \end{bmatrix}$$

$$L'_2=/Z/L_{ap}=\begin{bmatrix} \text{Eco}-\text{Park}, & \text{Components}, & \text{Forest} \oplus \text{Manmade Lake} \\ \Delta & \text{Location}, & \text{Park Center} \\ \Delta & \text{Functionality}, & \text{Separate Ecology} \oplus \text{Landform Protection} \end{bmatrix}$$

$$Z=\begin{bmatrix} \text{Boundary}, & \text{Above Ground Components}, & \text{Shelterbelt} \\ \Delta & \text{Under Ground Components}, & \text{Concrete Isolation Band} \\ \Delta & \text{Location}, & \text{Explosion Crater Rim} \end{bmatrix}$$

The specific locations can be formulated based on specialized knowledge about soil pollution levels and data analysis on the explosions influence and range. Thus the above ground forested shelterbelt and the underground concrete isolation will create isolated partitions allowing for simultaneous ecological restoration and resettlement in the disaster response park design (Figure 4).

When faced with an antithetical problem, a transforming bridge can be used to express the disaster response plan's strategies, vectors, scope, composition, and reasoning. Furthermore, the strategy generation system implementation can be combined with a computation database to provide for efficient plan preparation and rich decision making. This leads to the creation of strong problem solving ideas.

Figure 3. Design of tianjin port ecological park

Figure 4. Tianjin port disaster response park design proposal

5. Strategy Generation

The components of the strategy generation stage include strategy verification, evaluation, storage, and the expression of the results for a particular plan.

5.1. Strategy correlation function verification

The transforming bridge method can only solve the preliminary conception of a disaster response plan's antithetical problem. To generate a problem solving strategy it is still necessary to use a rules database and correlation function to judge the degree of coexistence and adherence to professional standards in the disaster response plan.

5.2. Strategy evaluation

Through the calculation of coexistence the optimal problem solving strategy can be obtained. Specialized knowledge is still needed to carry out optimal selection evaluation to determine the best strategy. Below, the gas station location example is continued to introduce the process flow for strategy evaluation.

6. Conclusion

This paper's research goal is to use the transforming bridge method to implement an urban disaster response plan with synthesis and comprehensive natures. It treats problem creation, transforming bridge creation, and strategy creation as four distinct steps. It provides an Extenics model and automatic generation principal for urban disaster response planes. It illustrates a separation-driven transforming bridge method for multiple simultaneous disasters. It describes strategy correlation function judgement, quality evaluation, and result expression method for rules. It establishes a two dimensional transforming bridge database platform for an urban disaster response plan. Subsequent research work will include: continuing to use database technology and specialized knowledge to plan an urban comprehensive disaster response plan's architecture, using a manual alternative test strategy to determine a plan's applicability and enforce standardization, and using visualization to develop urban comprehensive disaster response plan transforming bridge strategy creation software.

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