Hindawi
Complexity
Volume 2021, Article ID 6699204, 19 pages
https://doi.org/10.1155/2021/6699204

Research Article

Reconstruction of ER Network from Specific Academic Texts for the Governance of MSW-NIMBY Crisis in China

Qing Yang,[1,2] **Hui Zhou**,[2] **Xingxing Liu**,[1] **Chen Zuo**,[2] **and Jinmei Wang**[2]

[1]*School of Safety Science and Emergency Management, Wuhan University of Technology, Wuhan 430070, Hubei, China*
[2]*School of Management, Wuhan University of Technology, Wuhan 430070, Hubei, China*

Correspondence should be addressed to Xingxing Liu; liuxingxing@whut.edu.cn

Received 13 December 2020; Revised 8 February 2021; Accepted 1 April 2021; Published 15 April 2021

Academic Editor: Wei Zhang

Along with urban development globally, the NIMBY (Not-In-My-Backyard) crisis has been a complex social problem, which requires urgent remedial action. The inevitable management of Municipal Solid Waste (MSW) has been one of the toughest risk management tasks in the worldwide modernization process. At present, certain fuzzy and unstructured results and methods have been formed for MSW-NIMBY crisis response, mainly focusing on the sociology and politics which scatter in complex and sensitive reports and news. Aiming at enhancing the effectiveness of data mining from specific sparse text of MSW-NIMBY crisis, an improved knowledge extraction method is developed. Through rule-based text mining and complex network analysis, the Entity Relationship (ER) network of MSW-NIMBY crisis is reconstructed. Meanwhile, a novel transitivity for relationship between entities in semantic analysis is proposed to improve the feasibility and accuracy of information extraction. Characteristics and regularity of MSW-NIMBY crisis evolution and experience of crisis governance could be identified effectively. Results show that knowledge integration and ER transitivity can enhance knowledge recognition and major other factors, which could help formulate the governance strategies of NIMBY crisis from academic texts.

1. Introduction

With the development of modernization and urbanization, environmental conflict has been a top global focus and an issue for urban sustainable development. It is generally believed that some facilities with negative effects were built in this process, such as nuclear power plants, waste incinerator plants, and sewage plants, etc. [1–3]. It widely causes resistance and conflict between surrounding residents and local authorities [4], and this phenomenon is named as "NIMBY" [5]. After the 1970s, as more and more countries and regions have realized industrialization, NIMBY gradually became a cosmopolitan problem. Taking the United States as an example, NIMBY caused almost half of all clean energy projects to be delayed or abandoned [6], and only 8 of 81 toxic waste disposal sites scheduled to be built between 1980 and 1987 were successfully completed [7]. The impacts of various types of NIMBY facilities on society are complex and diverse in nature [8], and the risks are constantly changing due to the uncertainty of the types and interests of relevant stakeholders [9]. On the other hand, NIMBY crisis involves the interests of the masses and highly sensitive political decisions. It is difficult to be resolved once it has emerged, which has become one of the serious risks of "modernity" the transnational world faces [10]. The increases in public environmental awareness and community living standards, and the rapid development of media also have greatly accelerated the outbreak of the NIMBY crisis [11], especially in developing countries with a high population density. The rising NIMBY protest movement within the city caused by MSW has become a serious challenge during the process of urbanization in China [12].

Until 2019, there are about 330 MSW incineration facilities in China [13], but from 2007 to 2016 with more than five anti-incinerator demonstrations annually that claimed the relocation of MSW incineration facilities [14]. The continuous criticisms and protests that occurred in China in recent years show the significant characteristics of numerous

participants, unpredictable tendencies, strong diffusivity, and urgently required system solutions. Once the MSW-NIMBY crisis occurs, it usually creates tension between residents, local governments, and the private sector, and results in hindering waste disposal, causing trust crisis in the government and even triggering large-scale public events [15]. How to alleviate NIMBY crisis in MSW management would have a sustainable global impact. Although the existing literatures have not paid much attention to this issue, it has become the key point of managing MSW dilemma, strengthening the urban planning and development control, and promoting the construction of ecological civilization and environmental sustainability [16, 17].

The study of NIMBY crisis in the context of China shows hysteresis, compared with many western countries. It mainly focuses on related concepts [18], influence factors [15, 19], control measures [20], and relevant resolving experience [21], but most of them use qualitative and common methods, such as focus interviews to analyze effectiveness of public participation [22], case analysis to study government strategic orientation [23], and promotion of public participation [24], etc. There are relatively simple research types. The quantitative research just focuses on the site selection of NIMBY facilities [25] and other aspects mostly using structured interviews [26], questionnaires [27], and other positive methods for statistical analysis. Although scholars in this field are constantly innovating with regard to the research methods on MSW-NIMBY crisis, there is still a lack of scientific quantitative methods to enrich the theoretical basis of MSW-NIMBY crisis governance. This is because the problem of NIMBY generally has a strong political sensitivity, involving issues of national and social stability. It is difficult to obtain authoritative data or information from open access resources, such as the insufficient waste service in developing countries [28]. It results in research on such political sensitivity issues having certain limitations, and having not formed a complete method system yet. Therefore, the main contributions of our work could be summarized as follows:

(i) Constructing a systematic method of knowledge integration for complex and scattered information, and providing the reference for textual research on politically sensitive issues.

(ii) ER network of MSW-NIMBY crisis is reconstructed, which could help find key information and relationships, and a novel transitivity in semantic analysis is proposed to improve feasibility and accuracy of text analysis.

(iii) The application of a novel transitivity in semantic analysis could help identify characteristics and regularity of MSW-NIMBY crisis effectively, which provides method support for other NIMBY crisis governance.

The remainder of this paper is organized as follows: It addresses an analysis of related works on MSW-NIMBY crisis along Section 2. Section 3 describes the proposed method of using network to research in detail. The complete experiment and application of MSW-NIMBY crisis are presented in Section 4. In Section 5, analysis results show the mined information and knowledge in this field. Conclusions are given in Section 6.

2. Related Work

This research aims to obtain valuable knowledge from text information. This kind of text processing technology that extracts specified types of unstructured information from natural language text and converts it into structured data output is known as information extraction [29]. ER extraction is one of the most important and difficult contents, and it is also a key to the integration and analysis of Chinese text knowledge, especially such social science issues. The method of Chinese ER extraction is innovated based on the bidirectional maximum entropy Markov model [30], ontologies, and bidirectional long short-term memory [31], which all improve the precision or operability of extraction. Information extraction technology has extensive research and application in the fields of medicine, health, traffic, and artificial intelligence [32–34]. However, the current research in the field of MSW-NIMBY does not have a unified specification or standard expression, and the research of semantic analysis on Chinese is limited. A more accurate supervised extraction method is selected to identify the relationship between entities based on rules.

In addition, existing research on MSW-NIMBY crisis mostly focuses on explaining the outcome of NIMBY conflict and decision-making on NIMBY facilities, with the multiple theoretical and methodological approaches [35]. But all of them have largely neglected the role that nonhuman factors also played in such controversies and uncertain interactions within all factors [36], so that some scholars have called for social research on NIMBY crisis and its interaction with all factors [37, 38]. It has been discussed that NIMBY is a dynamic and complex problem involving mixed entities, including concepts, organizational departments, policy measures, influential factors [39], etc. It is characterized by inextricable relations among social, natural, and material factors [40], which have trouble in understanding and analyzing in sociological research. Among the approaches that have tried to develop a more complex analysis of the inherent relationship of NIMBY crisis, complex network occupies a prominent position because of its strong influence on theoretical and empirical sociological research [41].

Complex network not only focuses on the tight interdependence between an individual and others objectively in the system [42] but also keeps an eye on the overall interaction of the system from a holistic perspective [43]. It can analyze structural composition and relational components of evolving systems that cannot otherwise be identified using other techniques [44]. Complex network grasps the internal mechanism and system characteristics of complex systems, such as NIMBY, and provides reasonable indicators on quantitative analysis of network, namely, by the method of Social Network Analysis (SNA) [45], to tackle NIMBY problems. This kind of research in the form of network is

mostly used in information science, environmental science, geography, biomedicine, etc. [46]. In the fields of MSW and NIMBY, there are many scholars using network expression to research the public's acceptance of new energy infrastructure [47], the development of radicalism and organizational activities in NIMBY [48, 49], the relationship between stakeholders in waste management [50], etc. Most of the existing researches are mainly expressed in the form of ER network [51], that is, the entities and relationships between them are directly abstracted from the real world and presented in the form of network.

ER network can find the generality of a complex system under a unified framework by abstracting entities with different attributes into nodes, using links to represent relationships between entities, and then quantifying the indexes of network structure with nodes and links as components [52]. In natural language, the discontinuous structure of ER can represent semantic units such as words, sentences, and paragraphs, reflecting information from text as a network. This is based on the language-dependent constraint that each word or phrase is mapped into a node and edges are established according to syntactical relations [53]. Such textual representation has allowed the investigation of basic human behavior [54]. For example, expressing the words in the message set as an undirected graph [55], ranking events based on event relation graph for a single document [56], and expressing relationships between entities by Multi-Entity Bayesian networks [57], and so on. The method based on network model is effective because it can obtain the global information of network comprehensively, namely, the global information of text, through iterative calculation [58]. Note that there is an issue that the presence of specific words other than relevant entities in the network may hinder the accurate recognition of patterns. While several available methods grasp the ER between all words or specific classes of words as the characteristics of complex networks [59, 60], only a few researches focus on solving the problems of insufficient accuracy and difficulty in grasping the key points of the network constructed from text information. In this sense, this paper constructs a networked text representation by introducing the transitive expression of relationship, to analyze it more clearly.

The scientific literatures often contain a lot of information and knowledge, and store abundant research achievements. Inspired by the ER network, a series of rules for ER extraction and transitive relation model can be established to acquire overall information of MSW-NIMBY crisis from scientific literatures more accurately, and provide a solution for environmental conflicts like MSW-NIMBY crisis.

3. MSW-NIMBY Crisis Network

In this section, we present and explain all the methods used to construct the MSW-NIMBY crisis network. Rule-based ER extraction for MSW-NIMBY is proposed conforming to Chinese syntactic structures for information extraction. The transitive relation model is constructed by introducing transitivity in order to optimize ER network. The ultimate purpose of this research is digging valuable information from ER network in the MSW-NIMBY crisis. SNA is a common method in network analysis, which focuses on graph-theoretic properties of social networks with mathematical methods [61, 62]. This analysis method for structural networks focuses on the structure, pattern, topological complexities, and implications of interacting entities [63, 64].

In order to build the MSW-NIMBY crisis network, we propose a series of methods adapted to the specific requirements of any administrative domain, as shown in Figure 1.

Beginning from extracting ER triples by the semantic annotation and customized sentence rules of extraction, the relation transmission of ER triples is reconstructed and reinterpreted by the novel transitive relation model. In the network analysis, the macro level and micro level of measurements and disciplines can be analyzed comprehensively by SNA [65].

3.1. Rule-Based ER Extraction for MSW-NIMBY. ER extraction is a crucial part of information extraction, which is a text-processing technology extracting entities, relationships, events, and other unstructured information from natural language and converting them into structured data output [66]. Its task is to extract the triple (*Entity1*, *Relationship*, *Entity2*) from text, where (*Entity1*, *Entity2*) is an entity pair with some relationship, and "*Relationship*" is the word or word-sequence that describes the semantic relationship between entities in the context. For example, in the text "*NIMBY facilities generate negative externality effects*," the ER triple (*NIMBY facilities, Generate, Negative externality effects*) can be extracted to establish connection. That is, there is a relationship of "*Generate*" between "*NIMBY facilities*" and "*Negative externality effects*."

It is inconvenient to specify the classification of relationships in advance in the open-domain information extraction. Besides, the content omission and semantic judgment are necessary in extraction of complex sentences. There is a common method that using the vocabulary in the corpus representing relationships to model the ER [67] and extract all types of relationships that exist in the text, because most of the syntactical connections occur between neighboring words in the same sentences [68]. This paper customizes the supervised extraction rules for open-domain information extraction. It includes formulating the template of semantic annotation in advance for word segmentation and semantic role labeling of Chinese language, and constructing the sentence rules to extract the ER triples.

3.1.1. Template of Semantic Annotation. The template is applied to deal with word segmentation and semantic role labeling. It uses specific labels to mark roles of semantic units such as words or phrases in the text [69], and completes the word segmentation when judging these semantic units. In this way, it can formally represent the role features and thematic connections of semantic units in the text. The

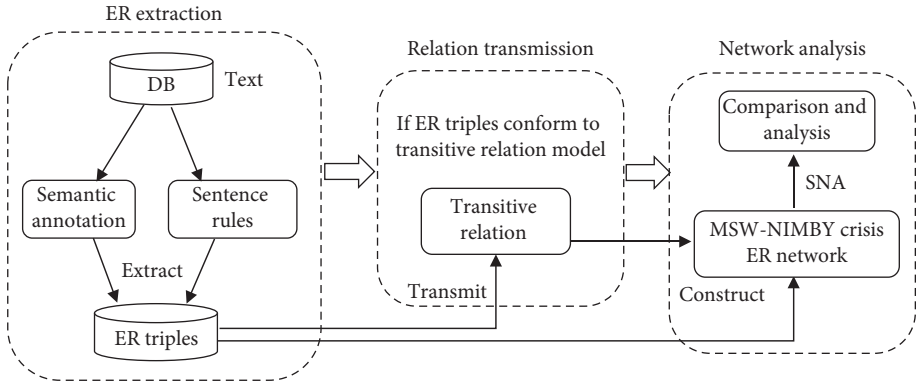


Figure 1: Overview of the research method proposed.

specified template of semantic annotation in the study of MSW-NIMBY, including the role label and its description, is shown in Table 1.

For the text of scientific research, the manual word segmentation and annotation for the semantic units in sentences can be done, according to their semantics and features. They are the premise of based-rules ER extraction. We use AE for action executor, which mostly represents the subject in sentences, and ACT for specific action of executor, including predicate verbs or linking verbs. AR is an action receiver and IAR is an indirect action receiver, which are expressed as direct object and indirect object, respectively, in the sentence structure. PREP and CONJ are conjunctions and prepositions, both of which are indispensable parts for analyzing structure and semantics of a sentence. In order to represent the preposition-object structure in English, POBJ is used to label object of preposition and expresses the action together with preposition. Besides, the component as an adverbial can be omitted in the manual annotation to simplify the extraction rules, or be retained to understand and extract sentences better, such as the adverbials of manner (MAN), purpose (PRP), reason (REA), background (BGD), condition (CND), time (TMP), location (LOC), etc. Because its definition is vague and it is not the key point of this research.

3.1.2. Sentence Rules for ER Extraction. ER triples almost only appear in stable syntactic structures, although the semantics in Chinese expression is very complex. There are many syntactic types containing characterization for relationship extraction, such as Subject-Predicate, Predicate-Object, Preposition-Object, and Coordinate and others [70]. A set of sentence rules for ER extraction of MSW-NIMBY in Chinese is constructed based on syntactic parsing [66]. It is based on 24 kinds of dependencies proposed by the LTP (language technology platform) of HIT-SCIR (Harbin Institute of Technology) [71]. It can be generalized into the combination of words, POS-tags, dependency paths, and dependency labels on paths [72]. We defined logical and graphical expression to display sentence rules in accordance with the above labels in the template of semantic annotation as well as extracted ER triples by the certain rules, as shown in Table 2. The rectangular block represents the annotated

Table 1: Template of semantic annotation in MSW-NIMBY.

Number	Label	Description
1	AE	Action executor
2	ACT	Action
3	AR	Action receiver
4	IAR	Indirect action receiver
5	PREP	Preposition
6	CONJ	Conjunction
7	POBJ	Object of preposition

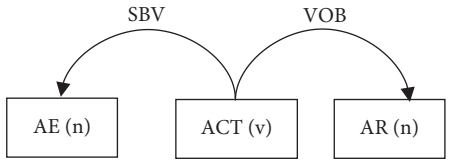
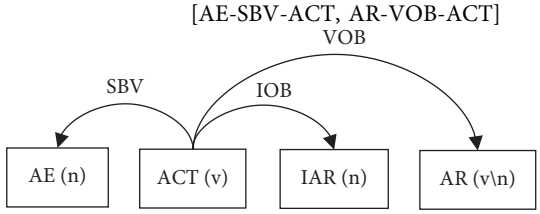
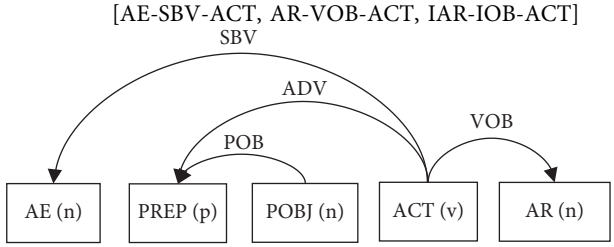
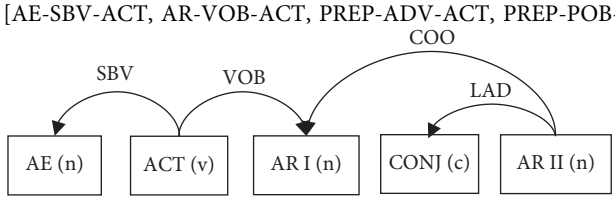
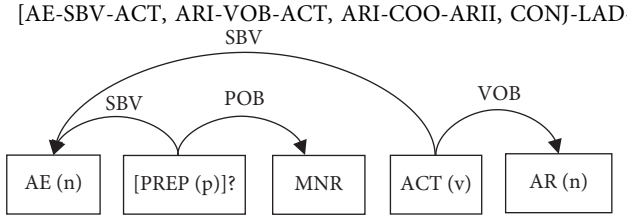
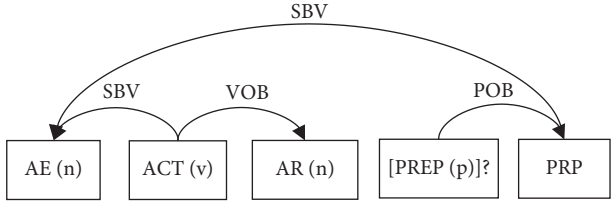
semantic unit, and the arrowed curve represents the dependency relationship between these two units, which is used to explain the specific relationship (these are all listed below).

This kind of rule-based ER extraction can be used for text information: using the template of semantic annotation to clarify each semantic unit and its role, and then extracting the ER triples in the text information according to the sentence rules. The specific applications of Rule1-Rule6 are explained as follows:

(i) *Simple Verbal Structure*. The Rule1 is often used in the verbal structure, in which the verb acts as the predicate phrase and may be the relationship word. For an entity pair, one is the subject of the predicate while the other is the object of the predicate, and both depend on the predicate word by labels SBV and VOB (these mean the kind of dependency labels defined by LTP from HIT-SCIR. http://www.ltp-cloud.com/intro). The triple (*NIMBY facilities, Generate, Negative externality effects*) can be extracted from the sentence "*NIMBY facilities generate negative externality effects*." We can easily extract this kind of ER triples based on Rule1.

(ii) *Double Object Structure*. The Rule2 applies to the double object structure. Taking the sentence "*Government gives inhabitant preferential policies*" as an example, it should be labelled as "[AE *Government*] [ACT *Gives*] [IAR *Inhabitant*] [AR *Preferential policies*]" according to Table 1. That is, there is a subject-predicate relationship (SBV) between [AE *Government*] and [ACT *Gives*], while [AR *Preferential policies*] is the direct receiver of the

Table 2: Sentence rules for ER extraction in MSW-NIMBY.

Rule	Logical and graphical expression	ER triple (Entity1); relationship, Entity2)
Rule1	 [AE-SBV-ACT, AR-VOB-ACT]	(AE, ACT, AR)
Rule2	 [AE-SBV-ACT, AR-VOB-ACT, IAR-IOB-ACT]	(AE, ACT, AR) (AE, ACT-AR, IAR)
Rule3	 [AE-SBV-ACT, AR-VOB-ACT, PREP-ADV-ACT, PREP-POB-POBJ]	(AE, ACT, AR) (AE, ACT-[AR]?-PREP, POBJ)
Rule4	 [AE-SBV-ACT, AR I-VOB-ACT, AR I-COO-AR II, CONJ-LAD-AR II]	(AE, ACT, ARI) (AE, ACT, ARII)
Rule5	 [AE-SBV-ACT, AR-VOB-ACT, AE-SBV-PREP, MNR-POB-PREP]	(AE, ACT, AR)
Rule6	 [AE-SBV-ACT, AR-VOB-ACT, AE-SBV-PRP, PREP-POB-PRP]	(AE, ACT, AR)

Note: – denotes the combination of two words. []?+ means the word occurring once or not.

action [ACT *Gives*] with the dependency relationship of VOB between them. [IAR *Inhabitant*] is the indirect receiver of the action [ACT *Gives*], namely, the indirect object (IOB) depends on it. The content should be retained at the greatest extent without violating the original intention of the sentence, so the two triples (*Government, Gives, Preferential policies*) and (*Government, Gives preferential policies, Inhabitant*) can be extracted.

(iii) *Light Verb Structure*. There are many light verb structures in Chinese expression, which is expressed as preposition-object structure in English. For example, in the sentence "*Government made a deal with citizens*," it is often expressed as "*Government with citizens made a deal*" in Chinese, and "*With...made a deal*" is a typical Chinese light verb structure. [AE *Government*] as the subject directly depends on the light verb [ACT *Made*] by SBV, and [AR *A deal*] as the object depends on the light verb [ACT *Made*] by VOB, which is obviously similar in the Rule1. Meanwhile [POBJ *Citizens*] follows the preposition [PREP *With*] as the prepositional object, indirectly depending on the light verb by POB and ADV. This structure can be handled with the Rule3, so the two triples (*Government, Made a deal, Citizens*) and (*Government, Made, A deal*) should be extracted. In addition, for the structure of the intransitive verb, it also can be treated as a light verb structure in ER extraction [73]. For example, the sentence "*The public protest in the street*" translated into Chinese gives us "*The public in the street protest*." There is no verbal object following the intransitive verb [ACT *Protest*], [AE *The public*], [PREP *In*], and [POBJ *The street*] with the same dependency relationships as the abovementioned light verb structure. At this time, only one triple of (*The public, Protest in, The street*) can be extracted, and the preposition cannot be omitted to ensure the semantic integrity.

(iv) *Coordinate Structure*. The Rule 4 adds a conjunction and an action receiver based on Rule1, used in the coordinate structure. This conjunction connects two action receivers expressing a coordinate relationship, both of which can be labelled as AR (distinguished by ARI and ARII in order to understand the extraction rules). The additional action receiver depends on the same role with another action receiver by COO, and depends on the conjunction by LAD. Other labels and dependency relationships are the same with the Rule1. This kind of sentence with coordinate structure can extract two ER triples. For example, the sentence "*The waste incineration plant provides employment opportunity and financial revenue*" can extract two triples of (*The waste incineration plant, Provides, Employment opportunity*) and (*The waste incineration plant, Provides, Financial revenue*). This rule also applies to the structure of action executors having a coordinate relationship between them, and the principle is the same.

(v) *Multiple Structure*. There are multiple extraction methods that can be used for the same sentence. In particular, the Chinese expression is flexible and various, and one sentence often contains multiple structures. For example, the sentence "*This way through communication and understanding to make profits*" expressed in Chinese can be understood as an adverbial clause of manner. It is annotated as "[AE *This way*] [PREP *Through*] [MNR *Communication and understanding*] *to* [ACT *Make*] [AR *Profits*]." The clause usually follows a preposition and depends on it by POB, with the structure of Preposition-Object. So, the annotations of PREP plus adverbial clause are used to express the sentence structure more clearly, also applied to other adverbial clauses. The Rule5 is suitable for the above situation. "[MNR *Communication and understanding*]" meaning specific manners can be omitted in the extraction, and only considering the dependency relationship of [AE *This way*], [ACT *Make*], and [AR *Profits*] according to Rule1 can extract a triple (*This way, Make, Profits*). At the same time, this sentence can also be understood as the adverbial clause of purpose, annotated as "[AE *This way*] [ACT *Through*] [AR *Communication and understanding*] [PREP *To*] [PRP *Make profits*]." It accords with the dependency structure of the Rule6, so a triple (This way, Through, Communication and understanding) can be extracted in a similar manner. The extraction rules of Rule5 and Rule6 highlight that there are different extraction methods and results for the same sentence.

Following the writing styles of Chinese articles, there are abundant complex expression formats, which can be split into multiple simple sentences for more than one annotations and extractions. And, the structure of a simple sentence is mostly covered by Rule1–Rule6, which are suitable as the basis and rules for ER extraction.

In order to maximize the integrality and correctness of information, and ensure the feasibility of analysis, the rule-based ER extraction for MSW-NIMBY follows these principles:

(i) Multiple methods of annotation and extraction can be implemented for the same sentence. For example, considering the subordinate clause as a single sentence to extract, all the extraction methods conforming to the sentence structure should be applied as much as possible, and all these results are retained.

(ii) Manual semantic annotation needs to master semantics and parts of speech of Chinese, and the unified regulation can be formulated to train labeling personnel before annotation.

(iii) Not all content appearing in the text need to be annotated. The main parts of the content should be retained when annotating, while the meaningless content is omitted as much as possible.

3.2. Novel Transitive Relation Model. The information of ER triples extracted from scientific literature is numerous and complicated, and it is difficult to find the key point of research. This section constructs the transitive relation model and demonstrates the effects with multiple relation transmission, in order to mine significant information in the text.

The principle of transitive relation model is that when the Entity1 in a triple is the same as the Entity2 in the other triple, a transitive relationship is established between these two triples. And, the new relationship is also generated connectedly, according to the characteristic of transitivity. The principle and example of the transitive relation model are shown in Figure 2.

Here is an example: with the transitive relation model, Triple1 (*Various ways, Confront, NIMBY project*) and Triple2 (*NIMBY project, Be faced with, Mass opposition*) can be expressed as (*Various ways, Confront, NIMBY project, Be faced with, Mass opposition*). Thus, an indirect relationship between "*Various ways*" and "*Mass opposition*" is constructed. There is no tense problem in Chinese expressions, as in English expressions, so it is easier to unify expression of entities to construct relationships. The relationship after transmission is an indirect relationship, the expression of which is more complicated and does not play a major role. Therefore, the specific indirect relationship between the entities can be omitted, and it is only regarded as an uncertain relationship between them. The novelty of transitive ER utilization could help the information receiver obtain major points rapidly without lots of noise screening work.

In order to depict the ER transmission network, the progress of pairwise relations is reconstructed, as shown in Figure 3. Obviously, the nonvital ER information in transitive relationship is discarded gradually. This reconstruction of transitive relation can be implemented iteratively. That is, there are three ER triples in the originals that can construct continuous transitive relation, which is treated as a second transitive relation. The multiple transitive relation is expressed in the same manner. After multiple relation transmission, the information of connections and changes between entities in the ER network is expressed as follows:

The nodes of A-F represent entities, while the edges between them represent relationships from Entity1 to Entity2 in the ER. The nodes and edges in the network after transmission have great changes, which relate to the number of times directly. It can intuitively reflect that the types of node decrease gradually while the edges between surviving nodes increase gradually, as the times of transmission increases. But, it should be noted, if the times of transmission is large enough, too many nodes and edges may be omitted, which cannot accomplish the aim of information mining in network analysis. The times of transmission needs to be determined according to actual effects of transitive relation in different problem.

In short, with the transitive relation model, entities are more closely connected, while its type is reduced and the number is increased. The primary and secondary status of entity information is still maintained, only amplifying the primary information and weakening the secondary information to some extent. In this way, it is possible to highlight the important nodes and structural relationships between them in the network, so that it is easier to analyze and research the potential knowledge in MSW-NIMBY crisis based on text information.

4. Application Analysis of MSW-NIMBY Crisis

In this section, we demonstrate how to implement the ER network analysis process of the MSW-NIMBY crisis. First, the process of ER extraction is demonstrated in detail, by the rule-based ER extraction. Then, we perform multiple relation transmission to the extracted ER and analyze their actual effects, and determine the optimal times of transmission for ER network analysis of the MSW-NIMBY crisis ultimately.

4.1. ER Extraction. For the ER extraction of the MSW-NIMBY crisis, the relevant scientific literatures are obtained and screened from the literature database. Then, the ER triples are extracted based on rules, and finally the extracted entities are filtered and unified to improve the accuracy and standardization of entity information from literatures.

4.1.1. Dataset Selection. Due to the regional differences of NIMBY, the CNKI database (the most comprehensive database of paper collection in China on https://www.cnki.net/) is selected to be the data source of the MSW-NIMBY in China. With the theme of "Waste" and the keyword of "NIMBY," 463 scientific literatures are collected before 2019 from the CNKI database by advanced search. The whole process is executed from the following seven aspects: removing all dissertations, positioning the Chinese core journal catalog of Peking University as the standard, and comprehensive consideration of publication time, times cited, times download, fund support, and core journal positioning.

As a rapidly developing country, the MSW-NIMBY emergency in China is a relative new issue in NIMBY field. But as long there is urbanization progress in China, the MSW-NIMBY could be a serious problem based on the history of developed countries. We derived pivotal literatures (see Table3) mainly containing management advices and social analysis for MSW-NIMBY events, which cover most of the views and strategies on the MSW-NIMBY crisis in China to some extent.

4.1.2. Annotation and Extraction. According to the above-defined method of rules-based ER extraction, extracting ER from 13 articles is related to the MSW-NIMBY crisis.

The content of these 13 articles is split roughly into a bulk of semantic units by using the Jieba Chinese Text Segmentation (a Python component of Chinese word segmentation on https://github.com/fxsjy/jieba). According to the template of semantic annotation, each semantic unit is manually judged and semantically labeled, before assigning it to a part of speech in the syntactic structure. Focusing on the syntactic structure of the annotated semantic units, the

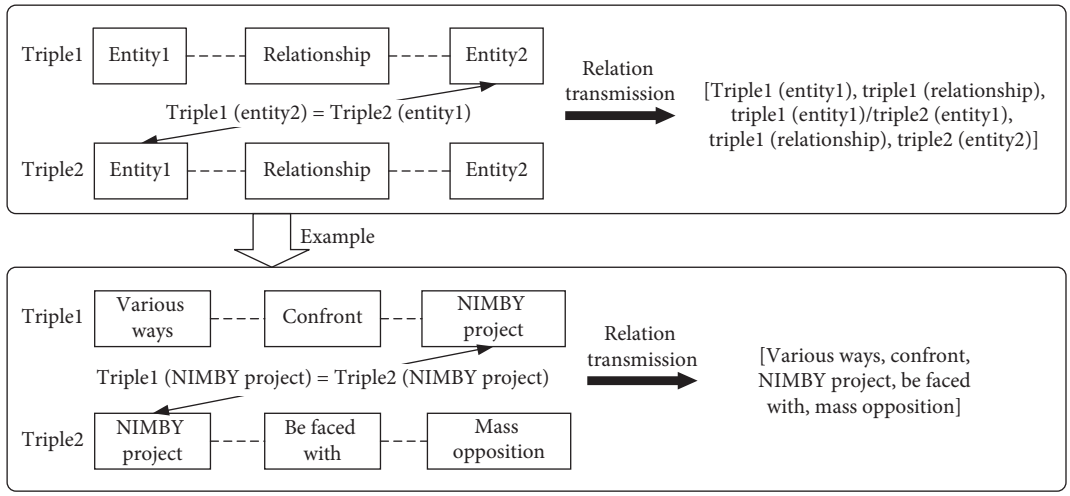


Figure 2: Transitive relation model and its example.

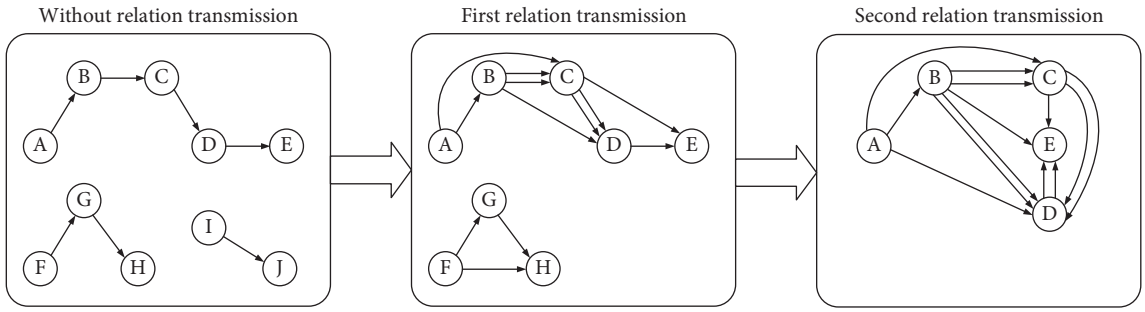


Figure 3: The changes of ER network with multiple relation transmission.

Table 3: Initial literature set in ER extraction.

Number	Title	Journal	Publication date	Times cited	Times download	Fund support
1	Effectively do a good job in the management innovation of waste incineration projects—turning "NIMBY" into "Neighbor benefit"	Consultation Report	2019.09.27			
2	Cause of environmental NIMBY conflicts and solution with dual-game structure as an analysis framework	City Planning Review	2019-02-09	1	723	2
3	Understanding the variation of government responses to NIMBY conflicts: from an urban governance perspective	Chinese Public Administration	2018-08-01	16	1848	1
4	Research on public participation in NIMBY conflicts caused by environmental pollution	Chinese Public Administration	2017-12-01	18	1241	2
5	Reflections on the "NIMBY" conflicts in environmental protection in the urban development—Based on the research of NIMBY conflicts in environmental protection projects in Shenzhen	Chinese Public Administration	2017-08-01	2	760	2
6	Manufacturing consent: strategies of the Guangzhou municipal government governing the NIMBY conflict	Wuhan University Journal (Philosophy & Social Science)	2017-05-06	19	1211	3

Table 3: Continued.

Number	Title	Journal	Publication date	Times cited	Times download	Fund support
7	How to promote the NIMBY project in dilemma: analysis based on "benefit-risk" perception theory	Chinese Public Administration	2017-04-01	22	1161	3
8	Formation mechanism and governance strategy of the NIMBY effect of waste treatment project under information asymmetry	Social Science Front	2016-04-01	11	654	3
9	The cause of the NIMBY movement and its governance paradigm: an empirical analysis based on NIMBY movements in Chongqing	Urban Problems	2016-02-27	46	1655	1
10	Role of social organizations in the NIMBY crisis management in British and American countries and the enlightenment to China	Chinese Public Administration	2016-02-01	21	1591	3
11	Beyond predicament: the provision patterns reconstruction of NIMBY facilities in transitional China: Reflection of site selection of incineration power plants in Panyu, Guangzhou	China Soft Science	2016-01-28	49	2303	5
12	New public involvement in the NIMBY conflict: from the perspective of the framing process	Journal of Zhejiang University (Humanities and Social Sciences)	2015-07-10	57	1860	1
13	The conflict caused by "NIBMY" and its solution: analysis based on urban collective protest Yanling He	Public Management Research	2006-12-15	319	4944	2

Note: The first report was adopted by the province-level government.

massive ER triples (Entity1, Relationship, Entity2) in the MSW-NIMBY crisis are extracted according to the sentence rules. All the above are done during manual handling. In order to improve the accuracy of ER extraction as much as possible, a strict extraction process is adopted in the actual extraction of ER triples:

(i) First, unified regulation can be formulated to train labeling personnel before labeling.

(ii) Second is the sampling inspection and consistency test after multiple rounds of labeling by multiple people repeatedly. If more than 3 people approve the same label, it is deemed available.

(iii) In the end, multiple random screening is carried out by multiperson and reextracting it if there are more inexactitude.

In information extraction, entity disambiguation is also an important part, which is used to solve the problem of ambiguity caused by entities with the same name [74]. The entity disambiguation is completed when the triples are extracted after annotation, because the constructed semantic template and sentence rules are based on the semantic relationship of the context.

4.1.3. Filtration and Unification of Entity. Due to the strong subjectivity of manual annotation, the annotated content is more complicated. Besides, the expression of scientific literature is multifarious and involves a wide range of information. Entity is filtered and unified after the extraction of ER triple, in order to standardize the entity expression for mining information reflected in the text directionally and accurately.

In this process, the entity with a length of more than 10 characters is filtered, and all the triples that contain them are also removed at the same time. Then, the extracted ER triples are filtered and uniformly named by construction of stop word lists and synonym lists. The Baidu stop words that remove English words [75] are utilized. If an entity appears in these stop words, all the ER triples where it exists are filtered to identify the more accurate ER. Based on the frequency of each entity in the extracted information, synonym lists are customized for the MSW-NIMBY crisis to unify and standardize the expression of entities. This is accomplished by using the synonyms (Chinese synonyms for natural language processing and understanding on https://github.com/huyingxi/Synonyms), which can automatically provide synonym and similarity for the Chinese word based on Word2vec model [76]. By calculating the similarity between words, the entities with the same meaning in extracted triples are replaced by a unified expression of high-frequency entity based on word frequency statistics.

4.1.4. Validity Check of Extracted ER. The extracted ER information contains 1954 entities and 1660 ER ultimately, and the statistics of the entities with high-frequency are sorted by frequency, as shown in Table 4.

The information of a high-frequency entity reflects the main subject involved in the research of NIMBY problems, and it is the focus in this field generally. For example, "Public," "Government," and "Local government" are undoubtedly the inevitable subjects of MSW-NIMBY in the real world. What's more, the frequency statistics conform to Zipf's law [77]. That is, if the words are sorted by frequency of occurrence, the frequency is almost inversely proportional to the rank exactly.

Table 4: Entity information sorted by frequency.

Rank	Entity	Frequency
1	Public	230
2	Government	120
3	Local government	97
4	Waste	43
5	Environment	41
6	NIMBY conflict	28
7	Countermeasure	25
8	Institution	25
9	Conflict	23
10	Project	21
...	...	...

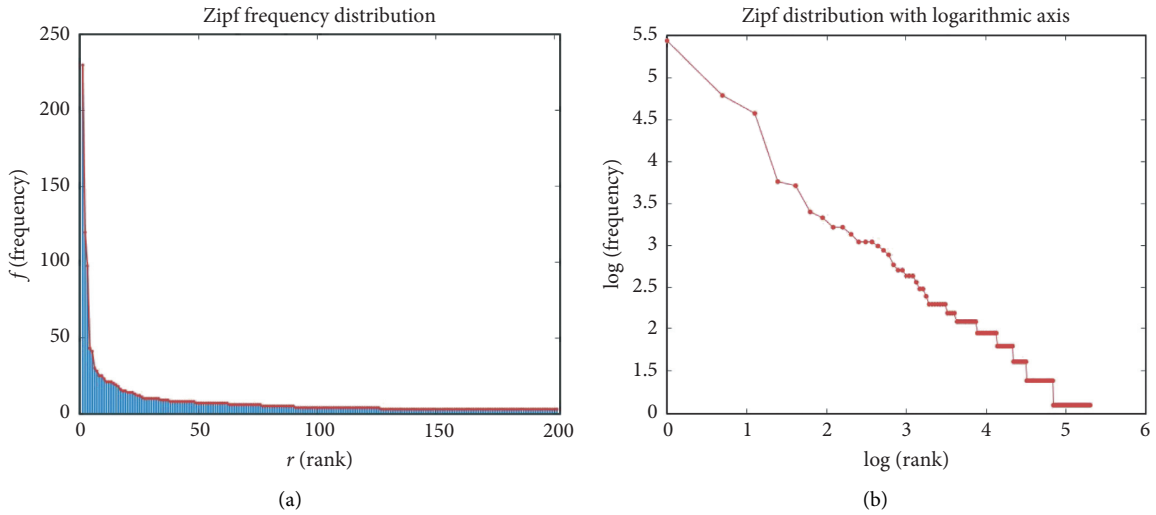


Figure 4: (a) Zipf distribution and (b) with logarithmic axis of top 202 high-frequency entities.

Zipf distribution of 202 high-frequency entity information with a frequency greater than 3 is shown in Figure 4, including Zipf frequency distribution with logarithmic axis. The logarithmic distribution between frequency and rank is close to a straight line, which can be regarded as conforming to Zipf's law on the whole. It shows that by covering a small part of the high-frequency words in the corpus, most of the information in the entire corpus can be understood. This fact also applies to a single article, so it is effective to use this entity information to analyze text information.

Table 5 reveals the excerpts of the ER output in the end. There is no tense problem of words in the Chinese sentence, so the meanings of ER triples are only expressed in English here, and their tense can be ignored.

4.2. Multiple Relation Transmission of the MSW-NIMBY Crisis. The network expressed by directly extracted ER from the text has defects of disordered hierarchy, intricate relationship, and ambiguous priority. These can be avoided by the transitive relation model, a method of relational data mining. Multiple relation transmission aims to transmit the extracted ER triples more than once, and then comparing and analyzing the topological parameter of nontransmitted and transmitted ER network to find out the most suitable times of transitive expression for research in the problem of MSW-NIMBY crisis.

4.2.1. ER Transmission. The extracted ER triples from the relevant literature are processed by the transitive relation model. If the same Entity1 and Entity2 are present in the two different triples, the association between these triples is established with the logic of transitivity. There is a relationship between each pair in these three different entities, and the triples that are not established are discarded. Repeating this operation, we can observe the changes of the output of transitive relationship during the experiment, about the number of entities and ER. The third transitive relationship has expressed the information of more concentrated entity and clear relationship, while the fourth transitive relationship expresses that the number of entities has been greatly reduced and run time for its operation is too long to achieve effective analysis. Therefore, only the ER information of original and the first three transmissions are retained for network analysis.

4.2.2. Comparison and Analysis of ER Network Attribute. The original ER and the transmitted ER are expressed in the form of a network, and the network of directed graphs is constructed by entities as nodes and their relationships between entities as edges. Gephi is used to calculate various parameters of ER network, which represent attributes of the network. Gephi is an open source network exploration and

Table 5: The ER triples of the MSW-NIMBY crisis (excerpts).

Number	Entity1	Relationship	Entity2
1	People	Carry out	The spirit of the 19th party congress
2	Countermeasure	Is	Strengthen expert management
3	MSW incineration project	Have	External risks
4	MSW incineration project	Be faced with	Mass opposition
5	External effect	Distribute	Imbalance
6	Common sense	Generate	Value conflict
7	Potential risk	Greater than	Potential profit
8	Government	Set up	Cooperation platform
9	Government	Organize	Stakeholder
10	Government	Participate in	Argument and decision
11	Government	Prevent	NIMBY crisis
12	Benefit compensation	Lack of	Coordination
13	Population	Express	Tendency
14	Report of the 19th party congress	Indicate	Direction
15	Benefit compensation	Is	Reason
16	Project	Guarantee	Right to know
17	MSW incineration project	Have	Pollution risk
18	People	Express	Willingness
19	People	Identify	Information
20	Countermeasure	Is	Design

manipulation software, which provides features such as high-quality layout algorithms, clustering, and sample filtering by specific characteristics of the network [78]. It also provides functions of calculation and statistical distribution of topological parameters, and the calculation results are presented in Table 6.

Comparing and analying the parameters of ER network attributes under different times transmission are done, so as to get the best expression of transitive relation model. The changes and analysis of parameters are shown as Figures 5–7. It is observed that the transmitted network is endowed with more obvious characteristics.

(1) Tighter Entity Connection. Average degree represents the average number of connected edges of each node. Its linear rise indicates the remaining entities are connected to more and more other entities, and the more important the former is, as the times of transmission increase. Graph density reflects the closeness of nodes in the network, and its changes show that the relationship among entities is getting closer and closer. The network without transmission is too scattered and its density is almost zero, because it is composed of ER triples which are massive individuals extracted from natural language text directly. However, with the increase of transmission times, the graph density has a linear upward trend in the scattered structure. In the study of this complex problem, it reflects the ER network with the second transmission having a tighter entity connection to a certain extent.

(2) Refined Module Division. Modularity index is used to measure the strength of the network divided into modules (also called groups, clusters, or communities). This statistic shows that the modularity index is gradually decreasing, because the close connection of information between entities reduces the number of communities where the entities belong, namely, the category or module. It indirectly reflects the refined module division with the increase of transmission times. The number of entities in each community is increasing, and the close entity connection in the same module will be affected negatively. In general, the modularity index is greater than 0.44, which means the network has reached a certain degree of modularity. For the complex problem of abundant entities, it is possible to grasp the key points with the refined module division under the second transmission.

(3) Higher Cohesive Clustering. Average network distance reflects the degree of separation among nodes in the network. It gradually decreases, indicating that the connection between entities is getting closer and closer, and the node which is more separated from others is filtered. Similarly, its decreasing trend also slows down after the second transmission. Clustering coefficient shows the effect of the so-called "small world" with average network distance together, so that they can display some overall signs of clustering or clumping of nodes. Compared with the ER network without transmission, each entity in the ER network tends to form a relatively higher cohesive clustering after transmission, but the times of transmission have little effect on the clustering coefficient.

Through the comprehensive analysis of various network attributes at different times of relation transmission, it is found that the ER network with the second transmission has the more obvious characteristics of tighter entity connection, refined module division, and higher cohesive clustering. At the same time, it does not weaken the effects of relation transmission. Therefore, it is more suitable for the study of MSW-NIMBY crisis. It can be directly used for analyzing the ER network structure and mining the potential information.

Table 6: ER network attributes with different times' transmission.

Network attributes	The original	First transmission	Second transmission	Third transmission
Nodes	1954	735	479	415
Edges	1660	3875	4453	5515
Average degree	0.849	5.272	9.296	13.289
Average weighted degree	0.952	19.427	95.591	755.077
Diameter	7	4	3	2
Graph density	0	0.007	0.019	0.032
Modularity index	0.884	0.625	0.452	0.192
Average network distance	0.003	0.277	0.268	0.226
Clustering coefficient	2.807	1.712	1.5	1.46

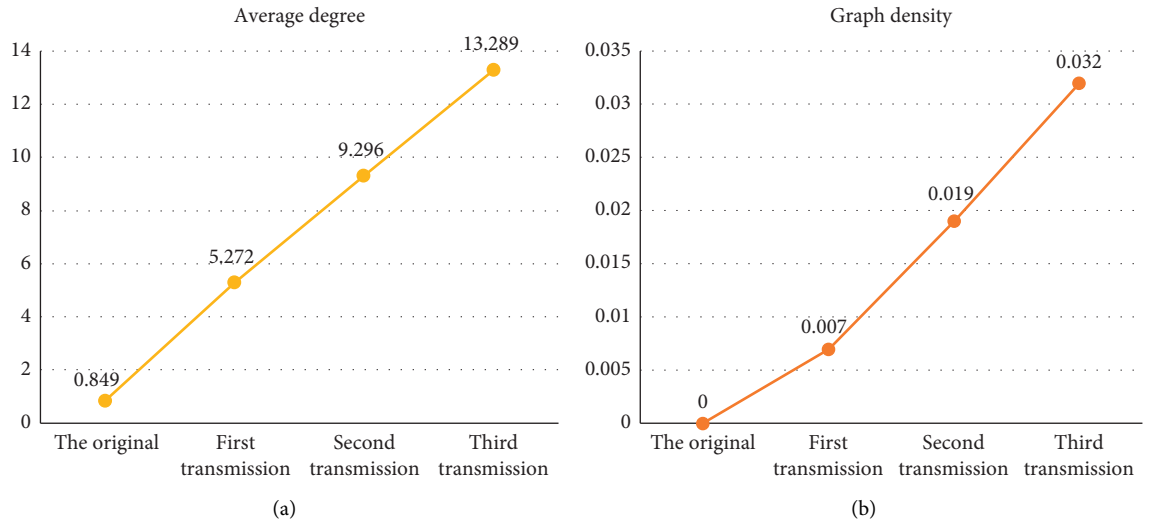


Figure 5: The changes in (a) average degree and (b) graph density of ER network.

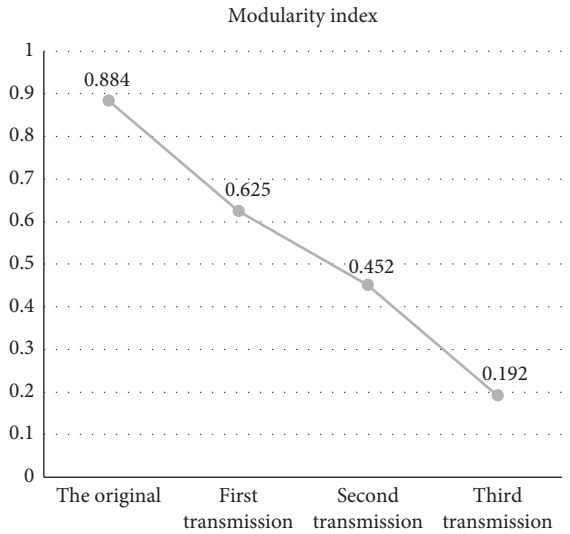


Figure 6: The changes in the modularity index of ER network.

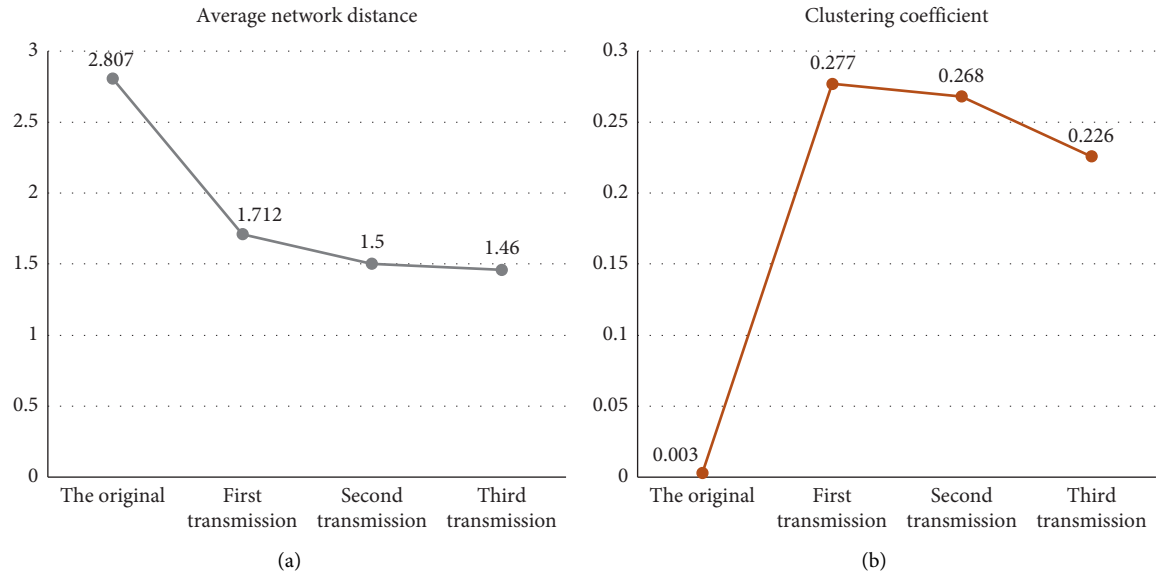


Figure 7: The changes in (a) average network distance and (b) clustering coefficient in the ER network.

5. Results and Discussion

The ER network with the second relation transmission is applied to analysis and mining information on detailed by the method of SNA, from the macro- and microlevels. It might be useful to reveal some general findings that provide knowledge of the MSW-NIMBY research field.

5.1. Macro Level of ER Network Analysis. Compared with the original ER network, the ER network with the second relation transmission is analyzed from the macro level of the ER network. It displays the optimization effects of the transitive relation model in text information extraction more intuitively.

There are two ER networks with the original and second transmission. .Size of nodes set up by node degrees, color of nodes divided by different modules, and colors of edges depend on its connected nodes color. Then, the network structures of nontransmission and the second transmission are displayed in the layout of Fruchterman and Reingold [79], with greater symmetry and local aggregation. The comparison of these two networks is displayed in Figure 8.

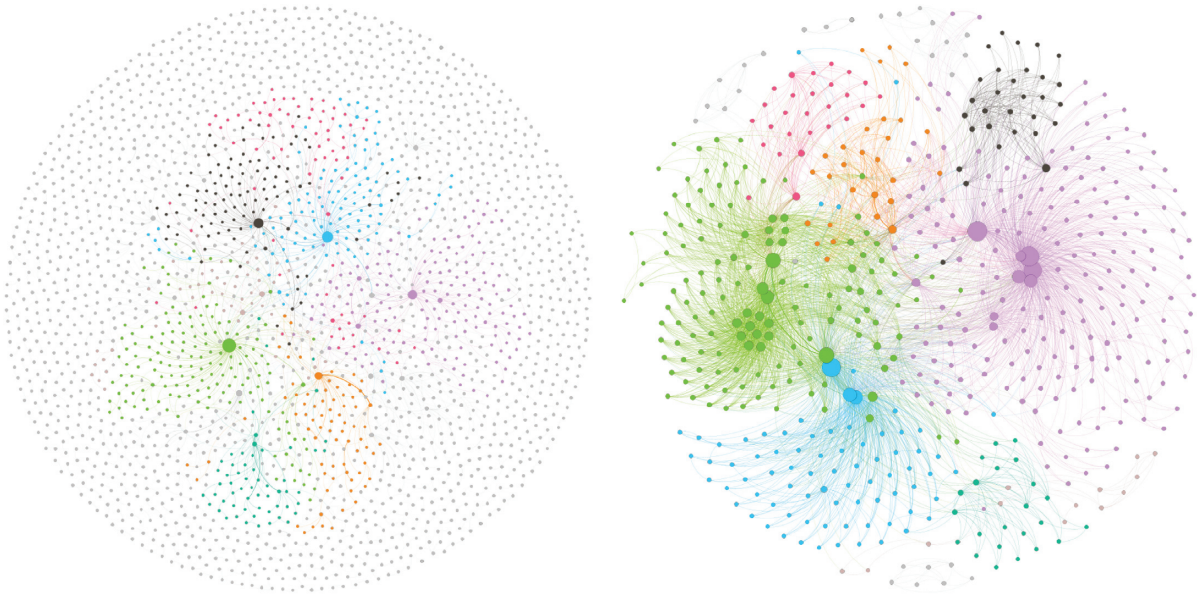
From the macro level of view, ER network without transmission is too scattered under the same parameter settings and layout algorithms. According to statistics, it is divided into 442 communities. Even if the modularity index reaches 0.88, the clustering coefficient is only 0.03 because the modular structure has not been formed with too many small communities. Besides, the sizes of nodes are overall too small to judge the importance of different entities. There is a lot of interference of useless information in the analysis of the overall network structure, which results in difficultly in grasping the key point.

On the contrary, the modularity of the ER network with the second transmission is relatively clear, and it is divided into 9 communities. The main communities and entities are more obvious than before transmission, even though the total number of entities in some communities is small. Therefore, under the same settings for the ER network, the key information mentioned in literature is more prominent with high cohesion and low coupling, and it is easier to research related issues by using the ER network.

5.2. Micro Level of ER Network Analysis. From the micro level of view, ER network analysis and knowledge mining can be implemented from multiple aspects, under the second relation transmission. The modularity and betweenness centrality of the ER network are selected to acquire knowledge, including general countermeasures of the MSW-NIMBY crisis proposed by experts, as well as research focus and general ideas.

5.2.1. ER Network Analysis with Modularity. For the ER network with the second relation transmission, the modularity is clear with the distinct color, and one community of network is selected for in-depth analysis to study one aspect of the complex problem.

Although the entities were filtered and unified during ER extraction, the result presented in the visualization still is slightly defective due to the subjectivity and incompleteness of manual annotation. In order to analyze local network better, the more obvious unfiltered and useless information is deleted manually, and nodes with similar meanings are merged. At last, there are 466 nodes and 2742 edges remaining in the network with the second relation transmission. Also, displayed under the same settings and layout as above, only one community of this ER network is displayed to grasp the key information of one aspect, which contains a total of 26 nodes (5.53% visible) and 70 edges (2.55% visible). Displaying the labels of its nodes in English, one community of ER network with the second transmission is shown in Figure 9.



(a) (b)

Figure 8: The comparison of (a) the ER network without transmission and (b) the ER network with the second transmission.

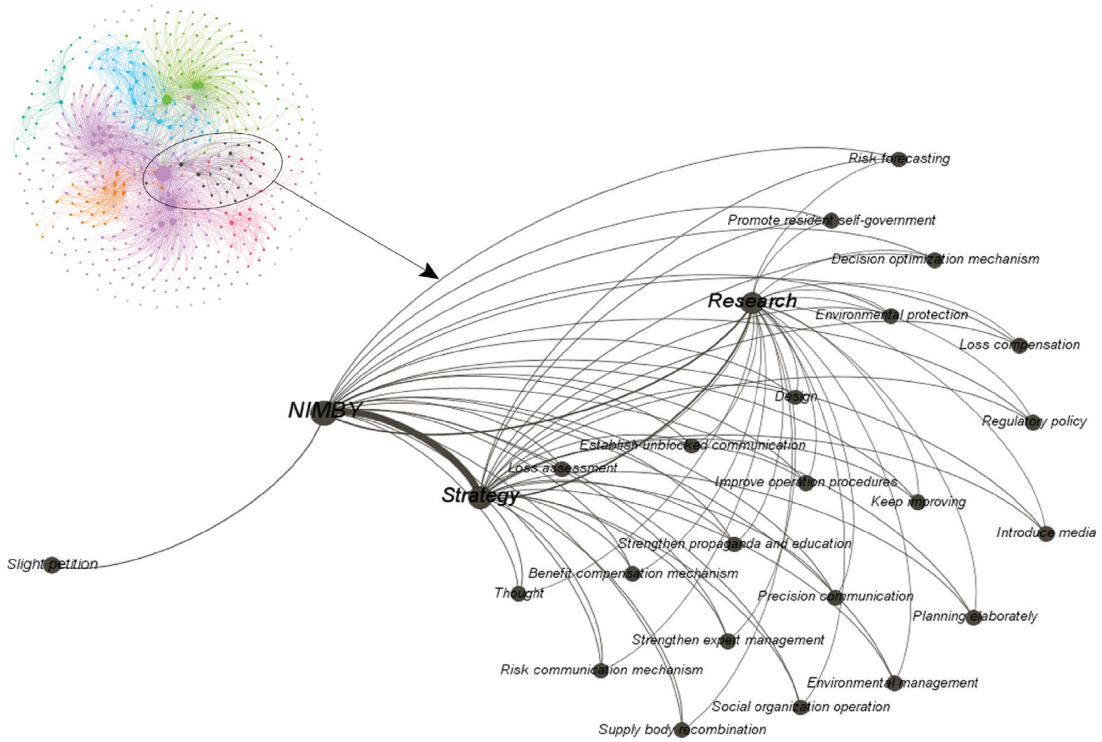


Figure 9: One community of ER network with the second transmission.

The labels of the largest nodes in this community are "NIMBY," "Research" and "Strategy," and other nodes that almost point out measures and suggestions. Obviously, from this community, the common and general strategies and suggestions on the MSW-NIMBY crisis can be acquired from the existing research results as follows:

(i) Expert management could help improve operation procedures, risk forecasting, and ensure loss assessment in environment governance.

(ii) Diverse decision optimizations like introducing media and regulatory policies should be applied in the supervision system.

Table 7: Top 20 betweenness centrality and frequency of nodes.

Number	High betweenness centrality		High frequency	
	Node	Betweenness centrality	Node	Frequency
1	Public	6079.9	Public	8009
2	Local government	2199.3	Subject	3539
3	Benefit	1474.0	Environment	1227
4	NIMBY facilities	525.0	NIMBY conflict	821
5	Subject	344.4	Conflict	732
6	Waste	146.7	Project	731
7	NIMBY conflict	146.6	Local government	715
8	NIMBY	145.3	Government	582
9	Environment	132.9	Society	437
10	Project	92.9	Externality	391
11	Institution	76.7	Waste	362
12	Government	60.0	Institution	349
13	Conversation	54.7	Conflict event	332
14	Conflict	48.4	Participation	259
15	Countermeasure	42.2	City	236
16	Assessment	42.0	Inhabitants	202
17	Research	28.8	Source	192
18	Participation	24.7	Supply model	192
19	Inhabitants	17.2	Region	190
20	Expert	12.8	Dilemma	186

(iii) Necessary mechanisms of benefit compensation, risk communication and loss compensation, strengthening education, establishing unblocked communication channel, and self-organizing rules for residents could enhance the guarantee for residents' rights and interests.

The above results show that the filed focus mainly includes the perspectives of environment, supervision, and residents' rights and interests for the strategies on the MSW-NIMBY crisis.

These are the major parts mentioned in the existing articles on countermeasures of the MSW-NIMBY crisis. In addition, the node of "slight petition" is far away from other nodes of the network in location, and it also seems out of place in content. From the perspective of the network structure, this node penetrates into the area where the orange group is located in Figure 9. Most information of nodes in this area has some focus and reflections of public institutions on NIMBY events. It can be seen the petition incident relates to public institutions closely in general, such as the Ministry of Ecology and Environment, the National Environmental Protection Agency, because people often petition these institutions to meet their requirements. The petition incident is also one of the research points of scholars on the MSW-NIMBY crisis governance, so it still belongs to the community of strategies and suggestions.

5.2.2. ER Network Analysis with Betweenness Centrality. The micro level of ER network analysis can reveal the characteristic of each node and acquire more valuable information, such as the betweenness centrality of the node, which means that if a node is traversed by many shortest paths, the node is very central in the network [80]. These entities of ER network are the key points in the existing research, which not only play significant roles in connecting other entities closely but also reflect most characteristics and phenomena on the MSW-NIMBY crisis.

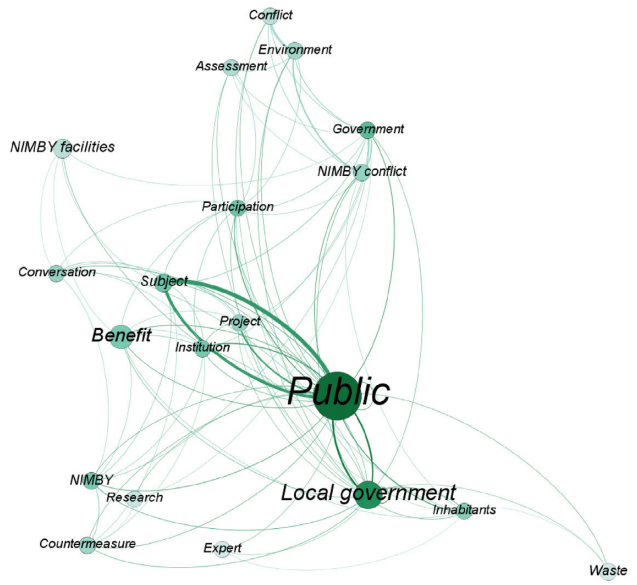


Figure 10: Top 20 betweenness centrality of nodes in the ER network.

The principle of relation transmission is to establish relationship through the same entity. So, the betweenness centrality of these entities is bound to become larger, and play a central role in the network with relation transmission. In the ER network of the MSW-NIMBY crisis with the second transmission, the betweenness centrality has a large distribution of values, and the highest 20 nodes are enough to analyze the focus. The Top 20 betweenness centrality and frequency of nodes (see Table 7) are highly overlapped, indicating that these key nodes are current hot topics in the research on MSW-NIMBY in China. The size of the node

represents betweenness centrality and the depth of color represents the frequency of entity, to construct an ER network. These two indicators can more intuitively present the information of the ER network as shown in Figure 10.

The statistical data and ER network show that the key point to constructing transitive relations in the study of MSW-NIMBY crisis is not only its keywords, such as "waste," "NIMBY," and "research," but also mostly all kinds of subjects, including public or inhabitants, government or local government, institution, etc. Most experts prefer to explore the inherent characteristic and evolution of this complex problem from the perspective of different subjects. Most of the research on the NIMBY crisis has formed the general logic. Based on analyzing the causes of the problems, related to conflicts, benefit, environment, etc., the countermeasures for crisis governance were proposed. It includes assessment NIMBY projects and facilities for environmental concerns, clearing the channels of conversation between multiple subjects, guaranteeing the people's participation right, and so on.

6. Conclusions

From different perspectives and concerns, more knowledge can be acquired from the ER network. It covers the theoretical research results for the MSW-NIMBY crisis, which is of great significance to a certain extent. The following findings can reflect the realities in MSW management along with urbanization:

(i) From the perspective of scholars, the importance of "Public" in the influence of NIMBY is consistent universally, while the role of experts is erratic. The public's awareness lacks professional guidance, so there will be high voices and too intense behavior from the public. As a result, the close connection between the public and government has become a kind of confrontation. For example, government would intitle waste incineration plants with obscure words, such as "Green energy."

(ii) From the perspective of the public, the activities of "Conversation," "Participation," and "Assessment" are too far away from each other, especially multi-agent associations are rarer. Therefore, the power of the public cannot be met effectively, the organization is broken up easily, and the sustainability of the public organization is challenged extremely. For example, there is no doubt that most of the protests organized voluntarily by the public come to an end easily.

(iii) From the perspective of correlation, "Benefit" has been shelved. In fact, the NIMBY conflict is the result of unbalanced distribution of benefits and damages. However, the NIMBY event triggers other social conflicts and historical issues easily, but it weakens the initial interest disputes of the NIMBY issue. This also explains why "Benefit" is not the most critical link point between the government and public.

Furthermore, we can think at the present stage, the government has adopted a more flexible approach for the NIMBY, and the public organization still cannot develop continuously under the existing system. The evolution of the NIMBY event can produce derivative hazards and enlarge the scope of influence easily. Therefore, there is still a long way for transformation cities of deliberative democracy and open decision-making in the future.

The result shows that the developed methods of rule-based information extraction are universal and could be applied to manage the knowledge of other research fields, especially the fields of political sensitivity or speciality. In addition, the information-mining techniques with transitivity-enhanced ER expression overcomes the obstacles of complex semantics and sparse corpus, which help researchers have a comprehensive understanding about the hidden knowledge in a large amount of scientific literature. By this method, it can provide more information for decision-makers based on the limited data and make full use of it. Remarkably, the research focus and framework of scholars on the MSW-NIMBY crisis are obtained, as well as the countermeasures and management of crisis governance in existing research are integrated.

At present, there are few studies on the NIMBY crisis governance by information extraction, and the research on such issues with political sensitivity has not formed a complete method system. Although we introduce transitivity to mine information effectively, there are still challenges with heavy workload and strong subjectivity to extract valuable information from many scientific literatures, because of the numerous existing research results and their continuous growth. Accordingly, the future work should involve improving the efficiency and accuracy of information extraction from text, in order for mining and integrating existing research results better to acquire knowledge. Furthermore, it can continue to mine information in the ER network based on the more and newer research literatures, and further provide theoretical basis for the NIMBY crisis governance in MSW.

Data Availability

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

Conflicts of Interest

The authors declare that they have no conflicts of interest reported in this paper.

Acknowledgments

This research was funded in part by the Major Projects of the National Social Science Fund of China (Grant no. 16ZDA045).

References

[1] C.-P. Chiu and S.-K. Lai, "An experimental comparison of negotiation strategies for siting NIMBY facilities,"

Environment and Planning B: Planning and Design, vol. 36, no. 6, pp. 956–967, 2009.

[2] M. Piat, "The NIMBY phenomenon: community residents' concerns about housing for deinstitutionalized people," *Health & Social Work*, vol. 25, no. 2, pp. 127–138, 2000.

[3] D. Easterline and H. Kunreuther, *The Dilemma of Siting a High-Level Nuclear Waste repository*, Kluwer Academic Publishers, Boston, MA, USA, 1995.

[4] D. M. Zhu, "Effects and drawbacks of environmental impact assessment in avoiding NIMBY," *Ekoloji*, vol. 27, pp. 149–154, 2018.

[5] M. O'Hare, *Not on My Block You don't—Facilities Siting and the Strategic Importance of Compensation*, HEDB English; Massachusetts Inst. of Tech., Lab. of Architecture and Planning, Cambridge, MA, USA, 1977.

[6] S. Lacey, "NIMBYism kills 45% of clean energy projects," 2011, https://cleantechnica.com/2011/10/24/nimby-ism-kills-45-of-clean-energy-projects/.

[7] G. R. Jacob, *Resolving Locational Conflict: Robert Lake*, Rutgers University Center For Urban Policy Research, New Brunswick, NJ, USA, 1987.

[8] F. Vanclay, "Conceptualising social impacts," *Environmental Impact Assessment Review*, vol. 22, no. 3, pp. 183–211, 2002.

[9] W.-N. Xiang, "Working with wicked problems in socio-ecological systems: awareness, acceptance, and adaptation," *Landscape and Urban Planning*, vol. 110, pp. 1–4, 2013.

[10] V. Eranti, "Re-visiting NIMBY: from conflicting interests to conflicting valuations," *The Sociological Review*, vol. 65, no. 2, pp. 285–301, 2017.

[11] D. Hoornweg, P. Bhada-Tata, and C. Kennedy, "Environment: waste production must peak this century," *Nature*, vol. 502, no. 7473, pp. 615–617, 2013.

[12] J. Mervis, "White house panel urges agencies to take more risks," *Science*, vol. 338, no. 6112, p. 1274, 2012.

[13] J.-W. Lu, Y. Xie, B. Xu, Y. Huang, J. Hai, and J. Zhang, "From NIMBY to BIMBY: an evaluation of aesthetic appearance and social sustainability of MSW incineration plants in China," *Waste Management*, vol. 95, pp. 325–333, 2019.

[14] Q. Yang, Y. Zhu, X. Liu, L. Fu, and Q. Guo, "Bayesian-based NIMBY crisis transformation path discovery for municipal solid waste incineration in China," *Sustainability*, vol. 11, no. 8, p. 2364, 2019.

[15] R. Kikuchi and R. Gerardo, "More than a decade of conflict between hazardous waste management and public resistance: a case study of NIMBY syndrome in Souselas (Portugal)," *Journal of Hazardous Materials*, vol. 172, no. 2-3, pp. 1681–1685, 2009.

[16] T. Shuang, "NIMBY movements and construction of the environmental civil society—a "backward pass" cross-case study," *Journal of Public Management*, vol. 14, pp. 48–58, 2017.

[17] X. N. Agency, "Several opinions of the central committee of the communist party and the state council of china and on further strengthening the management of urban planning and construction," 2016, http://www.gov.cn/zhengce/2016-02/21/content_5044367.htm.

[18] R. Lidskog and I. Elander, "Reinterpreting locational conflicts: NIMBY and nuclear waste management in Sweden," *Policy & Politics*, vol. 20, no. 4, pp. 1–16, 1992.

[19] K. W. Deutsch, "Changing images of international conflict," *Journal of Social Issues*, vol. 23, pp. 91–107, 2010.

[20] A. Schwenkenbecher, "What is wrong with Nimbys? Renewable energy, landscape impacts and incommensurable values," *Environmental Values*, vol. 26, no. 6, pp. 711–732, 2017.

[21] J. J. Cohen, K. Moeltner, J. Reichl, and M. Schmidthaler, "Linking the value of energy reliability to the acceptance of energy infrastructure: evidence from the EU," *Resource and Energy Economics*, vol. 45, pp. 124–143, 2016.

[22] L. Sun, D. Zhu, and E. H. W. Chan, "Public participation impact on environment NIMBY conflict and environmental conflict management: comparative analysis in Shanghai and Hong Kong," *Land Use Policy*, vol. 58, pp. 208–217, 2016.

[23] Z. Q. Fan and Z. W. Tang, "Strategic choice of China's local governments in response to NIMBY conflict: theoretical explanation and empirical evidence," in *Proceedings of the 2017 International Conference on Public Administration (12th) & International Symposium on West African Studies (1st)*, Accra, Capa coast, Ghana, 2018.

[24] T. Johnson, "Environmentalism and NIMBYism in China: promoting a rules-based approach to public participation," *Environmental Politics*, vol. 19, no. 3, pp. 430–448, 2010.

[25] C. Simsek, A. Elci, O. Gunduz, and N. Taskin, "An improved landfill site screening procedure under NIMBY syndrome constraints," *Landscape and Urban Planning*, vol. 132, pp. 1–15, 2014.

[26] A. Herrero and M. Vilella, "We have a right to breathe clean air': the emerging environmental justice movement against waste incineration in cement kilns in Spain," *Sustainability Science*, vol. 13, no. 3, pp. 721–731, 2018.

[27] Y. Liu, C. Sun, B. Xia, C. Cui, and V. Coffey, "Impact of community engagement on public acceptance towards waste-to-energy incineration projects: empirical evidence from China," *Waste Management*, vol. 76, pp. 431–442, 2018.

[28] A. S. E. Yay, "Application of life cycle assessment (LCA) for municipal solid waste management: a case study of Sakarya," *Journal of Cleaner Production*, vol. 94, pp. 284–293, 2015.

[29] J. Zhang, K. Liu, and G. Zhou, "Open information extraction," *Journal of Chinese Information Processing*, vol. 25, pp. 98–111, 2011.

[30] C. Lv, D. Pan, Y. Li, J. Li, and Z. Wang, "A novel Chinese entity relationship extraction method based on the bidirectional maximum entropy Markov model," *Complexity*, vol. 2021, Article ID 6610965, 8 pages, 2021.

[31] F. Ali, S. El-Sappagh, S. M. R. Islam et al., "An intelligent healthcare monitoring framework using wearable sensors and social networking data," *Future Generation Computer Systems*, vol. 114, pp. 23–43, 2021.

[32] F. Ali, S. El-Sappagh, S. M. R. Islam et al., "A smart healthcare monitoring system for heart disease prediction based on ensemble deep learning and feature fusion," *Information Fusion*, vol. 63, pp. 208–222, 2020.

[33] F. Ali, A. Ali, M. Imran, R. A. Naqvi, M. H. Siddiqi, and K.-S. Kwak, "Traffic accident detection and condition analysis based on social networking data," *Accident Analysis & Prevention*, vol. 151, Article ID 105973, 2021.

[34] K. Natalia, "Review of relation extraction methods: what is new out there?" *Communications in Computer & Information Science*, vol. 436, no. 1, pp. 15–28, 2014.

[35] C. Rootes, "Explaining the outcomes of campaigns against waste incinerators in england: community, ecology, political opportunities, and policy contexts," in *Community and Ecology*, M. M. Aaron and C. Terry Nichols, Eds., vol. 10, pp. 179–198, Emerald Group Publishing Limited, Bingley, UK, 2006.

[36] N. Magnani, "Nonhuman actors, hybrid networks, and conflicts over municipal waste incinerators," *Organization & Environment*, vol. 25, no. 2, pp. 131–145, 2012.

[37] Z. Gille, "Actor networks, modes of production, and waste regimes: reassembling the macro-social," *Environment and Planning A: Economy and Space*, vol. 42, no. 5, pp. 1049–1064, 2010.

[38] N. Gregson and M. Crang, "Materiality and waste: inorganic vitality in a networked world," *Environment and Planning A: Economy and Space*, vol. 42, no. 5, pp. 1026–1032, 2010.

[39] R. E. Dunlap, "Promoting a paradigm change," *Organization & Environment*, vol. 21, no. 4, pp. 478–487, 2008.

[40] S.-M. Khoo and H. Rau, "Movements, mobilities and the politics of hazardous waste," *Environmental Politics*, vol. 18, no. 6, pp. 960–980, 2009.

[41] V. S. Adami and J. R. Verschoore, "Implications of network relations for the governance of complex projects," *Project Management Journal*, vol. 49, no. 2, pp. 71–88, 2018.

[42] R. Ackland and M. O'Neil, "Online collective identity: the case of the environmental movement," *Social Networks*, vol. 33, no. 3, pp. 177–190, 2011.

[43] L. B. Cini Lorenzo, M. Giugni, and K. Uba, *The Consequences of Social Movements*, pp. 656–660, Cambridge University Press. Partecipazione e Conflitto 2017, Cambridge, UK, 2016.

[44] Y. Nugroho and O. Saritas, "Incorporating network perspectives in foresight: a methodological proposal," *Foresight*, vol. 11, no. 6, pp. 21–41, 2009.

[45] M. C. Kegler, J. Rigler, and M. K. Ravani, "Using network analysis to assess the evolution of organizational collaboration in response to a major environmental health threat," *Health Education Research*, vol. 25, no. 3, pp. 413–424, 2010.

[46] A. Cardillo, J. Gomezgardenes, M. Zanin et al., "Emergence of network features from multiplexity," *Scientific Reports*, vol. 3, p. 1344, 2013.

[47] S. B. Aaen, S. Kerndrup, and I. Lyhne, "Beyond public acceptance of energy infrastructure: how citizens make sense and form reactions by enacting networks of entities in infrastructure development," *Energy Policy*, vol. 96, pp. 576–586, 2016.

[48] P. M. Falcone, G. D'Alisa, A. R. Germani, and P. Morone, "When all seemed lost. A social network analysis of the waste-related environmental movement in Campania, Italy," *Political Geography*, vol. 77, 2020.

[49] R. Shemtov, "Social networks and sustained activism in local NIMBY campaigns," *Sociological Forum*, vol. 18, no. 2, pp. 215–244, 2003.

[50] M. Caniato, M. Vaccari, C. Visvanathan, and C. Zurbrügg, "Using social network and stakeholder analysis to help evaluate infectious waste management: a step towards a holistic assessment," *Waste Management*, vol. 34, no. 5, pp. 938–951, 2014.

[51] Z. Meng, S. Tian, L. Yu, and Y. Lv, "Joint extraction of entities and relations based on character graph convolutional network and multi-head self-attention mechanism," *Journal of Experimental & Theoretical Artificial Intelligence*, vol. 33, no. 2, pp. 349–362, 2021.

[52] W. A. Yuan, "Network security analysis method research and application based on graph theory," *Mini-Micro Systems*, vol. 10, pp. 1865–1869, 2003.

[53] Z. Mingquan, "Mutual-extraction between semantic relationships and lexical patterns in natural language processing," *Application Research of Computers*, vol. 25, no. 8, pp. 2295–2298, 2008.

[54] D. R. Amancio, "Network analysis of named entity co-occurrences in written texts," *EPL (Europhysics Letters)*, vol. 114, no. 5, p. 58005, 2016.

[55] W. X. Zhao, J. Jiang, J. He et al., "Topical keyphrase extraction from Twitter," in *Proceedings of the 49th Annual Meeting of the Association for Computational Linguistics: Human Language Technologies (Volume 1)*, pp. 379–388, Portland, Oregon, June 2011.

[56] Z. Zhong and Z. Liu, "Ranking events based on event relation graph for a single document," *Information Technology Journal*, vol. 9, pp. 174–178, 2010.

[57] K. Golestan, F. Karray, and M. S. Kamel, "An integrated approach for fuzzy multi-entity Bayesian networks and semantic analysis for soft and hard data fusion," in *Proceedings of the 2015 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, pp. 1–8, Istanbul, Turkey, August 2015.

[58] X. Weidong, "Subject sentence extraction based on undirected graph construction," *Computer Science*, vol. 38, pp. 181–185, 2011.

[59] M. E. J. Newman, "Finding community structure in networks using the eigenvectors of matrices," *Physical Review E*, vol. 74, Article ID 036104, 2006.

[60] P. M. Carron and R. Kenna, "Universal properties of mythological networks," *EPL (Europhysics Letters)*, vol. 99, no. 2, p. 28002, 2012.

[61] A. Fader, S. Soderland, and O. Etzioni, "Identifying relations for open information extraction," in *Proceedings of the Conference on Empirical Methods in Natural Language Processing*, pp. 1535–1545, Edinburgh, UK, July 2011.

[62] C. Niklaus, M. Cetto, A. Freitas, and S. Handschuh, "A survey on open information extraction," in *Proceedings of the International Conference on Computational Linguistics*, pp. 3866–3878, Santa Fe, NM, USA, August 2018.

[63] R. F. I. Cancho, R. V. Sole, and R. Kohler, "Patterns in syntactic dependency networks," *Physical Review E*, vol. 69, Article ID 051915, 2004.

[64] B. Popov, A. Kiryakov, D. Ognyanoff, D. Manov, and A. Kirilov, "KIM—a semantic platform for information extraction and retrieval," *Natural Language Engineering*, vol. 10, no. 3-4, pp. 375–392, 2004.

[65] Y. Jiang, G. Wu, C. Bu, and X. Hu, "Chinese entity relation extraction based on syntactic features," in *Proceedings of the 2018 IEEE International Conference on Big Knowledge (ICBK)*, vol. 17, pp. 99–105, Singapore, November 2018.

[66] D. Acemoglu, M. A. Dahleh, I. Lobel, and A. Ozdaglar, "Bayesian learning in social networks," *The Review of Economic Studies*, vol. 78, no. 4, pp. 1201–1236, 2011.

[67] N. E. Friedkin, "The problem of social control and coordination of complex systems in sociology: a look at the community cleavage problem," *IEEE Control Systems Magazine*, vol. 35, pp. 40–51, 2015.

[68] M. E. J. Newman, "The structure of scientific collaboration networks," *Proceedings of the National Academy of Sciences*, vol. 98, no. 2, pp. 404–409, 2001.

[69] S. M. Shafiei, A. Azar, and R. Esmaielpour, "Mapping and social network analysis of the nurses of razi hospital," *Iranian Red Crescent Medical Journal*, vol. 20, 2018.

[70] N. Aggrawal and A. Arora, "Visualization, analysis and structural pattern infusion of DBLP co-authorship network using Gephi," in *Proceedings of the 2016 2nd International Conference on Next Generation Computing Technologies (NGCT)*, pp. 494–500, Dehradun, India, October 2016.

[71] W. Che, Z. Li, and T. Liu, "LTP: a Chinese language technology platform," in *Proceedings of the 23rd International*

Conference on Computational Linguistics: Demonstrations, pp. 13–16, Beijing, China, August 2010.

[72] S. Jia, S. E, M. Li, and Y. Xiang, "Chinese open relation extraction and knowledge base establishment," *ACM Transactions on Asian and Low-Resource Language Information Processing*, vol. 17, no. 3, pp. 1–22, 2018.

[73] L. Qiu and Y. Zhang, "ZORE: a syntax-based system for Chinese open relation extraction," in *Proceedings of the Empirical Methods in Natural Language Processing*, pp. 1870–1880, Doha, Qatar, October 2014.

[74] Q. Liu, Y. Li, H. Duan, Y. Liu, and Z. Qin, "Knowledge graph construction techniques," *Journal of Computer Research Development*, vol. 53, p. 582, 2016.

[75] Q. Guan, S. Deng, and H. J. D. A. Wang, "Chinese stopwords for text clustering: a comparative study," *Data Analysis Knowledge Discovery*, vol. 1, pp. 72–80, 2006.

[76] Z. Wen-chao and X. Peng, "Research on Chinese word clustering with Word2vec," *Computer Engineering & Software*, vol. 34, pp. 160–162, 2013.

[77] S. J. Beck, "Review of human behavior and the principle of least effort: an introduction to human ecology," *American Journal of Orthopsychiatry*, vol. 21, no. 1, pp. 199-200, 1951.

[78] M. Bastian, S. Heymann, and M. G. Jacomy, "An open source software for exploring and manipulating networks," in *Proceedings of the International Conference on Weblogs and Social Media*, San Jose, CA, USA, May 2009.

[79] T. M. J. Fruchterman and E. M. Reingold, "Graph drawing by force-directed placement," *Software: Practice and Experience*, vol. 21, no. 11, pp. 1129–1164, 1991.

[80] L. C. Freeman, "Centrality in social networks conceptual clarification," *Social Networks*, vol. 1, no. 3, pp. 215–239, 1978.