

Social Network Analysis on Civil Complaints Regarding Parking: A Case of B City

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Abstract: - Rapid urbanization and industrialization have led to the increased popularity of automobiles. As a result, parking space has become limited, causing an array of conflicts and social problems among residents. Like many cities, the steady rise in population and the number of automobiles per household has increased parking-related civil complaints in Busan City, South Korea. As such, this study uses social network analysis (SNA) to evaluate parking-related civil complaints in Busan City in 2015. The results reveal that major civil complaints involved difficulties with parking, illegal parking, conflict among residents, lack of parking spaces, and public parking lots. In particular, the keywords related to these complaints included difficulties arising from lack of parking space and diverse problems caused by the resulting illegal parking. Follow-up research analyzing data from different years may be utilized as objective reference data in selecting priorities in policy execution, and quantitative prediction of the values of data on civil complaints will be helpful for decision-making by governmental organizations and relevant businesses.

Key-Words: Social Network Analysis, Civil Complaints Regarding Parking, SNA, Busan City, Degree Centrality, Betweenness Centrality, Closeness Centrality

1 Introduction

The popularization of automobiles caused by rapid industrialization and urbanization has led to the lack of parking space, and the utilization of inside roads as parking spaces. Because inside roads constitute residential living quarters, illegal parking has resulted in conflict amongst residents [1]. During the process of urban planning, only minimal requirements for parking space design are considered, and the cost and rental of parking spaces are not taken into account. Sufficient construction of parking lots capable of accommodating an increasing number of automobiles is almost impossible. Problems resulting from the increase of automobiles are considered to be very serious, with U.S. media outlets such as Streetline Media asserting that parking is one of the main difficulties associated with larger cities [2]. To resolve this issue, the government has begun implementing various parking-related policies. Nonetheless, the current amount of parking space is insufficient for resolving parking problems within residential areas where illegal parking is prevalent, and where older parking lots are limited in both parking flow and size. Accordingly, residents have filed civil complaints to their local government branches in

order to resolve parking-related problems. However, useful solutions cannot be implemented without a proper analysis of the fundamental causes behind the problems. As such, parking-related civil complaints are gradually on the rise each year [3].

Data related to parking-related civil complaints of Busan City, South Korea, will be the subject of this research. This study intends to examine the structure of parking-related civil complaints, analyzing what content is connected with what relationship. This study employs the use of social network analysis (SNA) in order to investigate the civil complaints by residents of Busan City. These results will provide a basic foundation of data that will give insight into meeting parking management policy demands.

2 Previous Research

2.1 Policies on Parking Management

Automobiles are an essential requirement for maintaining a modern lifestyle, as well as a crucial means of convenient transportation that bolsters national development [4]. The recent income surplus has allowed for a surge in the number of

automobiles, leading to an explosive demand for parking space. However, parking space is insufficient, and it is difficult to secure the necessary resources for appropriate parking facilities in larger cities. Therefore, the importance of creating parking-related policies is a growing concern in improving traffic communication and urban transportation policies.

The three policy goals of parking management are summarized as follows: First, insufficient parking lots should be expanded by systemic organization, and be evenly distributed among users so that existing facilities may be optimized. Second, when freights are loaded and unloaded, people block the flow of traffic and trigger a variety of problems. Thus, roadside parking should be controlled in order to enhance both traffic safety and communication between automobiles. Third, excessive automobile entry to urban centers should be prohibited, and parking policy measures should be taken into consideration to alleviate traffic congestion and regulate parking demands [5]. While the central and local governments have implemented some parking management policies to achieve these goals, the unrest with parking-related issues continues to rise.

2.2 Analysis on Civil Complaints

Through the process of urbanization and rapid economic development, cities in Korea have come to face many safety, transportation, and environmental issues. Local governments have instigated the use of electronic civil complaints as a means of resolving residential problems. However, the number of civil complaints have surged in the recent years [6]. Researchers have presented a number of outcomes aimed at resolving civil complaints in an efficient manner. For example, Busan City intended to establish strategies for city management by establishing public data based on the utilization of big data, the Busan Data Base on Civil Complaint and Counseling, and the Comprehensive Welfare Service [7]. Gyeonggi Province analyzed civil complaints received via smart phones by utilizing big data, and conducted research to find a resolution for such complaints [8]. Won et al.(2016) [6] collected data pertaining to the electronic civil complaints of Jinju City. They classified these complaints according to the reasoning behind them, and analyzed them in the dimension of civic space. In doing so, they were able to discover the fundamental causes behind civil complaints and seek the appropriate resolutions.

2.3 SNA

Early SNA techniques were first launched in the field of sociology when identifying relationships among people within diverse groups and organizations. While relationships have traditionally been understood through the use of human intuition, early SNA was able to measure, visualize, and mathematically solve relationships [9]. SNA approaches include network mapping, network analysis, and the use of networks as metaphors. Key concepts of SNA include the degree of connection, density, degree centrality, closeness centrality, and betweenness centrality. The degree of connection refers to the total number of nodes with which a single node has a connection. Density is the number of relationships actually formed among all possible relationships. Representative centrality concepts within SNA include degree centrality, closeness centrality, and betweenness centrality. Degree centrality shows how many are connected to nodes. Closeness centrality demonstrates how one node can be centrally located within a network. A representative indicator that expresses the total centrality of a node is closeness with (or distances from) other nodes. The central node has the smallest sum of short path distances. Betweenness centrality, presented by Freeman (1977) [10], is the sum of shares of the shortest paths that passes through a given node. Research through SNA includes an “analysis on innovative policy trend in Busan City utilizing text mining techniques [11],” “analysis on climate change using SNA through collaborative research networks [12],” and an “analysis on the degree centrality of issue terminology according to discussion on medical privatization[13]”.

3 Methods

To analyze parking-related problems in Busan, this study retrieved data regarding civil complaints from the internet bulletin board “Wish to Busan City,” where citizens are free to document their complaints. From nearly 1,000 annual civil complaints in 2015, only open notices were reviewed. Among approximately 2,000 civil complaints, 412 traffic-related complaints were investigated. Using parking-related keywords, three researchers constructed a keyword network and employed SNA to examine its characteristics. The program NetMiner 4.2 was used to analyze the roles and knowledge structure of the topic keywords.

When the network analysis was complete, weight (which shows the degree of connection among the keywords) had a high occurrence frequency when

the relative source and target keyword weights were high, demonstrating a strong connection to the given keyword [11]. As shown in Table 1, the weight of illegal parking and conflict among residents were highest, and the keywords “illegal parking,” “difficulties with parking,” “fines,” and “traffic jams” had strong connections with one another. Table 1 also emphasizes a large number of civil complaints regarding illegal parking, administrative treatment on illegal parking, and resident conflict following illegal parking. In the case of illegal parking due to the lack of parking space in a

residential area, noise and traffic jams triggered discomfort, which in turn caused conflict among residents. This shows that the management of conflicts among residents is a major parking policy concern. Civil complaints pertaining to crime prevention methods, such as the installation of closed circuit televisions (CCTV), were strongly noted, as residents stated they were often exposed to crimes within parking lots.

Table 1. Weight Order of the Keywords Used

	Source	Target	Weight
1	Illegal parking	Conflicts among residents	10
2	Illegal parking	Difficulties with parking	5
3	Illegal parking	Accident	5
4	Illegal parking	Fines	5
5	Illegal parking	Traffic jams	5
6	Illegal parking	Towing	3
7	Parking lots for residents only	Illegal parking	3
8	Parking lots for residents only	Conflicts among residents	3
9	Public parking lots	Parking information service	3
10	Parking lots	CCTV	3
11	Parking lots	Crime	3
12	Parking lots	Crime prevention	3

Fig. 1 shows the various connective relationships amongst major keywords within the civil complaint network analysis. The keywords are “illegal parking,” “parking lots,” “public parking lots,” “difficulties with parking,” and “lack of parking space.” To examine the network of keywords on illegal parking, the causes of illegal parking and civil complaints characterized by dissatisfaction about and discomfort from administrative treatment undergone by the violators after illegal parking are connected with each other. A major cause of illegal parking was the lack of parking space, and residents complained about administrative treatment following fines, towing, and written warnings. services, and errors.

Vehicle passing, traffic jams, and conflicts among residents were interconnected as civil complaints of experiences after illegal parking. Looking at the network structure centered on parking lots, resident discomfort stemming from streetlights, noise, and anxiety over the occurrence of crimes were strongly connected. Several civil complaints demanded that more resident-only parking lots be built, naming public parking lots as the reason for the lack of available parking. With regards to public parking lots, complaints also concerned unkindness, guidance, a lack of consideration for the underprivileged, parking information

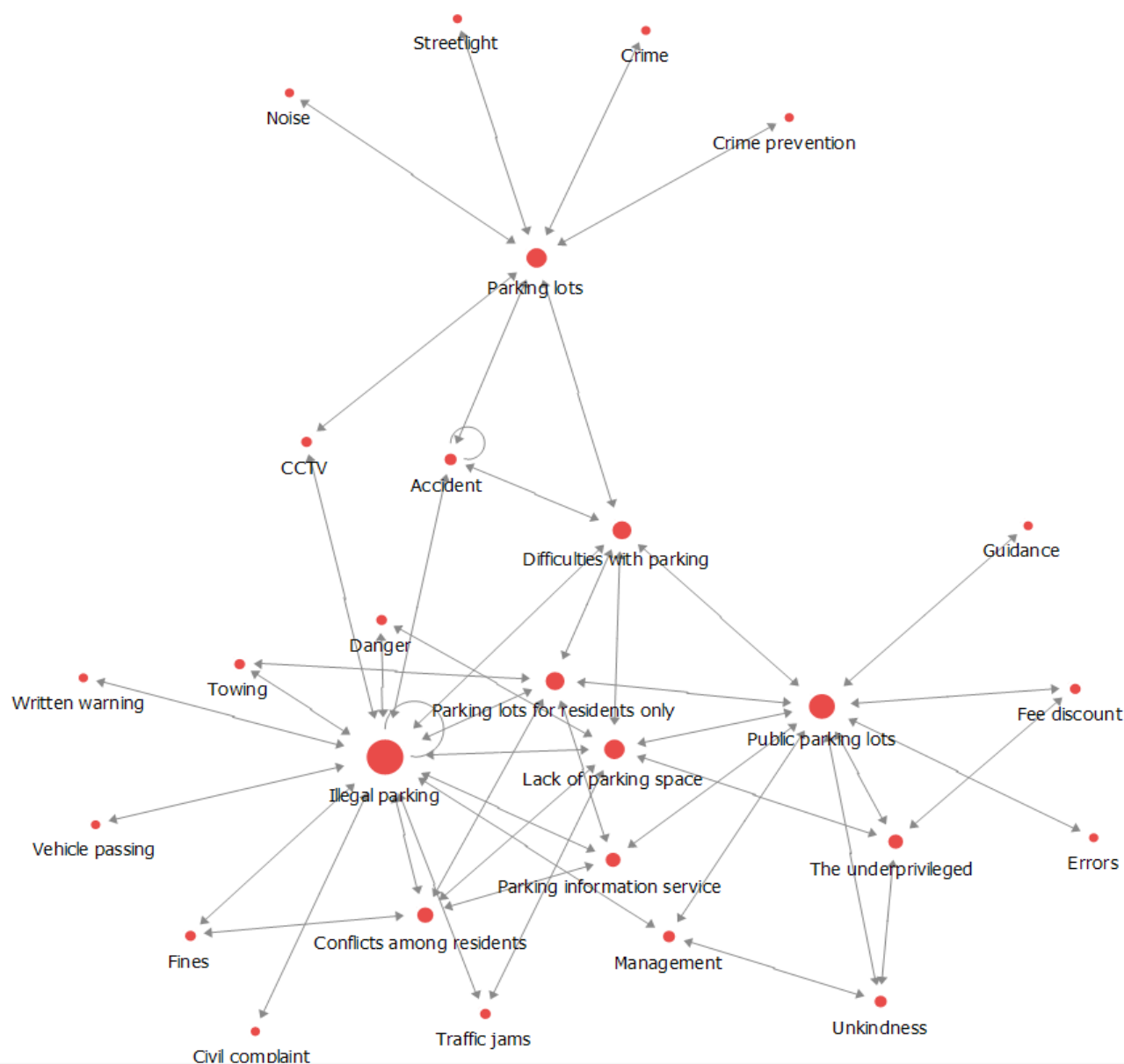


Fig.1 The Network of Parking-Related Civil Complaint Keywords From 2015

3.1 Analysis of Degree Centrality

Degree centrality represents the degree of a node, or keyword, located at the center of a network by quantifying the number of relationships where the node is directly connected to its neighboring keywords. In-degree centrality refers to the frequency of being selected from other nodes when there are n nodes. Therefore, a node with higher in-degree centrality has a higher frequency of being connected to other nodes, and is ranked higher within its network [14]. In other words, a keyword with high degree centrality

is used with other keywords more frequently. This means that higher in-degree terms are used more often in major civil complaints. Table 2 shows the degree centrality of keywords in the network of this study. Illegal parking ranked first, followed by other parking issues such as public parking lots, parking lots, and the lack of parking space, which were parking space-centered hardware contents. Software keywords included “conflicts among residents,” “problems with parking lot management,” “unkindness,” “the possibility of crime,” “lack of consideration for the underprivileged,” and “parking information services.”

Table 2. Degree Centrality of the Keywords

	In-Degree Centrality	Out-Degree Centrality
Illegal parking	0.576923	0.576923
Public parking lots	0.384615	0.384615
Parking lots	0.269231	0.269231
Lack of parking space	0.269231	0.269231
Parking lots for residents only	0.230769	0.230769
Difficulties with parking	0.230769	0.230769
Conflicts among residents	0.192308	0.192308
Parking information service	0.153846	0.153846
The underprivileged	0.153846	0.153846
Accident	0.115385	0.115385
Management	0.115385	0.115385
Unkindness	0.115385	0.115385
Danger	0.076923	0.076923
Traffic jams	0.076923	0.076923
CCTV	0.076923	0.076923
Towing	0.076923	0.076923
Fines	0.076923	0.076923
Fee discount	0.076923	0.076923
Guidance	0.038462	0.038462
Written warning	0.038462	0.038462
Crime prevention	0.038462	0.038462
Crime	0.038462	0.038462
Streetlight	0.038462	0.038462
Vehicle passing	0.038462	0.038462
Errors	0.038462	0.038462
Noise	0.038462	0.038462
Civil complaint	0.038462	0.038462

Difficulties with parking, illegal parking, conflicts among residents, lack of parking space, and public other. Illegal parking was connected with fines imposed after a crackdown on illegal parking, written warnings, towing, and difficulty of vehicle passing resulting from illegal parking and stopping,

parking lots with a high degree centrality were close in distance with each traffic jams, and dangers. In other words, complaints related to illegal parking and the unfairness of parking crackdown were raised and the first was more than the latter.

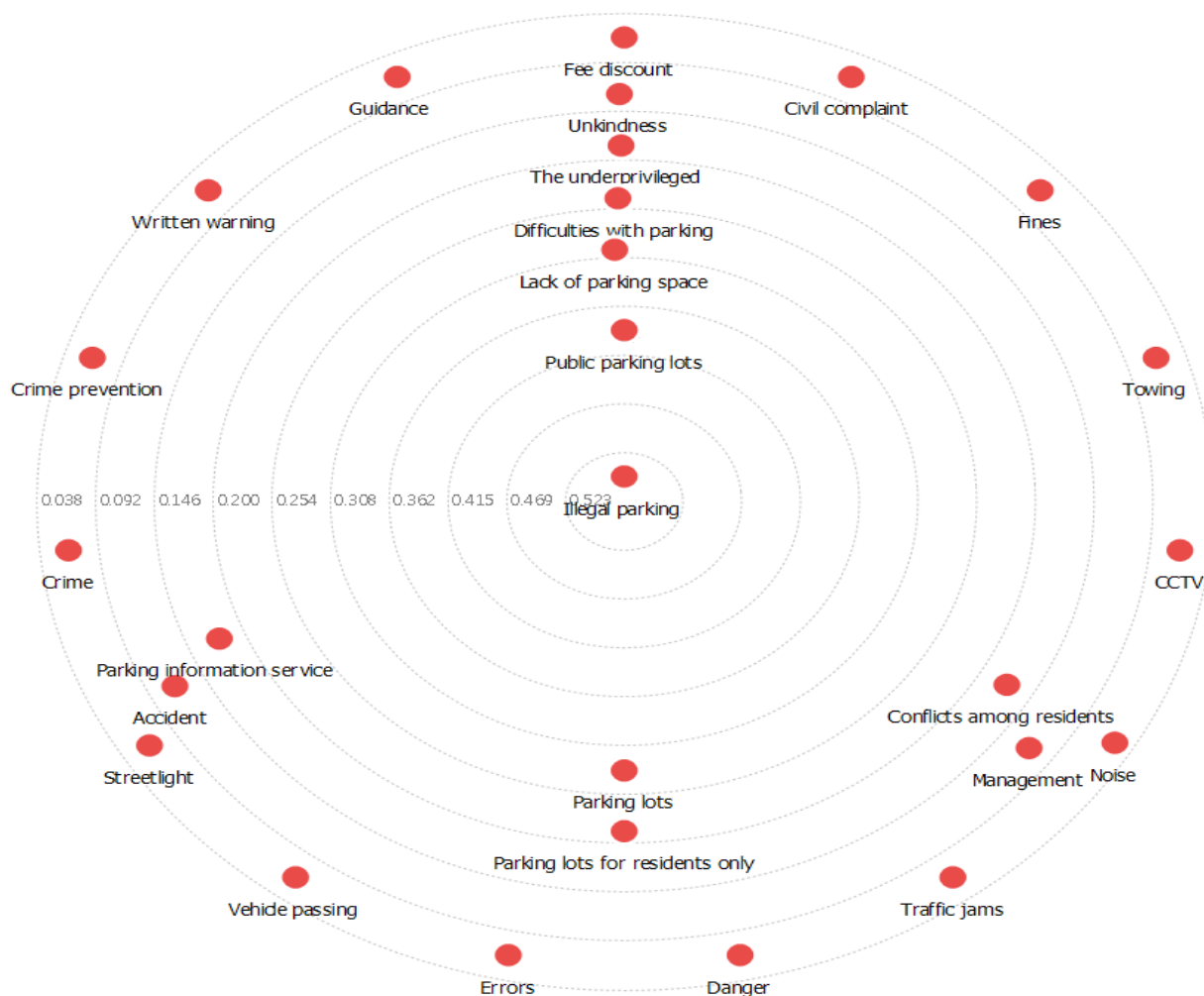


Fig.2 Concentric Map Showing the Degree Centrality of Keywords in Parking-Related Civil Complaints in 2015

In the case of public parking lots, management, unkind employees, a lack of consideration regarding the underprivileged, and system errors contributed greatly to civil complaints. Other complaints referred to the poor management of parking information services and inaccurate information on public parking lots when compared against private parking lots, reflecting the demand for smart-parking systems. There were also complaints related to the lack of crime prevention precautions as an issue of public parking facilities.

3.2 Analysis on Betweenness Centrality

Betweenness centrality involves measuring the mediating role of a node in the construction of other nodes and the network. A node may be influential in controlling the flow of information regarding different nodes within a network [15]. Calculation

of betweenness centrality involves the entire network, not just the closeness to the network. The location of a node within a network forms an important element in determining centrality. A keyword with a high level of betweenness centrality is closely associated with other keywords, showing the importance of specific topics. Centrality is high when many different keywords are connected. According to the betweenness centrality analysis results, illegal parking had the highest betweenness centrality, followed by parking lots, public parking lots, and difficulties with parking. The keyword “illegal parking” explains the reasoning behind civil complaints—lack of parking space and, conflict among residents caused by illegal parking, fines, and towing as a result of illegal parking.

Table 3. Betweenness Centrality of the Keywords

	Node Betweenness Centrality
Illegal parking	0.470099
Parking lots	0.294286
Public parking lots	0.276945
Difficulties with parking	0.232546
Lack of parking space	0.112007
Parking lots for residents only	0.05085
CCTV	0.047179
Accident	0.047179

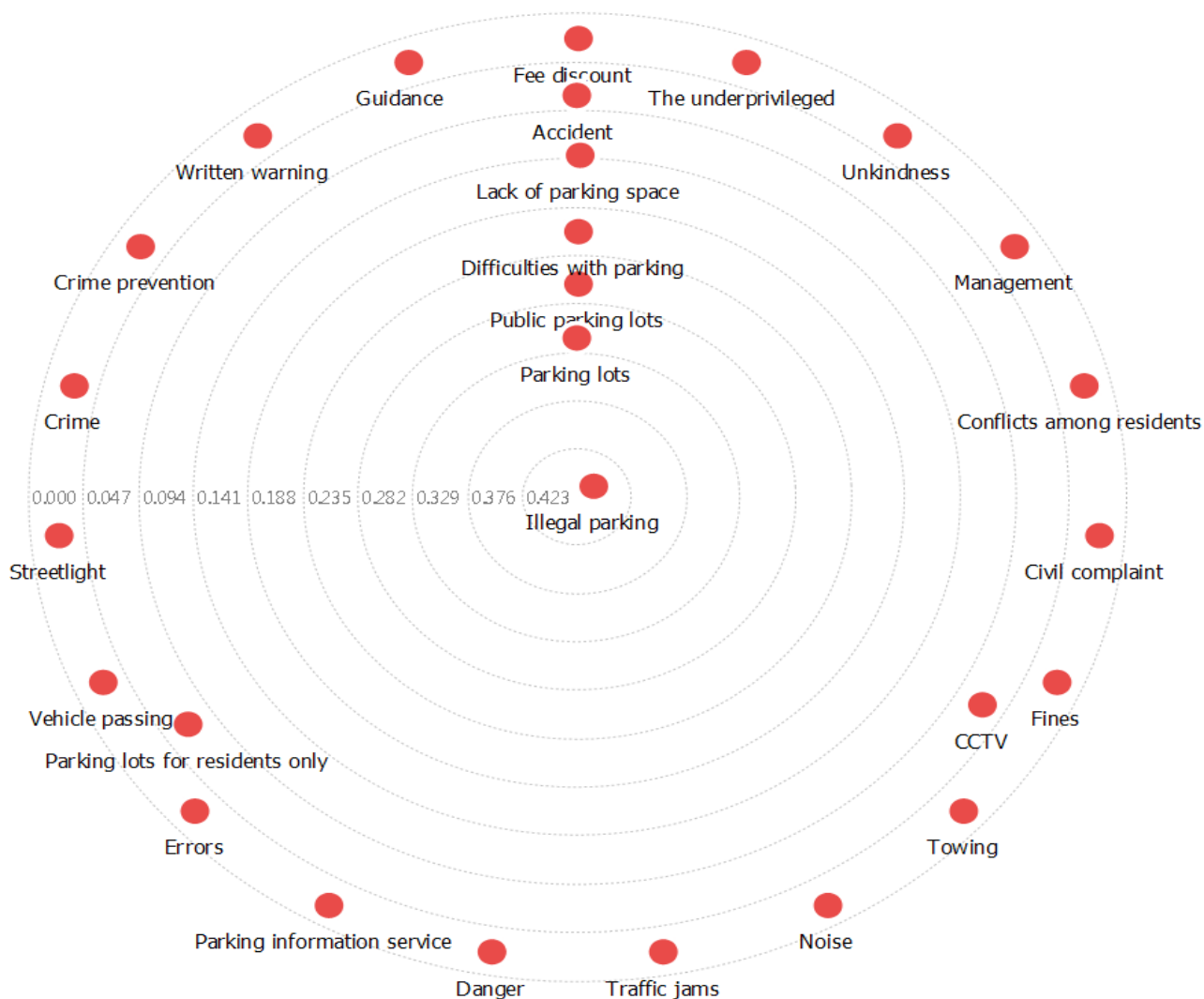


Fig.3 A Concentric Map of Betweenness Centrality of the Keywords

3.3 Analysis on Closeness Centrality

Closeness centrality places an emphasis on the distance between one keyword and all of the other keywords in the network, while even considering indirect connections to keywords. This is unlike

betweenness centrality, which highlights the activity of keywords. Closeness centrality stresses independence of keywords, and is calculated based on the reciprocal of the sum of a keyword's connection distances. The smaller the sum (or the more important the keyword), the greater the value

it has. Thus, a keyword with the highest closeness centrality reaches other keywords fastest, placing itself at the center of the network [16].

Much like the other centrality analysis outcomes of this study, the keyword with the highest closeness centrality was “illegal parking”, as it had the greatest influence on the other keywords in the network. “difficulties with parking” ranked second, followed by “lack of parking space” and “parking lots for residents only”. Unlike the other analysis outcomes, “parking information services” had a high closeness centrality. The above information is

meaningful, as it reveals that residents prefer parking information services to be the solution for problems with parking space, facility, management, and information. Another noteworthy outcome of this analysis is that keywords such as “parking lot for residents only”, “lack of parking space,” “conflicts among residents,” “illegal parking,” and “public parking lot” constituted top links, and the other relevant keywords were located within the network as the causes, outcomes, and media of the top links.

Table 4. Closeness Centrality of the Keywords

	In-Closeness	Out-Closeness
Illegal parking	0.590909	0.590909
Difficulties with parking	0.565217	0.565217
Lack of parking space	0.530612	0.530612
Parking lots for residents only	0.52	0.52
Public parking lots	0.509804	0.509804
Accident	0.481481	0.481481
Parking information service	0.45614	0.45614
Management	0.448276	0.448276
CCTV	0.440678	0.440678
Parking lots	0.433333	0.433333
Conflicts among residents	0.433333	0.433333
Danger	0.412698	0.412698
Traffic jams	0.412698	0.412698
Towing	0.40625	0.40625
The underprivileged	0.40625	0.40625
Fines	0.382353	0.382353
Unkindness	0.382353	0.382353
Written warning	0.376812	0.376812
Vehicle passing	0.376812	0.376812
Civil complaint	0.376812	0.376812
Fee discount	0.346667	0.346667
Guidance	0.342105	0.342105
Errors	0.342105	0.342105
Crime prevention	0.305882	0.305882
Crime	0.305882	0.305882
Streetlight	0.305882	0.305882
Noise	0.305882	0.305882

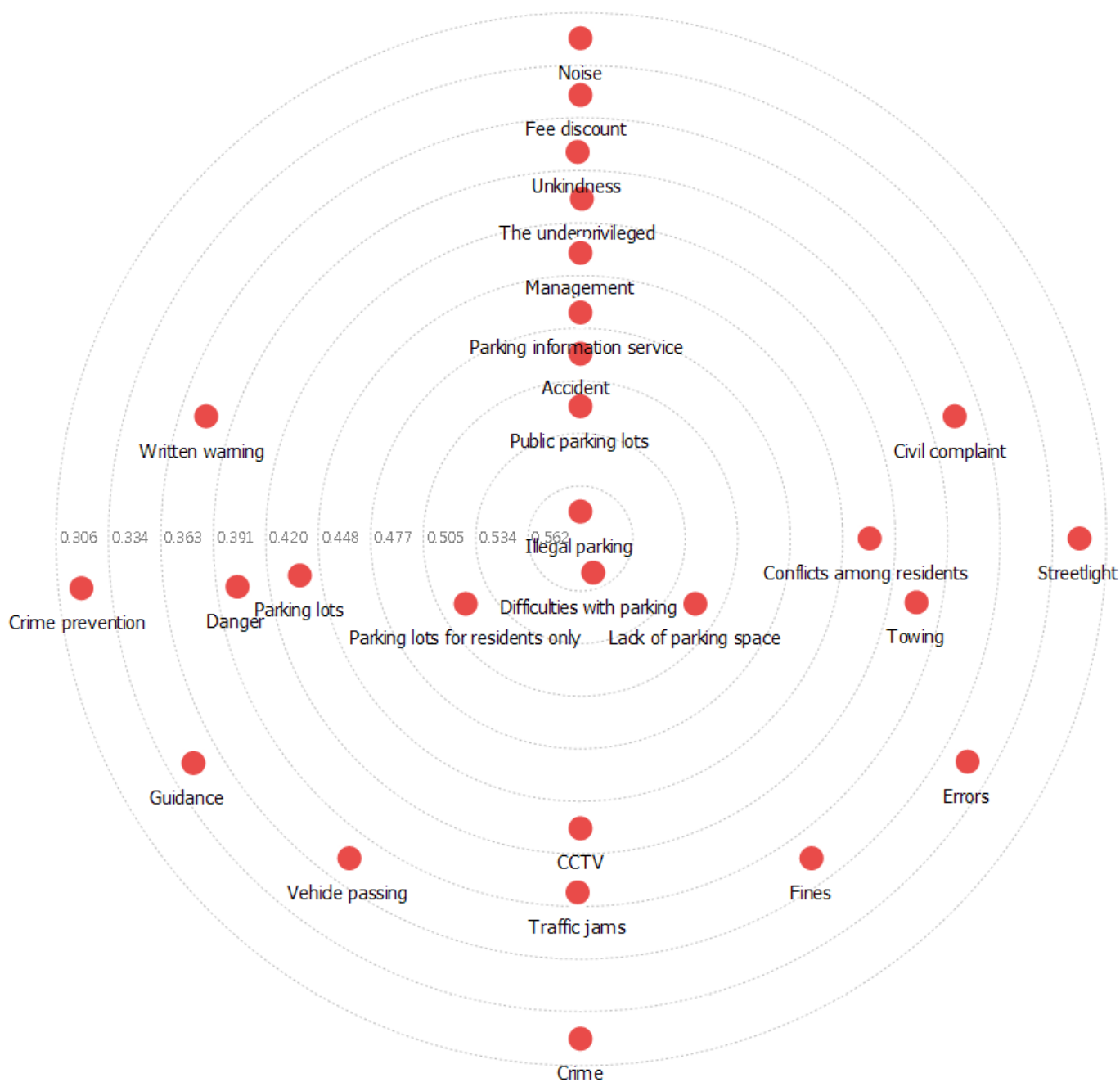


Fig.4 A Concentric Map of Closeness Centrality of Keywords

4 Conclusion

Urbanization has increased the number of automobiles in Korea, triggering road congestion and a lack of available parking spaces. As a result, discomfort experienced by automobile users is a serious issue. As of 2014, parking is only available for about 96 percent of the vehicles located in Korea. This means that approximately 0.9 million automobiles do not have anywhere to park [17]. In general, problems with parking occur due to the

insufficiency of parking spaces when compared against the total number of vehicles. To resolve this problem, the central and local governments have made efforts to decrease the demand for parking by expanding the number of available parking spaces. However, they have yet to produce satisfactory results. Because of this, parking-related civil complaints are on the rise, and new approaches to understanding parking complaints are necessary.

The analysis of civil complaints may improve administrative services in order to meet the diverse demands of citizens, improve incomplete processes

by objectively evaluating the available public services and considering citizen perspectives, and extract meaningful data for decision-making regarding public services [18]. As such, this study has provided basic data intended to assist with meeting parking-related policy demands by conducting a SNA on parking-related civil complaints retrieved from Busan City's 2015 "Wish to Busan City" civil complaint bulletin board. The outcome of the SNA produced the following results:

First, major areas of parking-related civil complaints included illegal parking, conflict among residents, lack of parking space, and public parking lots. The civil complaint keywords were categorized by the effects caused by the lack of parking space, resulting in illegal parking and varying other issues. These problems are similar to those felt by Busan citizens in the 2017 Report on Parking by the Busan Development Institute [19], which indicates that civil complaints have not been dealt with appropriately from an administrative perspective. Accordingly, parking policies should be established and based upon the precise analysis of electronic civil complaints submitted by Busan citizens.

Second, there was a large number of civil complaints related to illegal parking. In particular, complaints were associated with traffic jams, written warnings, fines imposed following the crackdown on illegal parking, treatment by administrative staff following the towing of a vehicle, and difficulties with vehicle passing due to illegally parked vehicles. In other words, illegal parking can be attributed to an array of contributing factors, including the lack of parking space, the mindset of the individuals who illegally park their vehicles and the socio-cultural environment surrounding them, insufficient policies related to illegal parking, and even conflicts arising from such crackdown. The above research outcome is consistent with that of Lee (2017) [20], who asserted the problem of illegal parking in Busan City to be serious—illegal parking within neighborhoods by vehicles that have failed to park in their assigned parking lot, vehicles parked on backroads that result in increased traffic congestion in residential areas, and exposure to safety accidents are all current and pressing issues. In the meantime, tightening the policies on illegal parking is an effective measure, as it is one of the most powerful methods of managing the demand for parking but is done insufficiently [21]. The fines levied in Korea are smaller than those in advanced countries, and do not restrict vehicle operation. This triggers illegal parking [22]. To prevent this from continuing, the human resources to do crackdown on illegal parking

should be expanded, fair and continuous administrative treatment should be applied, and punishment on illegal parking should be strengthened.

Third, a smart-parking system is needed. The problem of parking is difficult to resolve with only an increase in parking facilities. In more advanced countries, measures for efficient parking lot management and operation are sought after, as well as efforts to increase supply of appropriate facilities. Therefore, policies for smart-parking systems, such as parking information services, should be implemented.

Fourth, civic consciousness regarding parking should be encouraged. According to the result of a survey completed by the Korean Research Institute for Local Administration, most survey participants had illegally parked their vehicle. The results showed that 97.3% of participants had illegally parked in the past, while only 2.7% answered that they had not [23]. This is because while parking is insufficient, the lack of civic consciousness regarding parking is even greater. As such, continuous movements to reform public consciousness on parking is necessary.

This research conducted a quantitative network analysis on data regarding major parking-related civil complaints. The results can be utilized as basic data to predict future parking-related issues in Busan City. However, there are limitations to the research results of this study. Among the data retrieved for this study, there were 412 traffic-related civil complaints. Among these complaints, only 10% involved issues pertaining to parking. Therefore, the results should be cautiously interpreted, and the data from subsequent years is necessary in order to evaluate an overall trend properly reflecting civil complaints and the implemented policies. Follow-up research that analyzes data from different years will enhance the existing reference data and assist in determining the policy implementation, and the quantitative prediction of data will be conducive to enhancing the decision-making process for government organizations and relevant businesses.

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