The smart city policy with civil complaints through keyword network analysis:

the case of Shiheung city, Republic of Korea

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Environmental Science and Landscape Architecture Course

Graduate School of Horticulture, Chiba University.

Kyunghun Min

Approved by:

Prof. Dr. Katsunori Furuya, Advisor
Graduate School of Horticulture
Chiba University

Prof. Dr. Tsuyoshi Honjo, Main Committee
Graduate School of Horticulture
Chiba University

Asso. Prof. Dr. Takeshi Kinoshita, Committee
Graduate School of Horticulture
Chiba University

Asso. Prof. Dr. Noriko Akita, Committee
Graduate School of Horticulture
Chiba University

Abstract

Since 2013, the South Korean government has been pursuing urban policies aimed at utilizing data and actively engaging citizens as part of the government's version of the new 3.0 policy. Recently, smart concepts have been added to emphasize the analysis and deployment of data that can be reflected in policies. With the development of ICT, citizens are exchanging information through the Internet and SNS, and the government analyzes the information to devise future urban policies.

Citizens report complaints about dissatisfaction with the living environment or improvements in policies. Civil complaints have been on the rise since 2013, and settlement of complaints is considered important because it is directly linked to the credibility of local and national governments. Civil complaints are voluntarily reported by citizens and generated in real-time. They are considered important data in a data-based society, as the Korean government also reflects about 40 percent of the results of the civil complaints in national policies.

Shiheung of South Korea the study area was previously planned as a national industrial park, and environmental issues continued. However, although this city was selected as a pilot city for the ministry's data-based smart city project under the government in 2018, complaints about the construction of new towns and environmental issues due to the lifting of development restrictions continue to rise.

This study deals with collection the civil complaints of Shiheung City and analyzed the issues through keyword analysis. After analyzing temporary and continuous issues, a

civil complaints map was established based on geographical information of issues. Civil complaints map helps to understand the occurrence location of issues within the city and is useful in setting priority areas in urban management. In addition, the utilization of the civil complaints map is recognized in future urban policies where the smart concepts are introduced.

Civil complaint map is information built with voluntary participation of citizens, and it also plays a role in the policies participation of citizens in smart society. It will also be used as an important base in the policy-making process, as it has deep implications for data generation, deployment, generation, and governance, which are considered important in smart cities.

Keywords: civil complaints; civil complaints management; policy supporting mapping; smart cities; big data; smart governance

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Chapter 1. Introduction

1.1. Background

Cities are growing on a global scale, presenting both opportunities and challenges to sustainably improve the quality of life for the residents (Luederitz et al., 2015). As of 2019, almost half of the world's population resides in urban areas, and this ratio is expected to increase to 68% by 2050. This is called urbanization, which is the increasing trend of the population to migrate toward cities (United States, 2018). Urbanization contributes to economic development by promoting economic growth, but causes changes in land cover and land use, and affects crime and disease rates (Bettencourt et al., 2007; Frumkin, 2003; Lederbogen et al., 2011). Many modern cities have sufficient secure convenience amenities, infrastructure, and green space to fulfill the needs of citizens, but rapidly developed cities may face severe environmental issues in resources-dependent areas (Shen and Zhou, 2014; Wan et al., 2015). Therefore, the merits and drawbacks of urban development may differ depending on regions within cities (Luederitz et al., 2015).

With advances in information and communication technology (ICT) and the spread of smart devices and mobile systems, introducing new applications and services (Wu, 2018), residents can now better participate in urban management and development compared to in the past (Sun and Du, 2017). Social network services (SNSs) are considered a good example of the latest data and dedicated applications (apps), such as complaint apps. SNSs provide a faster and more convenient process than in the past. SNSs also support

accurate geographic information using tools such as smartphone apps, and most tools are accessible and available to anyone for free of charge. The information collected from this communication space can be generated and used as a new data type (Iglesias et al., 2016; Mora et al., 2018). Given that local data is expressed in a map based on data focused on a region, any resident can easily understand their area's overall environment, including whether their neighborhood is attractive or problematic. Although the limitation in the mapping process is that the data are obtained from users' daily lives, analysis of these data is more effective in terms of time and cost than the past given the use of citizens' opinions in an acquisition of real-time data.

Data collection has changed from a previously centralized government and surveying offices to a voluntary provision of data by citizens (Forghani and Delavar, 2014). Cities are rapidly changing, and urban people are producing enormous amounts of data in real time. These data are regarded as a new type of data and are processed as a basis for management planning to address problems faced by municipalities and local organizations. This processing could be used to improve the management of urban services (Ribeiro et al., 2015). Major cities around the world are releasing maps and reports that could be shared with citizens. Each state in the United States created a crime map that provides a detailed analysis of the locations and types of the crime based on the state police. The maps are used to help prevent crimes before they occur in these locations, and these maps enable the identification of the crime types in each area. New York City in the United States produces a noise map based on complaints, social media, and other data, revealing the distribution of noise in each area (DiNapoli, 2018; Wang et al., 2014). These data types and thematic maps regarding the urban environment contribute to the convenience and safety of urban

residents through the promotion of urban services and the prevention of foreseen challenges.

In the Republic of Korea, public discussion sessions, field meetings with citizens, and civil complaints are being used to improve policies and systems. In particular, 36.1% of the results of the civil complaints analysis were reflected in improvements to the policy system by analyzing two million civil complaints cases per year (Anti-Corruption and Civil Rights Commission, 2018) (hereafter ACCRC). A civil complaint prediction program was implemented to minimize repetitive damage (Incheon Metropolitan city, 2015); through regular analysis, the results were used to understand the communications with relevant stakeholders (Chungnam Institute, 2017). The government is trying to communicate with citizens by encouraging them to participate in policy creation and change through various channels.

Shiheung city in the Republic of Korea, study area, which was planned as a national industrial city in 1990, has been continuously experiencing environmental challenges. Besides, with the implementation of the new urban planning by lifting the development-restricted area from 2014, citizens' complaints are increasing. However, this city was selected as a pilot site for the smart city by the national government in South Korea in 2018, the local government encourages active participation in data-based new urban policies. Accordingly, this study is to create a map using civil complaints which citizens voluntarily represent their improvement or dissatisfaction in urban policies. The civil complaints maps based on real-time big data will be as basic data in the policymaking process in the future.

1.2. The purpose of this study

So far, there have globally not been many studies of civil complaints as data, nor have there been many studies using them as data in the smart city based on big data. In the Republic of Korea, there have been a few studies where civil petitions were used as data, such as illegal parking and problems and improvements in the civil service system only in certain areas, but the need for analysis of civil complaints has mentioned by only national and metropolitan city level reports.

In addition, the government's Big Data civil complaints web system launched in 2019 provides only analyzed results at the national and provincial level based on frequency, making it difficult for citizens to confirm the progress of their complaints as regional and city level is not actively analyzed.

Therefore, the main purpose of this study is to prepare a civil complaints analysis and its map that can be reflected in the policy. For detailed purposes are to: first, building a mapping process for local prominent issues and related issues through two types of keyword analysis. Second, it is to confirm the usability of civil complaints mapping in smart city policies implemented by the study area. Finally, it proposes to improve the current civil complaints system.

1.3. The research methods

Keyword networks analysis, one of the social network analysis methods, was used to explore trends and the relationship between research topics in many study fields, including information science (Leydesdorff and Vaughan; 2006), medical research (Zhang et al., 2012), computer science (Chen et al., 2016), and science research (Bornmann et al., 2018). Recently, studies have gone beyond analysis of relationships between individuals and organizations used to identify individuals and other networks. Related information or opinions on social media, such as Twitter for certain people, things, and even presidential speeches, have also been used for analysis (Bilbao-Jayo, 2018; Burnap and Williams; 2015; Chung et al., 2010). In addition, this analysis process contributes to greatly reducing the effort and time required for a traditional literature review and can be applied to all fields of science (Radhakrishnan et al., 2017; Min et al., 2019b).

A process should be performed for the extra analysis to identify meaningful keywords, because keyword network analysis relies on searched keywords. There is a variety of verification analysis methods, but this study conducted co-occurrence keyword network analysis (Figure 1). It focuses on co-occurrence of links between keywords in literature, and is useful in understanding components and knowledge structures in the scientific and technical fields (Chen et al., 2016; Radhakrishnan et al., 2017; Shichiyakh; 2016). The co-occurrence keyword network represents the number of times a pair of words simultaneously occurs in multiple articles, and constitutes the weight of the link that connects the pair (Leydesdorff and Vaughan, 2006; Zhang et al., 2012).

The co-occurrence keyword network represents the number of times a pair of words simultaneously occurs in multiple articles, and constitutes the weight of the link that connects the pair ((Leydesdorff and Vaughan, 2006; Zhang et al., 2012). A network map of this analysis consists of nodes and links, in which each keyword is a node, a pair of co-occurrence words is a link, and the number of times a pair occurs simultaneously in multiple articles explains the weight of the link that connects the pair. In this study, keywords with a co-occurrence frequency above 10 were used as data.

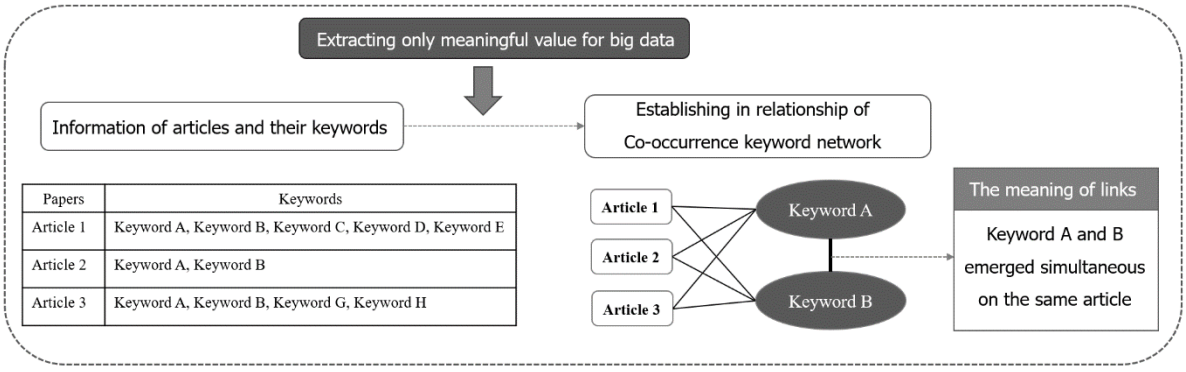

Figure 1. Co-occurrence keyword analysis.

In this study, keyword network analysis includes the process of constructing the network using the relationship of the collected keywords within research articles, and analyzing their structure. Our analysis consists of two methods; degree centrality and betweenness degree, which are useful to identify the role of words in the overall network map. Centrality analysis measures the importance of a node (word) and has the potential to interpret its structures and express the key properties. Betweenness analysis measures the number of times the shortest link between nodes and explained words acted as bridge between nodes; a node with a high betweenness value may have a significant impact on

the overall network (Radhakrshana et al., 2017). These analyses express trends in the latest issues with the centrality degree, and relevance to other issues with the betweenness degree (Abilhoa and De Castro, 2014; Benckendorff, 2009; Jung and Park, 2015; Matas, N et al., 2014), and are useful in understanding the properties of words and the flow of the entire network in the co-occurrence networks using Netminer 4 software (social network analysis software, CYRAM, Seongnam, Korea).

1.3.1. Centrality degree analysis

Centrality analysis measures the importance of a node (word) and has the potential to interpret its structures and express the key properties. Centrality analysis measures the importance of a node (word) and has the potential to interpret its structures and express the key properties. Degree centrality measures how many connections the nodes in the network (Newman, 2006). A node's degree is simply a count of how many social connections (Golbeck, 2015). The results, in general, represented those number into a 0-1 scale, and the higher values mean the node is more central. However, the higher values are always located in central in network map because this method just measures how many connections (Golbeck 2013). Such a node would have high value, even though it is distant from the core of the network and most of the nodes. Therefore, this process is required to perform in conjunction with other analysis methods to identify the role of the nodes (Peter and Slatkin, 2016). The formula for the centrality degree is as follows:

$$C'D = \frac{N}{(n-1)(n-2)}$$

N **:** the number of directly connected with nodes

n : the total number of the nodes in the network

For example, a node from A to E was configured within a network (Figure 2).

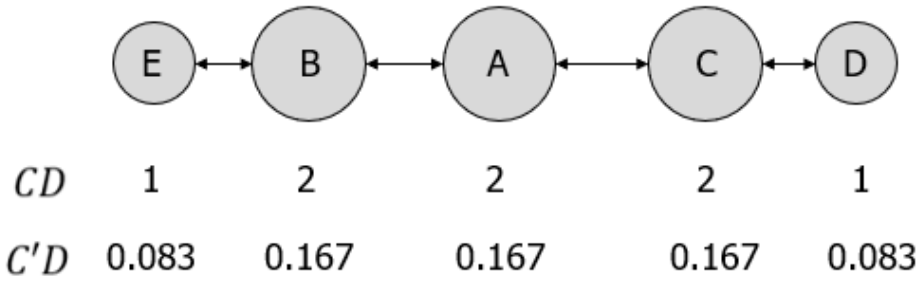

Figure 2. The calculation of the centrality degree.

The degree-centrality of CD(A) is 2, as it relates to B and C. The degree-contractility of CD(E) is 1 because it relates only to B. Standardizing this index is as follows.

$$C'D(A) = \frac{2}{(5-1)(5-2)} = 0.167$$

$$C'D(E) = \frac{1}{(5-1)(5-2)} = 0.083$$

Following the standardization process to make it an index between 0 and 1, C'D(A) is 0.167 and C'D(E) is 0.083. As a result, A is more degree-centered than E, which is interpreted as highly relevant within the network.

1.3.2. Betweenness Centrality analysis

Betweenness centrality measures how important a role is to the shortest links through the network (Golbeck, 2013), and identifies undertaking 'mediation' role in network. It captures how important a node is in the flow of information from one part of the network to another, for example, SNSs (Twitter, Facebook) (Grandjean et al., 2016; Landherr et al., 2010). A node with high value means information broker, although it may not be very noticeable, the node with the highest influence on the network (Metcalf et al., 2016). Recently, this process has been to identify the relationship between presidential speech and contents on the big data to understand the intention of flow. In light of these points, centrality degree is used to identify the most popular and prominent nodes, and betweenness centrality is used to identify the nodes that play the most important role among on the network (Radhakrishnan et al., 2017). The formula for the betweenness centrality is as follows:

$$B'C = \frac{X}{\frac{(n-1)(n-2)}{2}}$$

X **:** the number of times interrupt the shortest path between the two nodes of pairs

n : the total number of the nodes in the network

For example, a node from A to E was configured within a network (Figure 3).

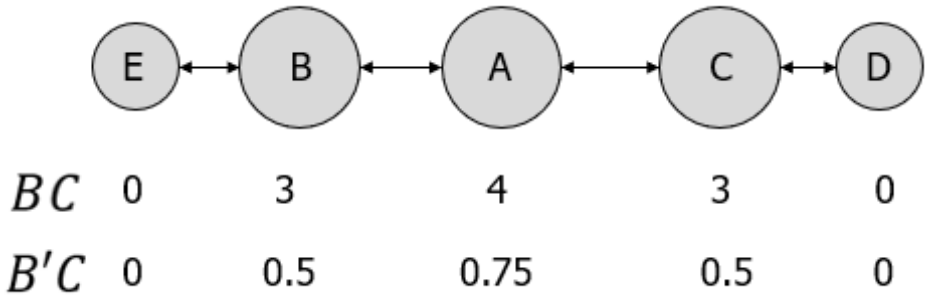

Figure 3. The calculation of the betweenness centrality.

The number of links to nodes that must pass through A is 4 as BC, CD, CE, and DE. Number of links to nodes that must pass through B is 3 as AE, CE, and DE. Standardizing this index is as follows.

$$B'C(A) = \frac{4(BC,CD,CE,DE)}{\frac{(5-1)(5-2)}{2}} = 0.75$$

$$B'C(B) = \frac{3(AE,CE,DE)}{\frac{(5-1)(5-2)}{2}} = 0.5$$

Following the standardization process to make it an index between 0 and 1, B'C(A) is 0.75 and B'C(B) is 0.5. Therefore, A plays a more important role in connecting other nodes within the network than B.

1.4. The Research Flows

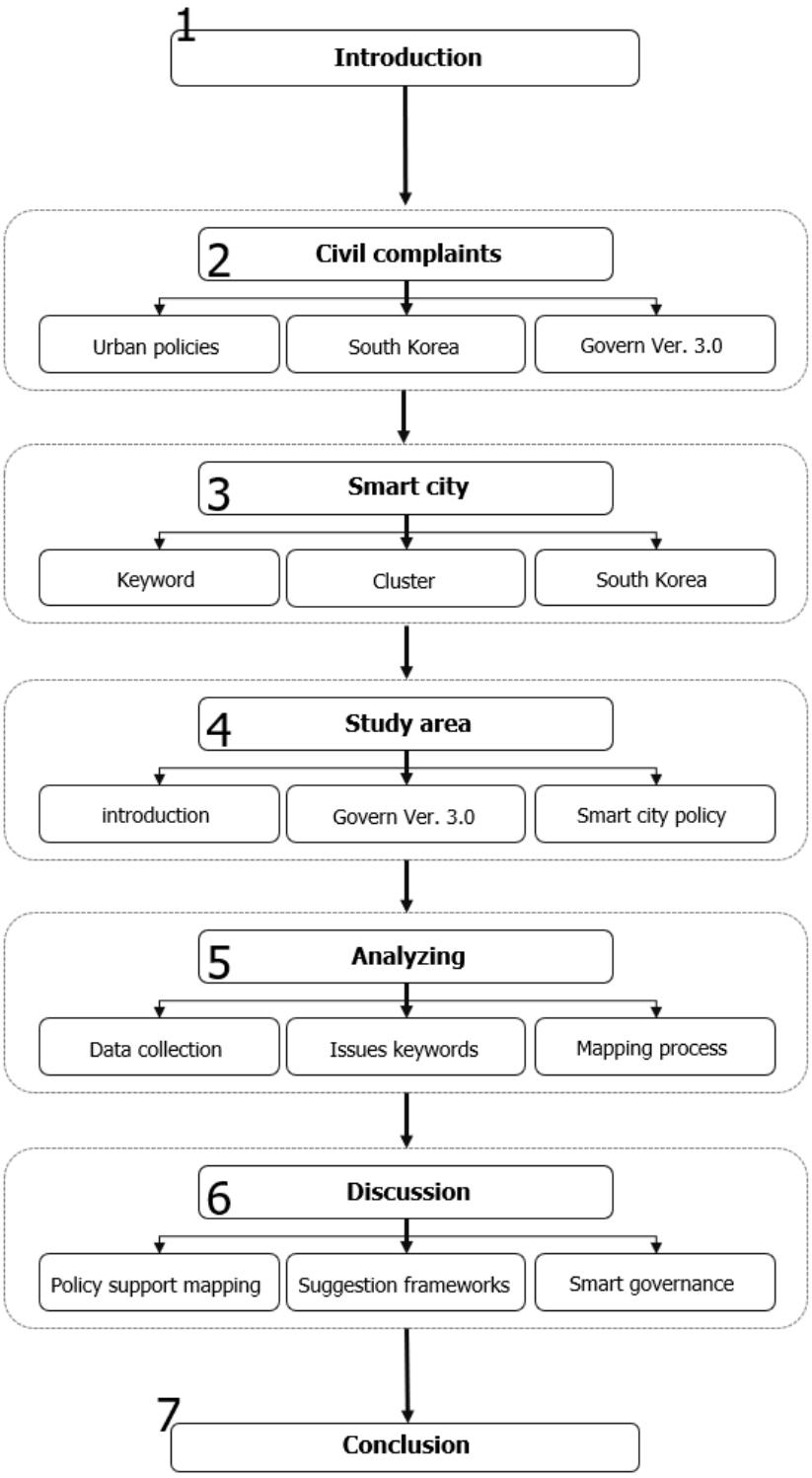

Figure 4. The Research flows

Chapter 2. Civil complaints

2.1. Civil complaints with urban policies

Civil complaints mean that citizens themselves voluntarily report their dissatisfactions or challenges to the local government or national government where they live. Citizens can freely criticize policies implemented by local governments through civil complaints and demand to solve the challenges or be improved. The civil complaints reporting channels vary depending on the circumstances of each country, they extensively cover on crime, environmental issues, noise, parking problems, etc. Advanced global cities recognize civil complaints as data and applicate to improve the management of urban services.

Considerable progress in data collection technology has occurred over the past decade worldwide. Data collection has changed from a previously centralized government and surveying offices to a voluntary provision of data by citizens (Ribeiro et al., 2015). Cities are rapidly changing, and urban people are producing enormous amounts of data in real time. These data are regarded as a new type of data and are processed as a basis for management planning to address problems faced by municipalities and local organizations. This processing could be used to improve the management of urban services (DiNapoli, 2018)

Major cities around the world are releasing maps and reports regarding analyzed complaints that could be shared with citizens. Each state in the United States created a crime map that provides a detailed analysis of the locations and types of the crime based on the state police. The maps are used to help prevent crimes before they occur in these locations, and these maps enable the identification of the crime types in each area.

New York City in the United States produces a noise map based on complaints, social media, and other data, revealing the distribution of noise in each area. These data types and thematic maps regarding the urban environment contribute to the convenience and safety of urban residents through the promotion of urban services and the prevention of foreseen challenges (Mora et al., 2018).

Figure 5 described crime location reported by citizens in New York City in May 2019. And Figure 6 described the impact based on the location of the reported noise complaints in New York city in 2012.

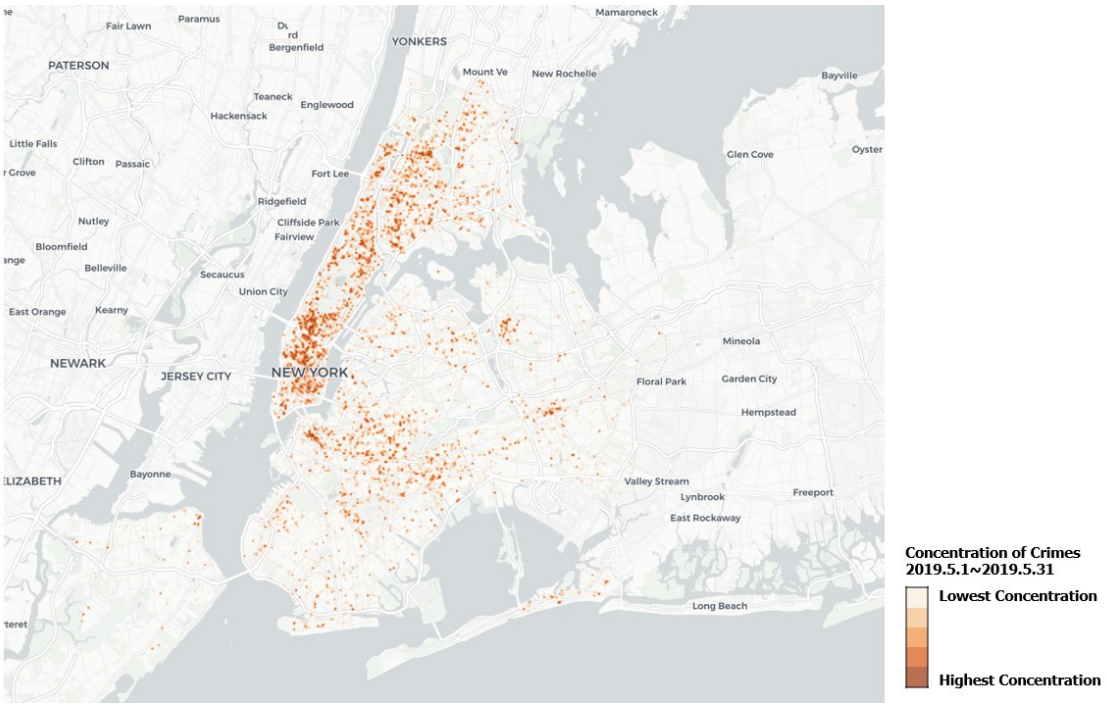

Figure 5. The criminal distribution map in New York, United States.
Source: NYC crime map(https://maps.nye.gov.crime/)

Figure 6. The concentration of Noise in New York, United States.
Source: NYC Open Data(https://opendata.cityofnewyork.us)

2.2. Civil complaints of the Republic of Korea

2.2.1. Legal definition of the civil complaints

Civil complaints are a means for the people to call on administrative agencies to consult, improve operation and deal with grievances. More specifically, civil complaints are divided into general complaints and ombudsman complaint. The general complaints are divided into court complaint, question complaint, suggestion complaint and extra complaint. The court complaint is an act of filing an application for authorization, permission or approval in accordance with law, or applying for registration or list for confirmation or proof based on law. The requests regarding complaint are act of requesting explanation or interpretation of the administrative agency regarding laws, system and procedures. For example, A intends to sell its own land to B, A may apply for the court complaint to prove its own land, and both A and B may require admissive procedures through the question complaint. In addition, citizens can demand improvement in the administrative system and operation through the suggestion complaint and request simple administrative procedure or inconveniences to administrative agencies through extra complaint. The citizens can file complaints of grievances if their rights are violated or inconvenienced by illegal or unreasonable administrative system of governments.

Civil complaints process is conducted by ′Civil petitions Treatment Act’ managed by Ministry of Interior and Safety. The act consists of 45 Articles, including definition, handling and improvement of civil complaints. According to Article 9, an administrative agency such as local and national government that has received a civil complaint by citizen cannot withhold or refuse the application except special cases accordance with other laws.

Article 27 states that after completing the processing of the received complaints, the administrative governments should notify the reporter of the result by document or telephone (Appendix 1). The entire process of civil complaints should be addressed important as citizens can directly contact and participate in the process of handling complaints. In this process, the credibility and expertise of the government are assessed to citizens (Ra et al., 2006). Hence, a complaint should be dealt with in a perfectly way because it may cause new complaints in the region or country (ACCRC, 2018; MIS, 2017).

In the Republic of Korea, public discussion sessions, field meetings with citizens, and civil complaints are being used to improve policies and systems. In particular, 36.1% of the results of the civil complaints analysis were reflected in improvements to the policy system by analyzing 2 million civil complaints cases per year (ACCRC, 2018). A civil complaint prediction program was implemented to minimize repetitive damage(Inchoen Metropolitan city, 2015); through regular analysis, the results were used to understand the communications with relevant stakeholders(Chungnam Institute, 2017). The government is trying to communicate with citizens by encouraging them to participate in policy creation and change through various channels. Therefore, civil complaints serve as important data in policies planning and management in South Korea.

2.2.2. Civil complaints reporting channels

Civil complaints were reported offline and online channels. Offline reports are filed by the reporter visiting the department of government or by phone calling the person in charge. Online reports are involving in local or national government webpage, specialized local or national application on smartphone based on the Internet (Figure 7). Prior to development of the Internet, most of complaints were filed by offline such as telephone and mail, but most of them have been filed online recently.

Figure 7. Online reporting channels (Internet webpage; Gugminsinmungo and applications on smartphone; Gugminsinmungo and Saenghwalbulpyensingo)

As Figure 8 described, the complaints toward local government are reported through document, phone calls, visits and the Internet. Except for webpage of local

government, Internet homepage and application are operated and managed by the national government and the Anti-Corruption and Civil Rights Commission. The local government requests help from higher authorities if difficulties in responding and resolving complaints, and the national government distribute complaints to local governments respectively.

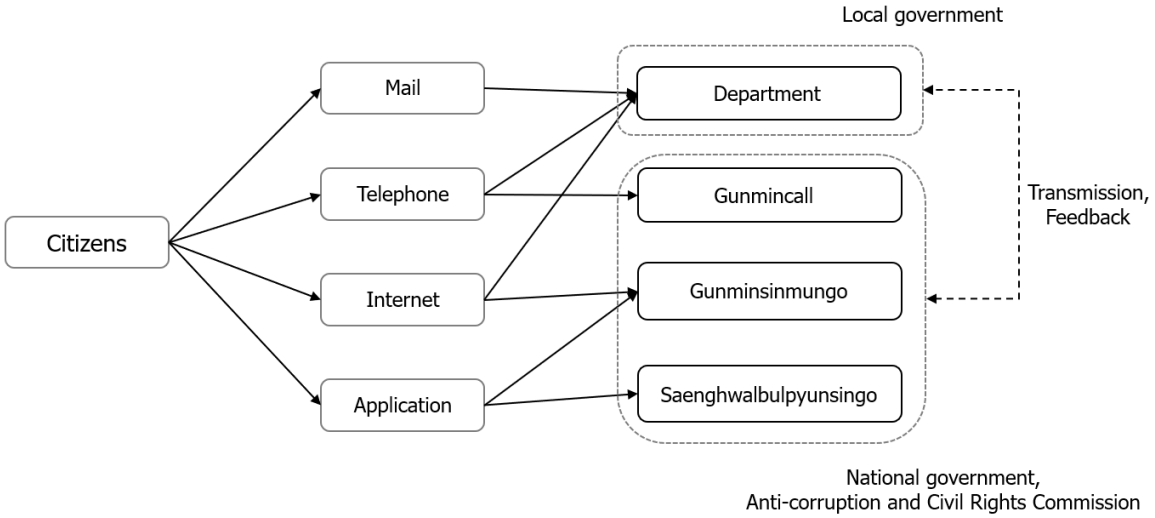

Figure 8. The flow of civil complaints reporting channels.

The national government operates website and application on smartphone; (Gugminsinmungo and Minwon24 in Korean) to help citizens conveniently file complaints. While local governments are providing citizens with webpages for civil complaints, not many local governments have developed reporting application on smartphone. Most reporting applications such as reporting for life inconvenience (Saenghwalbulpyunsingo in Korean) are developed and managed by the national government. The 24-hour call center (Gugmincall), which is also managed by the national government, provides a report services for the disable.

In offline reports, the communication involves face-to-face and phone call conversations which are securely closed with the security of personal information ensured, whereas citizens are more likely to express their sincere thoughts and feelings anonymously online (ACCRC, 2018). The former can help determine the exact opinions of each citizen, whereas the latter enables an understanding of citizens' perceptions and trends regarding local challenges. Both kinds of communication, which include voluntary citizen participation, should be analyzed to improve urban services.

The overall reporting frequency increased, but each channel has pros and cons. The offline channels are convenient for reporting complaints immediately because reporters talk directly with the person in charge, so the reporters can realistically convey their feelings and the situation causing dissatisfaction at the time. However, the subjectivity of the person in charge might affect the content of the recorded complaint, and it is difficult for the complainants to check the process or the result in real-time. In addition, if the person in charge does not understand the exact occurrence location being reported, or if the reporter does not describe its location correctly, the process of solving the problem could be difficult and time-consuming. Reporting via Internet bulletin and apps on smartphones, as online channels reported on the Internet, are not tied to place or time. Photos and videos can be attached to provide evidence of the issue, which can be released to other citizens through bulletin board homepages and apps. Although online methods enable convenient monitoring of the process, immediately provide results, and the location of problem can be automatically transmitted from apps or described in detail by the reporter, these methods can be abused or misused by a particular person or a specific problem. The person in charge may struggle to interpret or understand complaints because of the free form nature of the

process. Online channels are useful for real-time analysis and mapping compared to offline channels because information is more open, and reporting is independent of time and place. In particular, a more well-organized online platform will help citizens report complaints and gather information, enabling managers to easily obtain and analyze data.

2.2.3. Civil complaints management system

A management system of complaints in Republic of Korea was launched to increase transparency about public officials' inadequate behaviors and the financial conditions. This system, known as the OPEN (Online Procedures ENhancement for Civil Applications) system, was introduced by the Seoul metropolitan government in 1999, released to public, and recognized as an internationally efficient system for citizens by the United Nations (UN). Since then, the process of controlling and managing local government has become more transparent through the active participation of citizens.

As figure 9 described, the process of handling civil complaints varies depending on the channels through which or where citizens filed civil complaints. The national government presents guideline and standards for solving civil complaints, analyzed the data of local governments and reflects them in national policies. Local governments investigate the cause of the problem, directly addressing complaints. The Anti-Corruption and Civil Rights Commissions is a division of the national government, but it mainly serves as a management and supervision. This organization manages and operates the homepage and application of civil complaints and is transferring complaints to local governments. Depending on the weigh and severity of the complaints, trials may take place with the local government appealing commission.

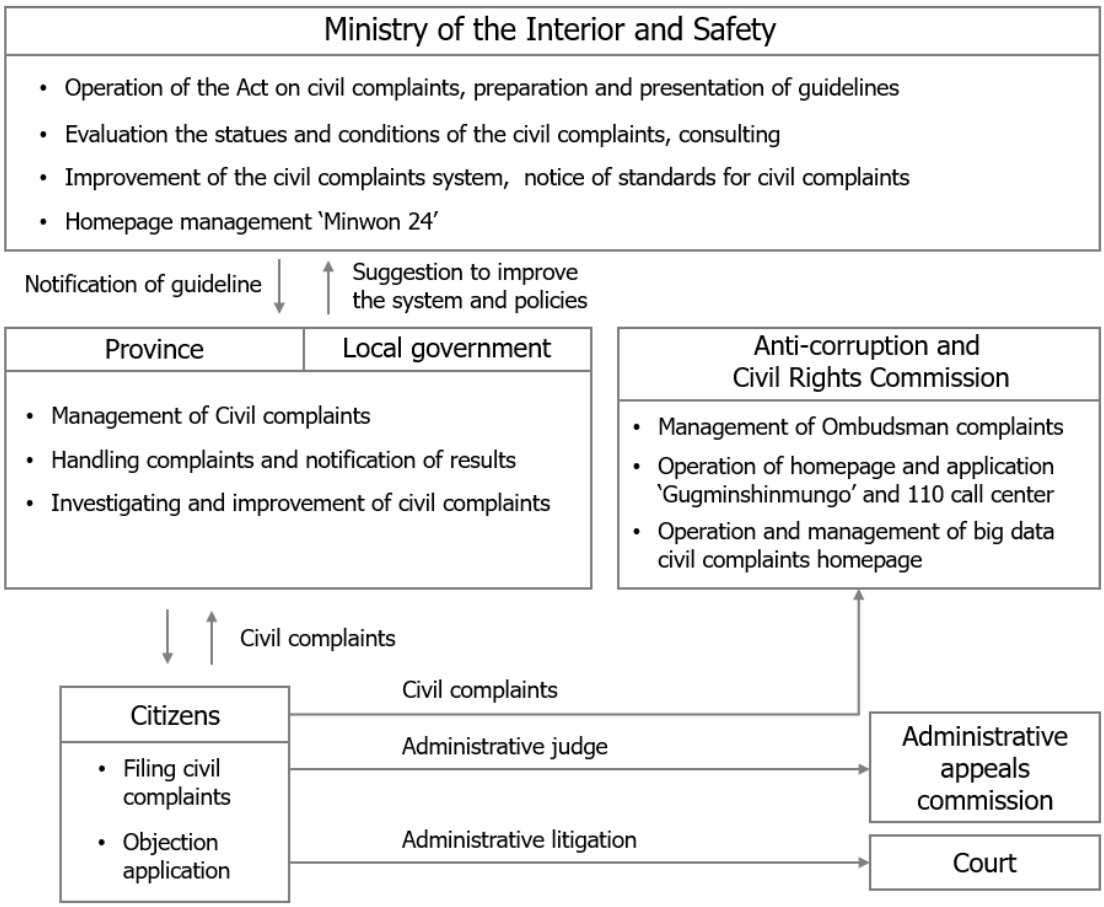

Figure 9. Overall management flow of civil complaints

2.3. Government policy Ver. 3.0

Government Ver. 3.0, which the administrative slogan of the South Korea, has launched in 2013. It is a new government operation paradigm that actively opens and shares public information, communicates and cooperates with department to eliminate divisions between governments, provide customized services for the citizens, and create jobs and support the creation economy. In the past, active and public citizen participation is required compared to Ver. 1.0 and 2.0. Compared with Ver. 2.0 emphasized communication both side, Ver. 3.0 offers customized services for citizens with both directions. Also, Since Ver 3.0 is based on the Internet and smart mobile devices, the public participation by citizens is more empathized (Figure 10).

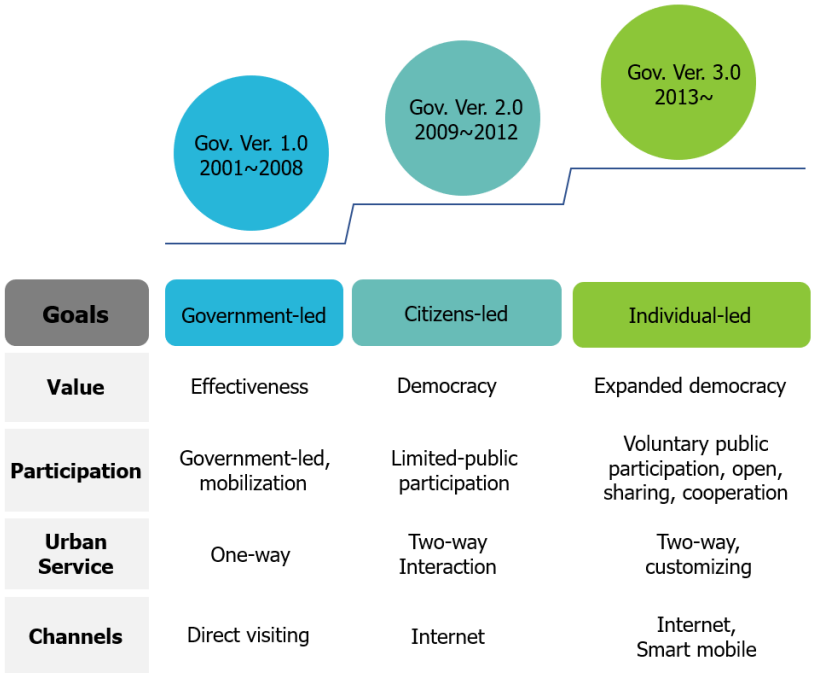

Figure 10. Comparison of Government Ver. 1.0, 2.0 and 3.0.
Source: amend by Government 3.0 report.

2.4. Statues of civil complaints in the Republic of Korea

The national human rights commission of the Republic of Korea the status of and trends in filed civil complaints in real time by province units, institutions, sex, and age on a website on 30 January 2019. The website also discloses the status of the various classifications being handle, such as living conditions, civil and criminal types, environment, and industry. Although this system is effective for managing and predicting the entire national territory on a government level using keywords, it is difficult for citizens to understand the issues in detail at the city unit level. In this regard, the complaints from city units are required by the local government, especially the chronic complaints that should be handled immediately that require cooperation at the national level.

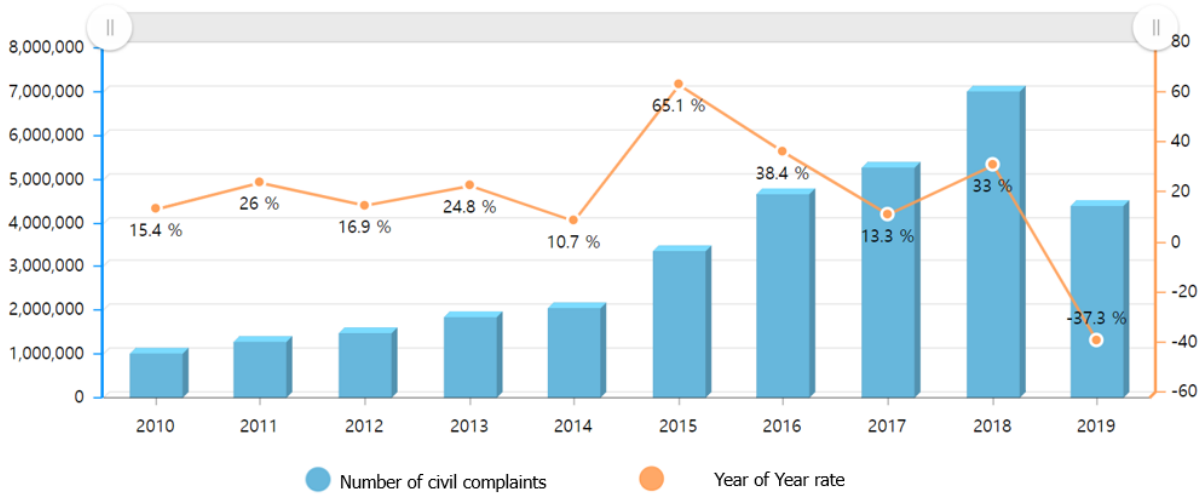

Figure 11. The number and year of year rate of civil complaints.
Source: Korean big data system of civil complaints(bigdata.epeople.go.kr) (accessed on June 23)
This platform provides the status every day, monthly, annually statics.

The complaints in South Korea has been on a steady rise since 2010, and the number of complaints was the highest about 7 million. 2015 should considered important as a time when had the highest rate of increase and decrease at 65.1% (Figure 11).

Most of the complaints reported on June 23, 2019. were concentrated in Seoul Metropolitan city and the metropolitan areas. The highest number was over 3,000 cases, and less than 50 cases were found in the lowest. This platform expresses the number of complaints filed by the public to the national and provincial levels (Figure 12). However, since not all cities in South Korea have real-time processing systems, it is limited to identify civil complaints filed by citizens to local scale.

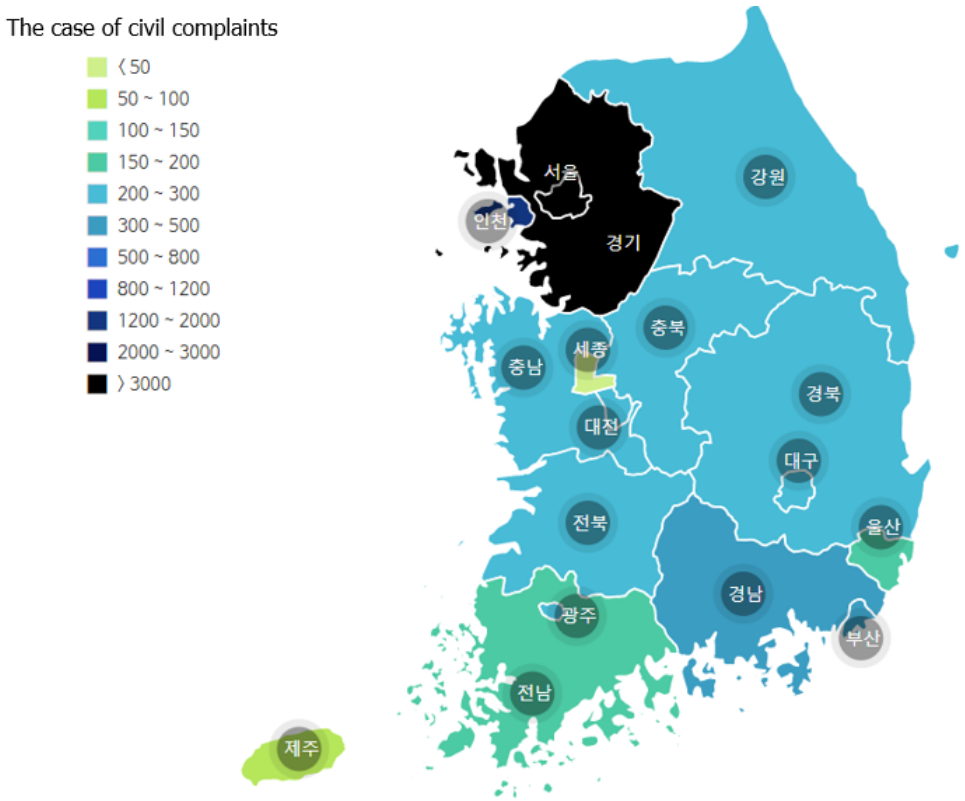

Figure 12. The province-level map of reported civil complaints on June 23, 2019.

Source: Korean big data system of civil complaints(bigdata.epeople.go.kr) (accessed on June 23)

Data on this platform is based on the Gugminsinmungo webpage and application and Gunmincall 100 data operated by Anti-Corruption and Civil Rights Commission. It is very effective to analyze real-time complaints on a national level but has limitation in analyzing below the provincial level.

Ansan city, located in Seoul metropolitan areas, launched a real-time construction map service on the local government's website on June 20, 2019. The service is operated to share with citizens and communicate with them by providing information in advance that could cause inconvenience to citizens or cause civil complaints. Each site of construction has various information, including the contents, type and duration of the construction. In light of this, city or local-level maps have the advantage of being directly utilized by citizens (Figure 13).

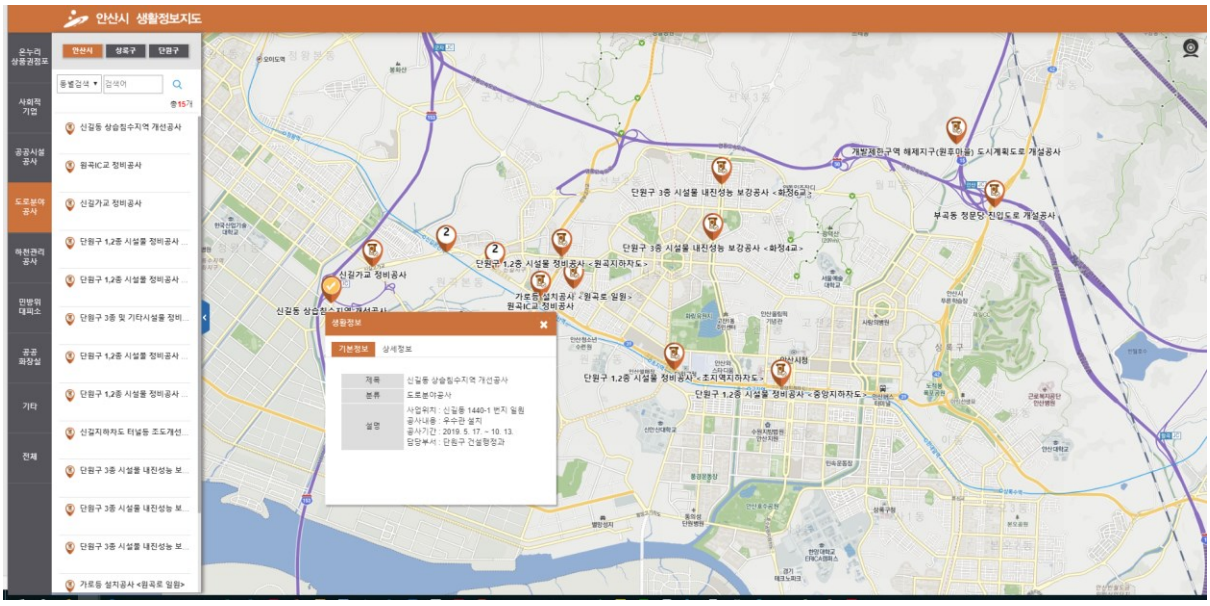

Figure 13. The real-time construction map service in Ansan city (accessed on June 23, 2019)
Source: https://www.ansan.go.kr/lifelnfo/map/life/index.do

2.5. Researches of civil complaints in the Republic of Korea

Won and Yoo (2016) collected data on electronic civil complaints for a total of six years from 2010 to 2016 in Jinju city, South Gyeongsang Province, South Korea. The authors analyzed the frequency of the data using 'KoNLP' of R software that is an open source and free statistical data analysis. A pattern analysis with a radius of 50m was conducted to identify spatial distribution of the occurrence locations of civil complaints to understand areas where civil complaints were reported. Besides, the result was the highest number of illegal parking complaints reported around the residential area. The authors pointed out that the growing number of civil complaints are not being addressed by a systematic process of civil complaints.

Hong (2018) collected also electronic civil complaints in environmental issues in 25 districts of Seoul Metropolitan city for one and a half years from January 1, 2016 to June 30, 2017. Using LDA (Latent Dirichlet Allocation)'s sampling methods, keywords were identified that construction/noise, architectural deliberation, city aesthetics, life style and safety interception. And the author identified the emotional spatial score of each reported location reflected on emotional word score by Hedonometer. Through the result, the author stressed that emotional analysis priorities the resolution of civil complaints and allows the voice of citizens to feel closer.

Park (2015) conducted the spatial distribution by utilizing reported civil complaints based on environmental keyword in 2013 to Incheon Metropolitan city. Keywords with more than 20 frequency was mapped through hotspot analysis. To make more accurate spatial pattern analysis, the author empathized the need to build a databased of spatial big data.

The researches using civil complaints as data stressed the need for systematic solution process such as identifying cause and side effect of each occurrence location through an integrated database management system.

2.6. Civil complaints Issues in the Republic of Korea

The Government Ver. 3.0 and newly launched smart city policies highlighted the utilizing of data at the site and the participation of local residents. Meanwhile, civil complaints in South Korea are increasing every day, but data-based management system is not being organized at national and regional levels. With the development of ICT, citizens are more willing to participate in urban policy than in the past, and need cooperation from citizens is absolutely necessary in managing cities because citizens creates information that they feel directly in the field. Therefore, the issues of civil complaints in South Korea are as follows.

1. A connection platform is required between a national level and city-level. Although national or provincial units are efficient to grasp statistics and trends, the local analysis of civil complaints will be more effective for citizens.

2. The process of handling civil complaints is complicated, and the time varies depending on reporting channels. The reason why is different reception and handling department of civil complaints. It may also take a long time, as transfer was required depending on the scale and content of the complaint. If it takes a lot of time, citizens can report the same things or malicious complaints, thinking that their complaints were ignored.

3. A city level service map exist, as in Ansan city, but this is not based on civil complaints. This map is a pre-predicting system for citizens, which is difficult to predict if the contractor does not provide information.

4. The Government Ver. 3.0 and smart governance stressed the importance of citizens' participation, but it is unclear what role citizens play in policy and how the civil

complaint is being utilized as data. It is reflected in governance with citizens plays an important role in a future society pursuing the smart concept, citizens' opinions will be significantly utilized as data.

Chapter 3. Smart city

3.1. Background

A smart city may be considered as an advanced concept related to the concepts of the information city, digital city, intelligent city, and sustainable city (Basiri et al., 2017; Yigitcanlar, 2006), and has been widely cited and studied, along with the sustainable city concept, since 2013 (De jong et al., 2015; Trindade et al., 2017). According to Google trends regarding the "smart city" (accessed on 13 March 2019) (Figure 14), the smart city's search terms have been on the rise since 2004 and peaked in 2015, but have remained high, suggesting many studies and discussions are occurring on the smart city concept (Allam and Newman, 2018; Trindade et al., 2017). However, the concept of a smart city is controversial, and no exact agreement has been reached on its definition. Despite efforts to conceptualize the smart city in many research fields and studies, most definitions of the smart city have been ambiguous or duplicated (Andrade et al., 2015; De jong et al., 2015). For example, many studies have used smart city, smart sustainable city, sustainable smart city, and so on interchangeably. These terms need to be clearer because they have the potential to be confused with specific and related terms, often interactively used by policymakers, planners, and researchers, when considering the common aspects of urban sustainability (De jong et al., 2015). It is not yet possible to establish a comprehensive approach that addresses the various dimensions of sustainability at the urban level (Maiello et al., 2011). However, in general, the smart city is understood as an ideal model for urban

planning and development, adaption to environmental issues such as climate change and global warming, and efficiently utilizing and managing energy. In addition, Information and Communication Technologies (hereafter ICT) will extensively and effectively help cities achieve a comparative edge (Angelidou; 2014; Caragliu, 2011; Trindade et al., 2017), and be used as the tools and means to develop Intelligent Transport Systems (hereafter ITS) with mobility information and the Internet of Things (hereafter IoT) (Lin, 2017; Silva et al., 2018; Turner et al., 2016), as well as to achieve urban policy making based on governance and open data (Castelnovo, 2016; Pereira et al., 2018; Ruhlandt; 2018). Accordingly, in improving the urban quality of future urban areas, the term smart city is considered as an umbrella concept that includes various sub-concepts such as sustainable smart environments, smart technology, smart energy, smart transportation, smart mobility, and smart government (Bibri and Krogstie, 2017a; Cocchia, 2014; Giffinger et al., 2007; Gudes et al., 2010; Lara et al., 2016; Silva et al., 2017).

The concept of the smart city has emerged over the past decade through ideas of ways to improve the functioning, efficiency, and competitiveness of cities, and solve their environmental challenges. Early on, it was speculated that ICT would play a key role in the smart city (Batty, 2012; Harrison, 2010; Neirotti, 2014). With the development of ICT, the functions of urban management were improved in various fields, such as transportation, energy, health care, and water (Basiri, 2017), and the use of ICT facilitated the development and delivering of information and knowledge generated in daily life, promoting citizens' participation in e-governance and e-services (Pla-Castells, 2015). Additionally, ICT is a technical platform for the process of collecting and processing massive amounts of data, called big data, enhancing digital devices, Internet services, the IoT, and the Internet of

people's societies (Pla-Castells, 2015), and these techniques and technologies have been recognized as tools of urban planning to create innovative, intelligent spaces and improve urban sustainability (Patil, 2017). In this way, the information gathered by these processes is accelerated to achieve intelligence and efficiency in managing urban resources and settings (Bonomi, 2014; Deloitte, 2015; Elgazzar, 2017). Collectively, ICT-based predictive analytics can demonstrate the best implements for gaining insight into data for future decisions (Lechman and Marszk, 2017; Kibria et al., 2018), and enhance the outcomes for other stakeholders in the smart city area (Basiri, 2017).

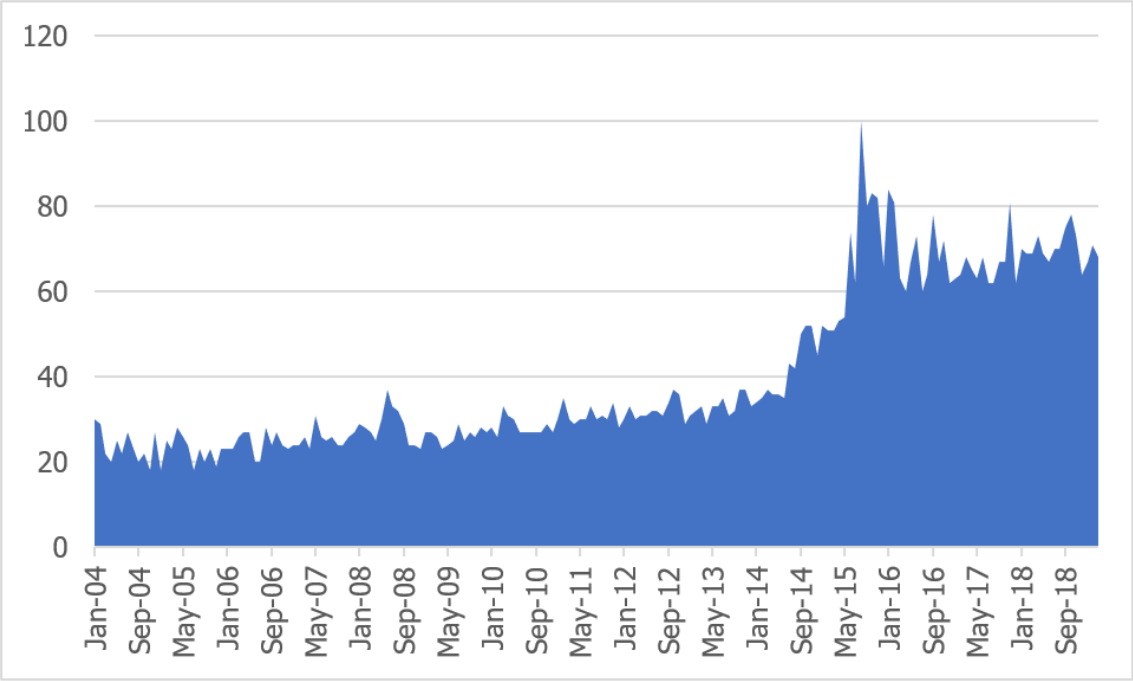

Figure 14. The trend of the concept of the smart city on Google trends (accessed on 13 March 2019).

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environmental challenges. Early on, it was speculated that ICT would play a key role in the smart city (Batty et al., 2012; Harrison et al., 2010; Neirotti et al., 2014). With the development of ICT, the functions of urban management were improved in various fields, such as transportation, energy, health care, and water (Basiri et al., 2017), and the use of ICT facilitated the development and delivering of information and knowledge generated in daily life, promoting citizens' participation in e-governance and e-services (Pla-Castells et al., 2015). Additionally, ICT is a technical platform for the process of collecting and processing massive amounts of data, called big data, enhancing digital devices, Internet services, the IoT, and the Internet of people's societies (Pla-Castells et al., 2015), and these techniques and technologies have been recognized as tools of urban planning to create innovative, intelligent spaces and improve urban sustainability (Patil and Nadaf, 2017). In this way, the information gathered by these processes is accelerated to achieve intelligence and efficiency in managing urban resources and settings (Bonomi et al., 2014, Deloitte, 2015l Elgazzar and EO-Gazzar, 2017). Collectively, ICT-based predictive analytics can demonstrate the best implements for gaining insight into data for future decisions (Lechman and Marszk, 2017; Kibria et al., 2018), and enhance the outcomes for other stakeholders in the smart city area (Basiri et al., 2017).

A new and important flow in ICT is the identification and utilization of meaningful data collected from information systems (Alkhamisi et al., 2013), and the analysis of the data in various applications in smart cities (Wu et al., 2018). ICT is being spotlighted in urban planning as one of the key components of the urban infrastructure that enables access to a smart city (Bibri, 2018), and the smart city concept relies on the IoT technology's visions of pervasive computing and related big data applications (Bibri and Krogsite, 2017a,

2017b). Many process technologies have been introduced to understand and analyze a lot of the information connected to the IoT, among them data mining which is one of the most valuable technologies (Chen et al., 2015). Technological and technical advancements in ubiquitous computing, wireless sensor networks, cloud computing, and machine learning have adopted by big data analytics as supporting tools (Silva et al., 2017a, 2017b; Suthaharan, 2019). Moreover, smart devices share their own information and access with other devices, and generate information with internal applications by themselves (Vermesan et al., 2015). Through these computing and ICT processes as core enabling technologies, the information is used for understanding, analyzing, evaluating, and monitoring, and this contributes towards the goals of sustainable development in the sustainable city (Bibri and Krogstie, 2017b). Predictions and outcomes analyzed from information gathered through ICT may be efficiently reflected in various aspects within urban areas, and help the decision-making process in urban service policies, such as those around the environment, education, and well-being. In light of this, ICT is deeply involved in the need for smart, data-centric technologies for dynamic and evolving urban plan systems aiming towards sustainability for the management and development of urban functions (Bibri and Krogstie, 2017b; 2017c Chen et al, 2015; Silva et al., 2017a, 2017b; Suthaharan, 2019; Vemesan et al., 2015).

The concept of the smart city with advanced technologies is not certainly complete to achieve optimal sustainability in urban development and planning yet (Bibri and Krogstie, 2017a; Nuaimi et alk, 2015; Zheng et al., 2014). However, ICT analytics, including big data, are considered to be fundamental ingredients for urban analyses (Bibri

and Krogstie, 2017a; Nuaimi et alk, 2015; Zheng et al., 2014). In addition, ICT is being considered to achieve long-term goals of sustainable development, as a way to mitigate increasing social-economic concerns and complex environmental challenges in modern cities in their various forms of sustainability, infrastructure, data analysis, and services (Batty, 2012; Bibri and Krogstie, 2017a). The applicability of smart systems in contemporary cities requires the comprehensive understanding of the possibilities of how unpredictable and unprecedented urban issues, such as population growth, environmental pressure, and human welfare and safety, can be efficiently handled (Bibir and Krogsite, 2017c, 2017d). In this regard, the Smarter Cites Challenge program of IBM achieved smart city projects in 100 cities around the world, with essential themes for urban management such as urban planning, transportation, environment, civic engagement and civil management, and public safety (Alizadeh, 2017). Its program has helped global cities to significantly improve quality of life through data analytics (IBM). Huawei, a technologies company in China, published a report in 2017 comparing the 20 cities in the United Kingdom in detail, with themes such as digital innovation, social management, urban mobility, energy education, and sustainability, to address challenges facing cities and communities moving towards strategic smart cities (HUAWEI enterprise).

Cities are absolutely required in the process of urban planning; utilizing their infrastructure and technologies, and cooperation from citizens, will be needed in order to approach the optimal smart city, because the ultimate goals of urban planning based on sustainable development are to improve the quality of life of citizens (Simonofski et al., 2017). Citizens are deeply involved in urban initiatives and governance, and contribute to disseminating smart devices and Internet sharing, and generating information (Oberti and

Pavesi, 2013). In implementing smart city projects, citizens should be considered as important decision makers, with their priorities for the strategies and goals to be understood as relating to the needs and challenges in their own city; the government should support their initiatives and governance (Albino et al., 2015). In fact, a study supported by the EU reviewed 300 initiatives in smart cities and the community highlighted that governance, which consist of citizens, government agencies, private companies, and investors, should be important in the processes of resolving problems and making policy decisions (European Commission, 2016). The positive effect of governance frameworks based on citizens, companies, and governments should not be understated in smart urban planning, and smart governance frameworks that are established must be credible to community members, stakeholders, and experts.

While various indicators of urban functions and development have been used, few studies have indicators for assessing the smart city (Caird and Hallett, 2018). At a time when the definition of perfection is not yet agreed upon, the assessments of smart cities have been conducted differently in the ICT-centered approach and the people-centered approach (Ahvenniemi et al., 2017). Moreover, the form, size, and funds for each city are considered priorities as fundamental dimensions; small cites are not guaranteed to have an effective understanding of innovative strategies, and smart strategies should be harmonized with government policies (Angelidou, 2014). In this regard, the reflection of smart strategies should require a considerate approach depending on the degree of urban development, the latest technologies, and the composition frameworks of governance with the community (Vanolo, 2014).

In light of the above, smart cities have the potential to provide better urban services to urbanities than urban planning in the past. Existing cities would be applicated by the smart systems as they become accustomed to new technologies that trigger a new paradigm shift in urban planning. Many cities around the world are considering approaches to achieve sustainability in their respective urban environments. Smart concepts are not inherent to the building of cities, but should be considered as the root of a big urban concept. Therefore, cooperation in various research fields is required to address challenges arising in real time based on ICT, utilize data, and reflect this in urban planning. However, few studies have been performed in collaboration or in joint study with other research fields on the actual application of smart functions. Most of the literature is on the advanced technology of urban planning, focusing only on specified fields such as transportation, building, and energy, where ICT was applied to existing cities to emphasize a new city brand (Shelton et al., 2015). Others have noted that an effective smart policy is required to develop suitable infrastructure, along with governance by a watchdog and collaborator through public–private partnerships (Allam and Newman, 2018; Angelidou, 2014; Paskaleva, 2019). However, a smart city cannot be led by just any organization or government, nor can it be achieved in one study area.

3.2. The Concept of the Smart City

Research has been conducted on diverse aspects of the smart city in various research areas. There are many definitions of a smart city; none have been widely recognized, although they can be summarized to concepts. Through some review papers, we came to our understanding of the concept of the smart city of urban planning. Trindade et al. (2017) used qualitative methods to identify information about research, models, frameworks, and tools, considering 'smart city' and 'sustainability' as keywords in published web papers. Their paper emphasized that the smart city affects the concept of sustainable urban development. D'Auria et al. (2018) examined the concepts and relevance of the 'smart city' and 'sustainable city', utilizing a systematic review through H-index on the Web of Science. The smart city has the goals of urban planning reflected in a new philosophy and approach, but the two concepts cannot be considered in contrast, although it was stressed that the principle should be aligned with sustainable development. Yigitcanlar et al. (2019) reviewed 35 academic works about smart cities and insisted that cities could not be smart without sustainability. They highlighted that smart cities need to have appropriate technology, complex city management, and consensus on concepts of sustainability for future sustainable cities. Meijer et al. (2016) presented technologies, human resources, and governance as the concepts of the smart city through qualitative analysis of three phases (search, paper selection, and review). They defined that the smart city is human capital, as attracting human capital among various individuals and governance, and these human resources, are used to operate and maintain the smart city through the use of ICT. Yigitcanlar et al. (2018) did a systematic review based on literature

aimed at conceptual development of smart cities. They addressed the idea that smart cities are more than a technology concept, with goals such as productivity, sustainability, accessibility, well-being, lifestyle, and governance linked to communities, technologies, and policies. Albino et al. (2015) attempted to clarify the meaning of the concept of the smart city through a literature review of papers published after 2008. The results stressed that because the concept of a smart city is not universal and is too complex, the visions and conditions of a certain city should be reviewed to approach the idea of a smart city. Arroub et al. (2016) noted people, infrastructure, and operations as core to the concept of the smart city, which depends on the geographical, environmental, economic, and social constraints of each city. As a sub-concept, they highlighted education, health-care, and social programs in terms of human service; energy, water, and transportation in terms of infrastructure; and governance, public safety and managing urban resources in terms of the operation concept. Giffinger et al. (2007) evaluated 94 small and medium-sized cities in Europe through the smart city indices. They also pointed out the ambiguity of the concept of understanding, stressing that it should be intelligently integrated into the areas of industry, education, civic engagement, and technology infrastructure, and applied to citizens. Accordingly, a smart city was considered to reflect two major trends; one was integration networks as a collection of smart devices, sensors, and real time big data with ICT related to human life, and the other was a new paradigm in urban planning polices related to governance and the economy (2012). Nam and Pardo (2011) argued that the key components of a smart city are the technologies, the people resources such as creativity, diversity, and education, and the institutions such as policy and governance. To sum up, the smart city may be considered to be deeply involved in various planning and areas within a city, based on ICT

technologies such as infrastructure, education, environment, public welfare, safety, and participation, with the goal of sustainability, and maintained by human resources such as governance and frameworks.

3.3. ICT in the Smart City

A smart city should provide a network of integrating technologies, systems, services, and capabilities for sufficiently multi-sectorial and flexible future development that is open-access (2015). All governments and public institutes at all levels should aim to improve strategies and programs by reflecting the concept of smartness in their existing policies (Nam and Pardo, 2011; SmartResults Research team, 2013). This would mean that ICT is the foundation for promoting new forms of technology, and is the facilitator for more broadly and innovatively balanced development (Komninos, 2011). Therefore, it is important to have a better understanding of in which areas ICT development provides the best advantages for society and the environment, because it has great potential for urban system management and urban sustainability (Kramers et al., 2014). ICT can be applied from a regional level to the national and world level, such as in the forecasting of environmental pollution and weather, energy transportation, and transport management (Global e-Sustainability Initiative, 2012; Hashem et al., 2016; Lazaroiu, 2014). Indeed, ICT has adopted a broader approach to the most important aspects of people's everyday lives, stimulating smartness in the components of city (Giffinger et al., 2007), and also allows the smart ecosystem to expand its smart space from a personal context to a large community or the city as a whole (Yovanof and Hazapis, 2019). In fact, data generated by ICT are used in data analytics in various urban fields, generated by smart devices such as smartphones, smart sensors, social network services, wearable smart devices, Internet, and the IoT through data mining techniques, and analyzed and utilized by data analytics such as machine learning and deep learning. The processes and results of ICT can be reflected

throughout the entire city, and used to predict urban challenges. Sanseverino et al. (2018) comprehensively reviewed the smart urban concept, and compared the smart city concept of Europe to cities in China. The authors stressed the integration of cities through ICT infrastructures with smart initiatives and a smart governance system in urban intelligent solutions for energy, agriculture, transportation, buildings and urban services, and advised moving away from a government-led top-down approach, and to invest in ICT infrastructures in the long view. IoT applications such as smart grids, environment monitoring, and intelligent lighting were emphasized as a good example to reduce the environmental impact of pollution and energy consumption (Le-Dang and Le-Ngoc, 2018). Governments around the world are adopting and utilizing big data in ICT as part of moving towards smart cities, to improve the living conditions for citizens. Big data is a technology with enormous potential to improve smart city services, which could be reflected in national and urban policies (Hashem et al., 2016). In fact, data mining techniques can collect real time data generated by smart devices, including smartphones, wearable smart devices, smart applications, and the Internet. The IoT is also being developed for deep learning technologies with machine learning that can analyze and utilize collected data from cloud computing.

3.4. Governance with the Smart City

Since ICT cannot transform cities without human capital, ICT should not be distinguished from human capital in the smart city (Neirotti et al, 2014). The importance of governance is increasing, in order to manage initiatives or projects to make a smart city. According to Meijer et al. (2016), smart city governance is required as new forms of human collaboration through utilizing ICT is beginning to create better results and more open governance processes. These authors emphasized that smart city governance should not be a technical issue, but studied from a social, political, and institutional point of view. Odenddal (2003) argued that smart governance promotes data exchange, service integration, collaboration, and communication. Besides, the frameworks of human capital and governance are emphasized, which play important roles individually, as well as in the community, groups, and components of the entire city (Alawadhi et al., 2012). Smart governance is considered a core component of smart city initiatives, because it promotes interaction between people, policies, information, and technologies (Chouabi et al., 2012). Smart governance enables creativity and innovates implementation for the smart city, and all initiatives require collaboration, disclosure, and participation based on smart governance models, which are essential components for the smart city (Lopes, 2017). Thus, smart governance is a new channel of communication between governance and citizens, such as e-governance, and requires cooperation from government departments and local communities (Alawadhi et al., 2012; Giffinger et al., 2007). In fact, creations and data from initiatives and governance should not finish with analysis and prediction. Government servants will continue to

communicate with citizens, so that they should co-produce and create more new services (Chourabi et al., 2012). The participation and cooperation of private technologies is also considered to be an important element of smart governance, because different stakeholders are involved in the development of technologies for the smart city. Accordingly, models of smart governance with government, business companies, and citizens are proposed to promote the transparency of society. Citizens are able to suggest opinions or express complaints about government policies through various communication channels, such as the Internet, apps on smartphones, and telecom services (Bolivar and Meiger, 2016; Guenduez et al., 2017). Business companies are willing to acquire new knowledge and information in line with the government's policies, and can contribute to government policies through analysis of real-time data and technology development (Fang, 2002). Based on ICT tools, governments are able to perform tasks with other departments online more quickly, with immediate access and sharing of data available to officials (ASCIMER, 2017). After all, the overall governance framework should be built for a sustainable smart city.

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3.5. Materials

2016 is considered important as a time when new national policies have implemented to achieve goals under international agreements. The United Nations' Sustainable Development Goals (SDGs), agreed in 2015, specified inclusively sustainable urban society and residences (target 11). In particular, Mauritius published a report in which a smart city scheme reflected on the SDGs in Feb 2016. A new climate change strategy was adopted in the Paris agreement in December 2015, and the Sendai framework was adopted by the United Nations Office for Disaster Risk Reduction in 2015 to reduce and mitigate damage of disasters. Therefore, we noted the global debates around 2016 in the data collection process.

We investigated "Scopus", a representative international thesis search engine that provides bibliographic information, to grasp the research flow of a smart city. Using "smart city" search terms, keywords from a total of 5526 articles were extracted from 1970 to 13 March 2019, focusing on the social sciences and environmental science subject areas. These two fields were described as areas where the social, economic, and environmental aspects of urban planning have been studied extensively (Votsis, 2019). These subject fields needed to be addressed in terms of urban planning because these three aspects influence the living conditions of urbanites (Shichiyakh et al, 2016). In this process, a total of 4281 articles were used in the study, excluding articles that did not include keywords information. As illustrated in Figure 14, the data used in the analysis increased rapidly from 2015.

The collected keywords were refined in Excel to prepare for overlapping meanings of words due to the problems of singular and plural forms, upper-case and lower-case letters, abbreviations, and full words written together. Although prominent authors expressed that they wanted their articles to be included as keywords, the refining process was inevitable because the purpose of this study is to grasp the overall flow and related research fields, and the form of keywords varies depending on each journal style. For instance, “Information and Communication Technologies (ICT)”, “Internet of Things” and “cities” were changed to “ICT”, “IoT”, and “City”, and the phrase “smart city” was removed due to it being related to other words. Figure 15 shows the amount of data for each year in this study.

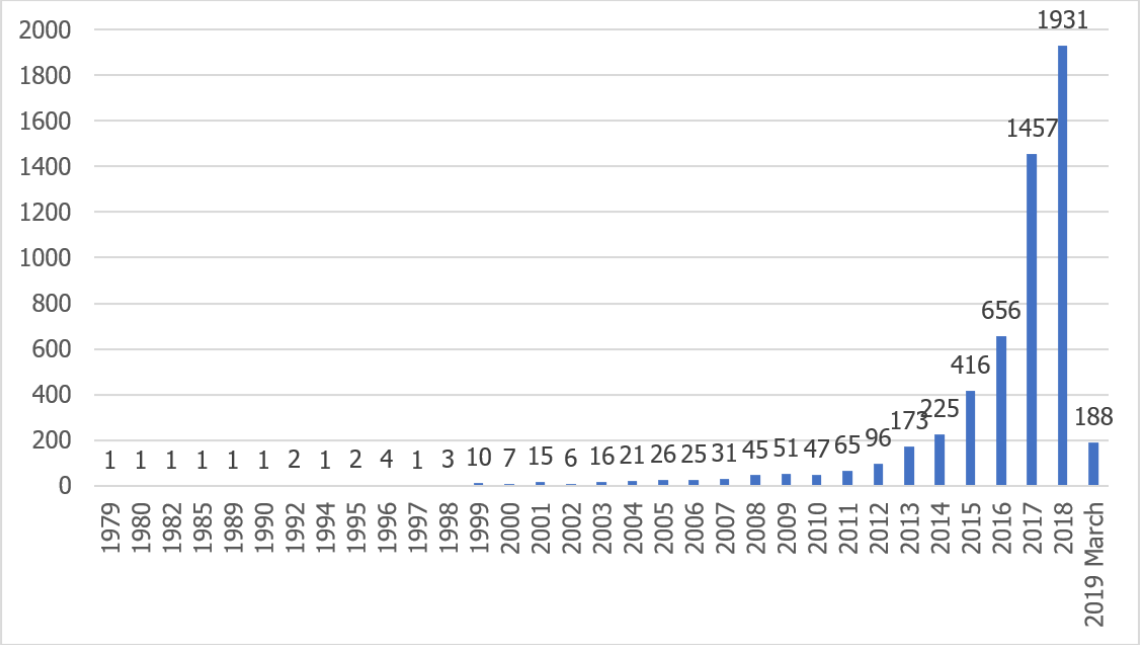

Figure 15. A mount of annually collected data.

3.6. Keywords analysis

3.6.1. Keywords before 2016

We analyzed the keywords of papers, conference proceedings, and books from 1979 to 2015. Significant keywords were identified based on a frequency above 10, representing nodes, and links were identified via degree centrality and betweenness degree analysis. A frequency of more than 10 meant that one keyword appeared in more than ten papers, and the number of keywords used in the analysis was 381 (21 types). The total number of papers is 1294. Over 36 years, the frequency of the words in decreasing order was as follows: smart growth (59), sustainability (32), ITS (26), mobile application (25), urban sprawl (22), and Internet of Things (22). The degree centrality of the words in decreasing order was as follows: smart growth (0.25), sustainability (0.15), big data (0.15), sustainable development (0.15), urban planning (0.15), and GPS (0.15). The betweenness degree of the words was as follows: climate change (0.526316), big data (0.542105), governance (0.521053), urban development (0.521053), and mobility (0.510526) (Table 1).

Overall, the network map was linked by main flow with the words “city”, “climate change”, “governance”, and “big data”, with a high betweenness degree, and the words “urban development” and “mobile application”, with a high degree of centrality, were located at both sides of the main flow, wherein two keywords were linked to other related words. Focusing on these two words, the words “urban development” were related to the words of “overall urban planning and development”, and the words “mobile application” were related to words related to the tools and technologies of using mobiles. In other words, over 36 years, many studies have been conducted involving urban development, city,

climate change, governance, big data, and mobile applications, and in particular, urban development studies were considered to be primarily studied with the urban planning, sustainable development, urban sprawl, urban form, and sustainability words centered on the words “smart growth”. Further, sustainable development studies had been conducted based on smart grids with renewable energy and big data with open data research, and mobile applications had been utilized in research on ITS, the IoT with cloud computing, and GPS with GIS and mobility (Figure 16). In the network map, the properties of the words were represented as nodes. The larger the size of a node, the higher the degree centrality, and the darker the color of a node, the higher the betweenness degree.

Table 1. Frequency and the centrality value of the degree and betweenness of each word up to 2015.

Keywords	Frequency	Degree Centrality	Betweenness Degree
Smart growth	59	0.25	0.057895
Sustainability	32	0.15	0.22807
ITS	26	0.05	-
Mobile application	25	0.2	0.5
Urban sprawl	22	0.2	0.057018
IoT	22	0.1	0.1
Big data	21	0.15	0.542105
GIS	18	0.05	-
Governance	17	0.1	0.521053
Sustainable development	16	0.15	0.189474
Urban planning	15	0.15	-
City	13	0.1	0.521053
Mobility	12	0.05	-
Urban development	12	0.2	0.510526
Smart grids	11	0.05	-
Urban form	10	0.2	0.057018
Climate change	10	0.1	0.526316
Renewable energy	10	0.1	0.1
GPS	10	0.15	0.194737
Cloud computing	10	0.05	-
Open data	10	0.05	-

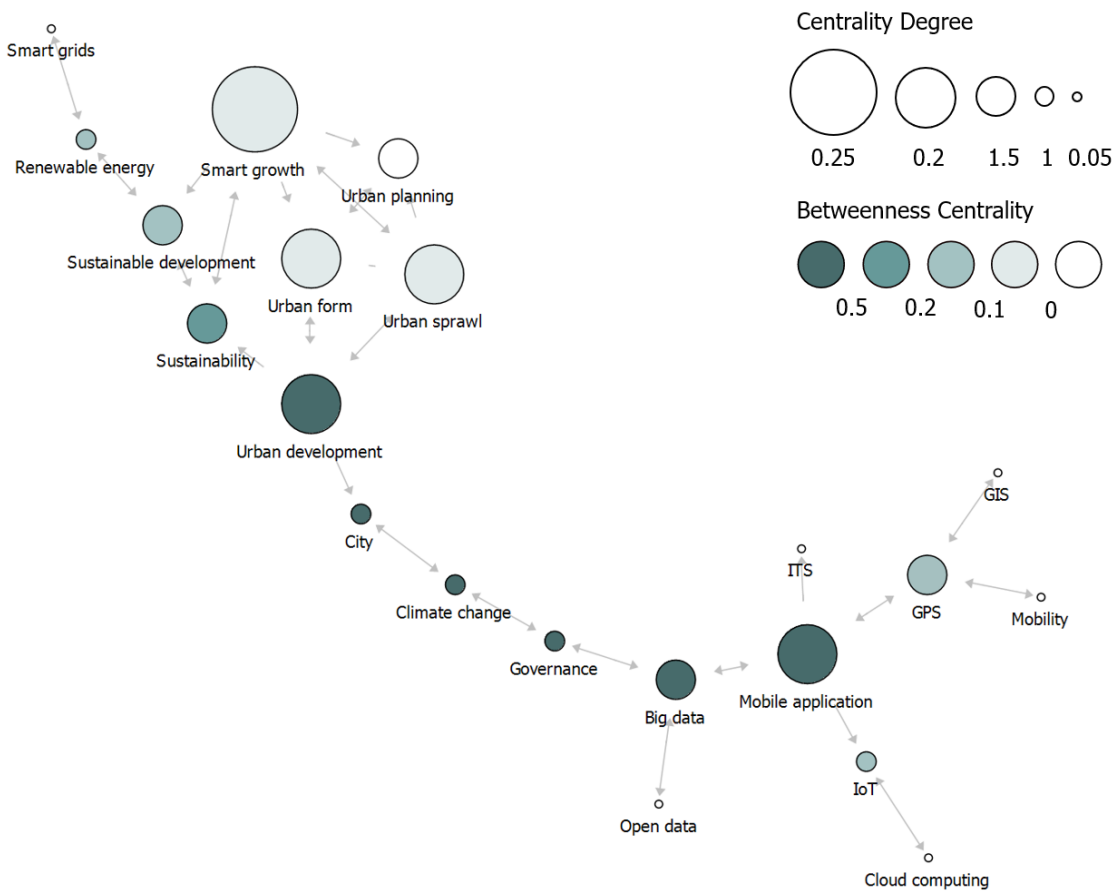

Figure 16. The keywords network map up to 2015.

The words that largely make up the flow of the research trend in the analysis were urban development, city, climate change, governance, big data, and mobile application, which had a high betweenness degree. These words were keywords in areas related to the smart city concept up to 2015. In particular, urban development and mobile applications play significant roles in understanding the flow of related research, as important keywords that connect other keywords in the overall structure. ‘Smart growth’ was the highest in frequency, but is not highly relevant to related studies in the network, while climate change,

on the other hand, was one of the lowest-frequency words, but its relevance to related studies is very high in the network. In addition, the words smart growth, urban form, and urban sprawl, which has a high degree centrality, were studied actively as keywords, but mainly in large frames belonging to urban development. The study of mobile applications was conducted in relation to big data, ITS, the IoT, and GPS, and was particularly relevant to big data. In other words, studies on the concept of the smart city up to 2015 were the most active in urban development, and some studies were conducted with mobile applications and big data as keywords. Overall, given the study of relevant areas, it can be expected that studies of conceptual approaches have been conducted more often, rather than studies of active applications or utilization.

3.6.2. Keywords after 2016.

We also analyzed the keywords of papers, conference proceedings, and books from 2016 to 2019. Significant keywords were identified based on a frequency above 25, represented as nodes and links via degree centrality and betweenness degree analysis, and the number of keywords used in the analysis was 1164 (22 types). The total number of papers is 4232. Over more than three years, the frequency of the words in decreasing order was as follows: IoT (248), big data (133), sustainability (81), smart grids (71), ICT (51), and cloud computing (48). The degree centrality of the words in decreasing order was as follows: data analytics (0.238095), sustainability (0.190476), ICT, cloud computing, data mining, machine learning, and urban planning and innovation (0.142857). The betweenness degree of the words was as follows: urban planning (0.666667), data analytics (0.500794), sustainable development (0.495238), ICT (0.466667), and sustainability (0.456524). Through this result, it could be inferred that words such as data mining, innovation, and IoT, with a high degree centrality, have been used widely in research, and that words such as urban planning, sustainable development, and ICT, with a high betweenness degree, have been used in many research projects together with other keywords with a high betweenness degree. In particular, for data analytics and sustainability, the high centrality and betweenness degree played a key role in the flow and direction of the research (Table 2).

Table 2. Frequency and the centrality value of the degree and betweenness of each word after 2016.

Keywords	Frequency	Degree Centrality	Betweenness Degree
IoT	248	0.142857	0.097619
Big data	133	0.095238	0.077778
Sustainability	81	0.190476	0.459524
Smart grids	71	0.095238	0.095238
ICT	51	0.095238	0.466667
Cloud computing	48	0.142857	0.093651
Data mining	44	0.142857	0.011111
Energy efficiency	43	0.095238	0.180952
Machine learning	43	0.142857	0.095238
Governance	41	0.095238	0.007143
Urban planning	39	0.142857	0.666667
Security	34	0.047619	-
Sustainable development	33	0.095238	0.495238
Innovation	30	0.142857	0.221429
City	30	0.095238	0.040476
Data analytics	30	0.238095	0.500794
Open data	29	0.095238	0.095238
Optimization	29	0.047619	-
Deep learning	28	0.047619	-
GIS	27	0.095238	0.257143
Renewable energy	27	0.047619	-
E-Government	25	0.047619	-

Overall, the network map was linked by the main flow of the words sustainable city, ICT, sustainable development, urban planning, and data analytics, with a high betweenness degree. The words urban development and mobile application, with a high degree centrality, were located at both sides of the main flow, and two keywords were linked to other related words. In particular, the urban planning word played a significant role as a keyword; it had a low degree centrality value, but a high betweenness degree value. Sustainability was related to innovation, city, and renewable energy, and urban planning was related to data analytics and geographic information systems. Data analytics was deeply related to bid data, cloud computing, data mining, and machine learning (17).

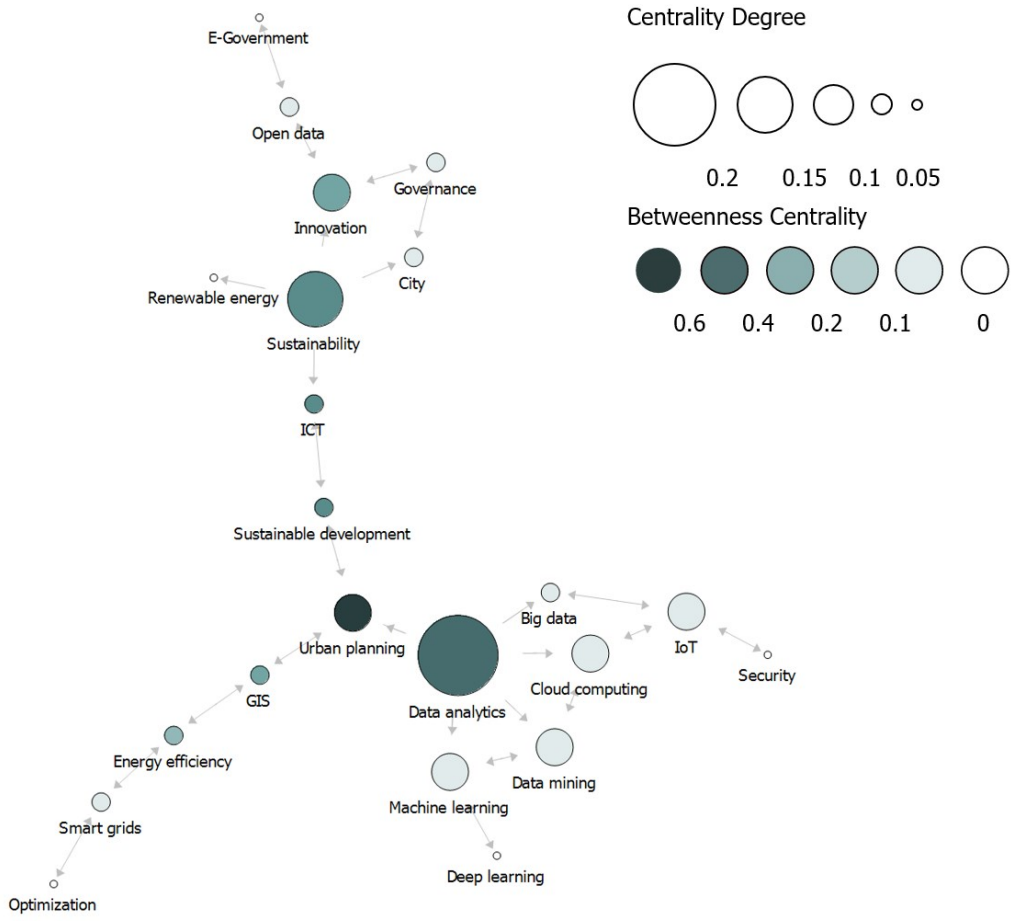

Figure 17. The keywords network map after 2016.

The words that made up the flow of the research trend in the analysis were sustainability, ICT, sustainable development, urban planning and data analytics, which had a high betweenness degree. These words were keywords in areas related to the smart city concept after 2016. Among them, the research relating to sustainability and data analytics have been the most active, and the relevant fields of research of these two words have been identified. In particular, the urban planning word, which had the highest value in the network map, was considered important in understanding the flow of the smart city concept,

as it was located at the center of the network map while playing an important role in connecting the words of data analytics, sustainable development, and GIS. On the other hand, the IoT word had the highest frequency and the highest degree centrality, but did not have a high betweenness degree. This means that there have been studies using IoT as the keyword, but few related to other deep studies. Overall, compared with previous studies in 2015, the studies after 2016 have been more actively focused on collecting and analyzing data to apply the smart city concept to urban planning.

3.7. Clusters analysis

3.7.1. Cluster before 2016

To further analyze the relevance of the words, we conducted a cluster analysis. This analysis was useful for understanding the related research in a large framework. The cohesion index describes the concentration within the group. At a value of above 1, the concentration density inside the group is greater than outside the group. This analysis was based on the cohesion of each word, organized into groups with high cohesion. In other words, the words in a group were considered keywords for related studies, and can be used to interpret the flow of research with group cohesion. As a result of the modularity cluster analysis, the related research projects were confirmed. Cluster 1 included words related to "related fields" such as "climate change", "governance", and "big data". Cluster 2 included words related to "smart technologies" such as "mobile application", "GPS" and "Internet of Things". Cluster 3 included words related to "smart concept of urban planning and development" such as "urban development", "sustainability", and "sustainable development" (Figure 18).

Table 3. The cluster context based on research up to 2015.

Clusters	Words	Cohesion Index
C1 (Related fields of smart concept)	5	8
C2 (Smart technologies)	7	14
C3 (Smart concept of urban development)	9	21

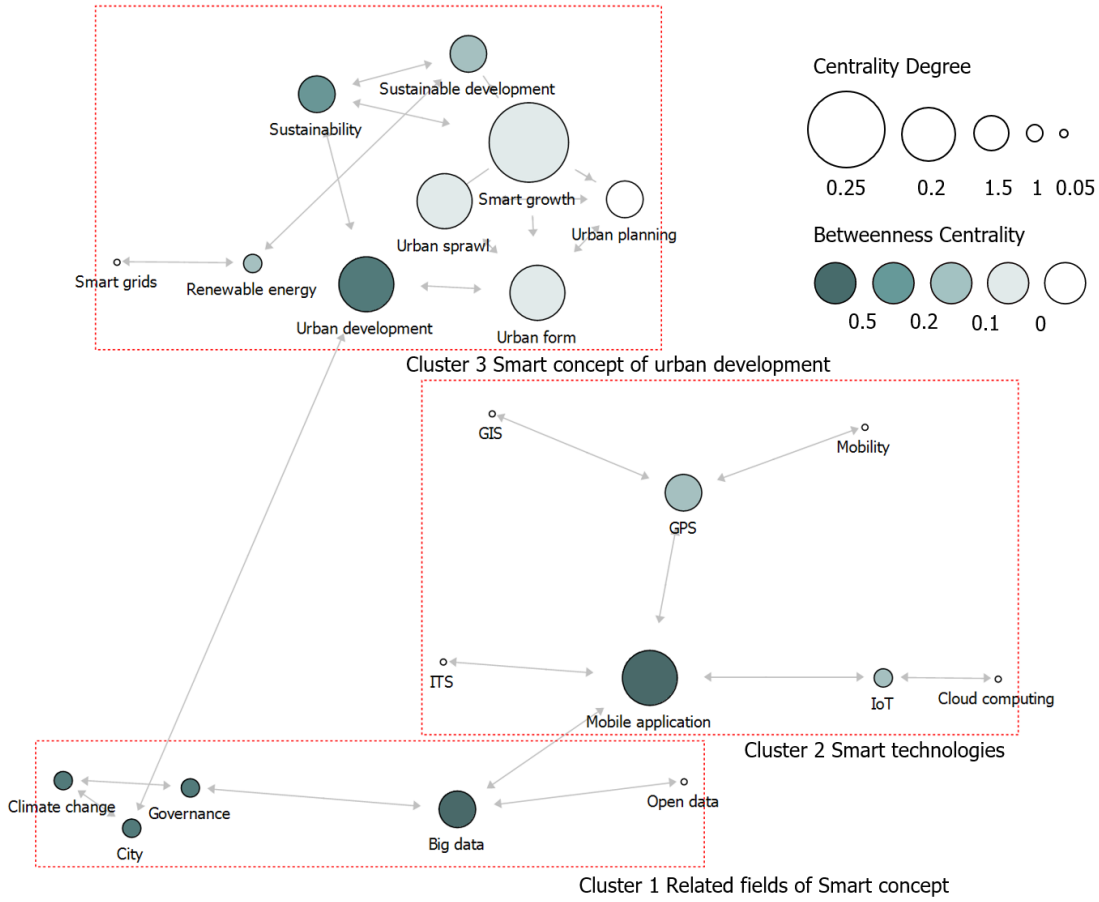

Figure 18. The cluster network map up to 2015.

Up to 2015, studies can be considered as introducing and applying specific areas of smart concepts. Overall, the words that were included in Cluster 1 contained words from the higher concepts of the studies. Cluster 2 was considered as a means of utilizing the "big data" of Cluster 1, and Cluster 3 was also considered a sub-concept based on the "city" of Cluster 1. Cluster 1 consisted of words with a high value of betweenness degree, but the properties of clustering were the lowest. This suggested that many studies have been conducted with the words as the main keywords, mainly in the higher concept, while the

sub-studies involved were less. The words in Cluster 2 consist mainly of “mobile applications”, suggesting that many studies related to the big data of Cluster 1, or consisting of its sub-concepts, had been carried out. The value of each cohesion index was the highest for Cluster 3, related to the “city” of Cluster 1. This suggested that many studies that were deeply related to words in the same cluster were actively carried out. As a result, many studies based on words and their combinations in Cluster 3 were conducted, mainly focusing on the conceptual application of the smart city concept, and its introduction to existing cities. In addition, interpreted in terms of the cohesion index, Cluster 1, with the lowest index value, was mainly used as an important keyword for the studies as a higher concept, but was studied with other keywords. On the other hand, Cluster 3, with the highest cohesion value, suggested that words from the same cluster were studied together as keywords. Combining the trends of studies up to 2015, the urban studies and technology fields had been the main fields investing in the study of the smart city, and the concept of the smart city was still seen as being in a period before being actively introduced and applied to urban areas (Table 3).

3.7.2. Cluster before 2016

After 2016, the related research was confirmed. Cluster 1 included words related to "sustainable smart city", such as "sustainability", "innovation", and "open data". Cluster 2 included words related to "data analytics", such as "machine learning", "big data", and "cloud computing". Cluster 3 included words related to "smart urban planning", such as "sustainable development", "ICT", and "energy efficiency". Overall, the words that were included in Cluster 1 contained words of concepts related to a smart city based on sustainability, which was linked to ICT in Cluster 3. Cluster 1 studies based on sustainability implied that they were related to ICT. Cluster 2, which included words from the process of utilizing and applying data, was associated with the urban planning of Cluster 1, and implied that many studies based on collecting and analyzing data were conducted related to urban planning. Cluster 3 contained urban elements words around urban planning related to sustainability and data analytics, and suggested that many studies have been conducted in fields related to the urban planning elements for a smart city (Figure 19).

Table 4. The cluster context based on research after 2016.

Clusters	Words	Cohesion Index
C1 (Sustainable smart city)	7	17.5
C2 (Data analytics)	8	20
C3 (Smart urban planning)	7	7.5

In terms of the cohesion index (Table 4), Cluster 3, with the lowest index value, was mainly used for an important keyword in the related studies as a higher concept, ICT

was related to sustainability and urban planning was related to data analytics. On the other hand, Cluster 1 and 2 were high in the entire network, which implied that most of the studies involved in data analytics have been performed in conjunction with the words in their own cluster. Since 2016, many studies related to the words of Cluster 2 have been conducted as keywords for the studies, which consisted of technologies and the process of data analysis research projects. Combining research trends after 2016, smart city research has been more specific and detailed than in the past. In particular, data analysis suggests that various data collection methods and analysis techniques were studied as important elements. This confirmed that traditional data analysis was used on an open data basis, as a large concept, and that related research was used as a basis for mobile applications. Information gathered from existing GPS and smart devices can now be expected to gather information more automatically. In doing so, data analysis is considered to be the most important element in smart cities, and the most advanced area. In addition, open data has also been more usable than in the past, and can be expected to be more utilized as data.

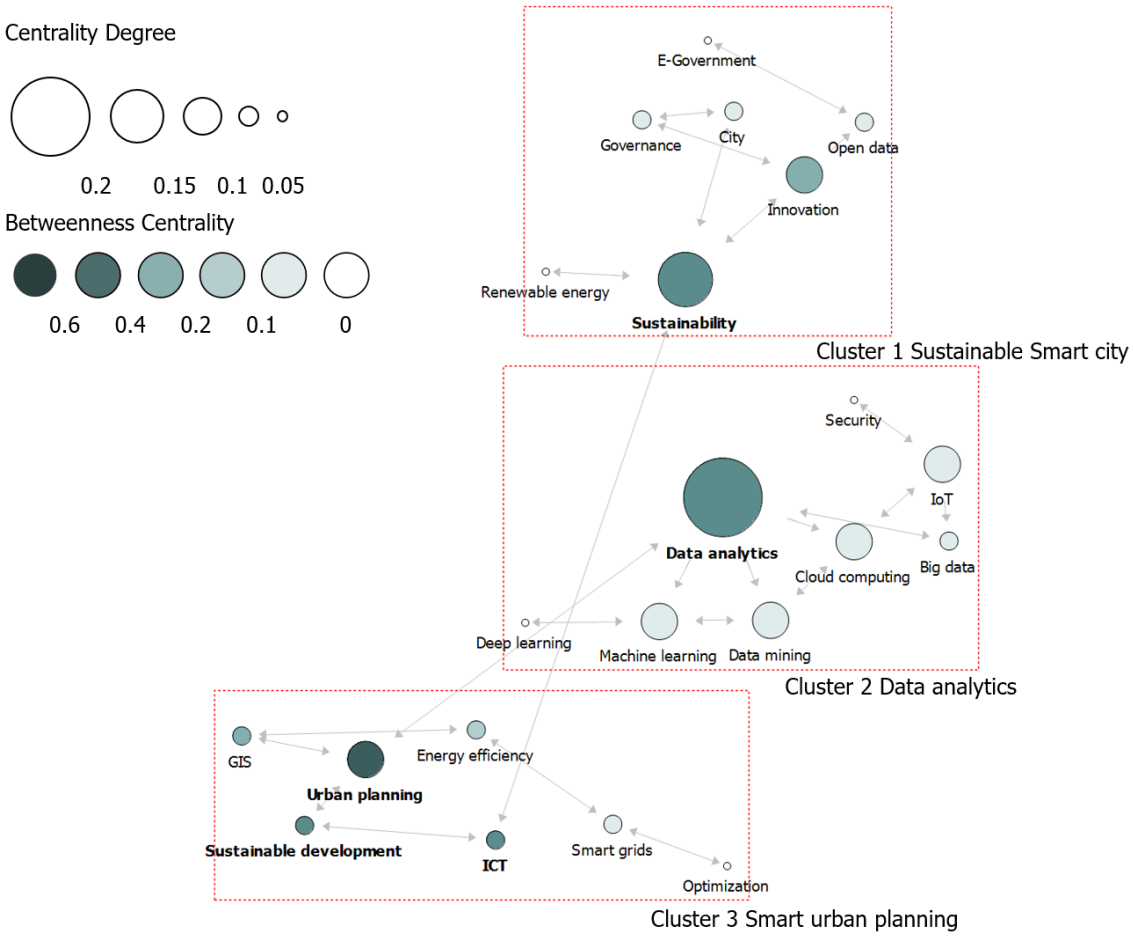

Figure 19. The cluster network map up to 2015.

3.8. Comparing the Keywords

3.8.1. Disappeared and emerged keywords after 2016

The words appearing in the studies until 2015 were as follows: climate change, ITS, mobile application, mobility, GPS, smart growth, urban sprawl, urban development, and urban form. Among them, smart growth was researched as the keyword with the highest frequency and degree centrality, and mobile application, mobility and climate change were the keywords with the highest betweenness degree related to other research. In particular, up to 2015, many research projects on smart growth were implied too much addressed as keywords. On the other hand, the words that appeared after 2016 were as follows: energy efficiency, innovation and E-government, data mining, machine learning, security, deep learning, data analytics, ICT, and optimization. Among them, data mining and machine learning were researched as keywords with a high centrality degree, and data analytics, ICT, and innovation were keywords with a high betweenness degree related to other research. In particular, after 2016, data analytics and ICT were frequently used as keywords (Figure 20). Words addressed as keywords up to 2015 were used in research as big concepts in related fields to the concept of the smart city, such as climate change, used in mobile applications through geographical information and mobility, and as concepts of overall urban development fields such as smart growth and urban sprawl and form. On the other hand, the words that emerged after 2016 have reflected, in many research projects, elements of the sustainable smart city, such as innovation and E-government, and in the

words for data analytics such as data mining and machine learning, as well as in the words for elements of urban planning for the smart city, such as ICT and energy efficiency.

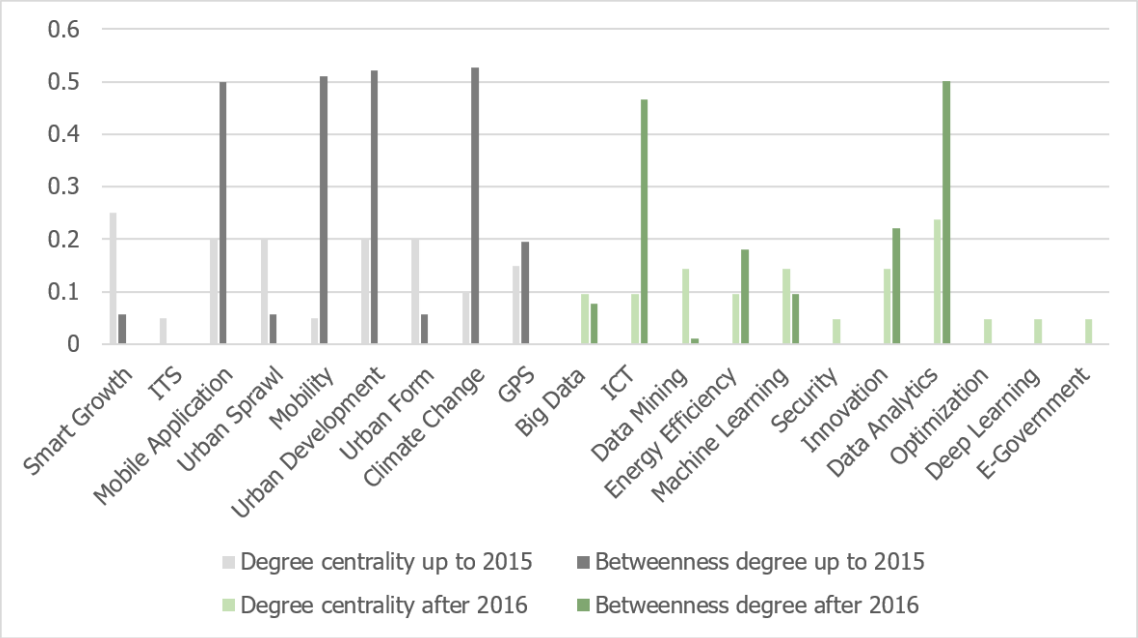

Figure 20. Disappeared and emerged keywords after 2016.

3.8.2. Comparison of Keywords on Smart city

In the whole flow of the emergence and disappearance of words, up to 2015, studies had been carried out focused on the concept and introduction of a smart city, related to adaptation and mitigation to climate change, and applied to transportation systems based on mobile applications and geographic information, such as that derived from GPS. Since 2016, studies have evolved towards research based on sustainability with the Internet, information, and technologies as key focuses. The compositions of the clusters were added to the words such as E-government and ICT in order to apply the smart city concept, and various processes such as machine learning and data mining were added to the data analysis process. In other words, previous research focusing on conceptual and specialized fields was conducted, and recent research has focused on actively applying smart urban planning based on big data of broader fields, with the development of information technologies (Figure 21).

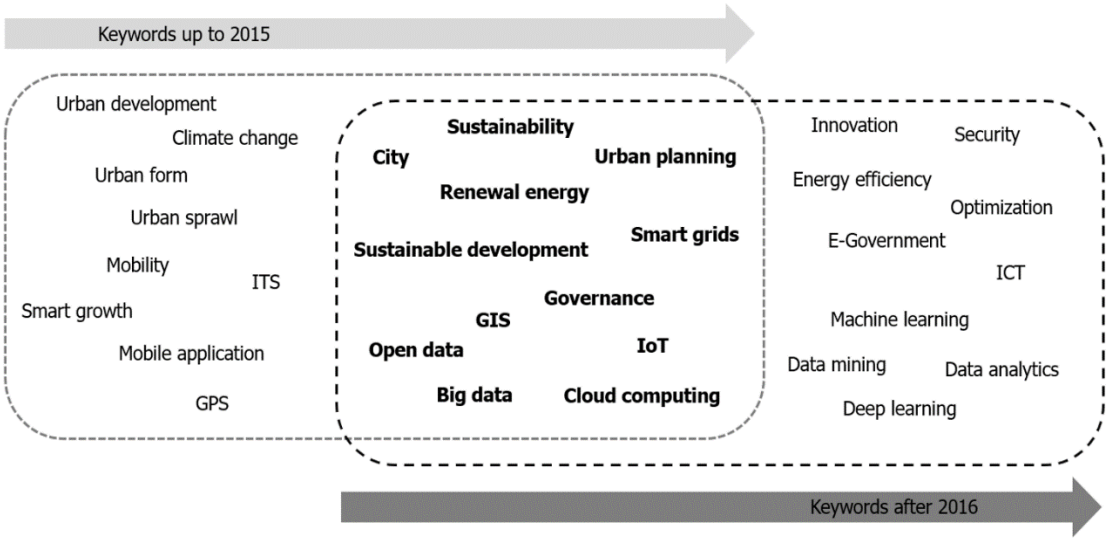

Figure 21. Comparison of keywords before and after 2016.

We can also identify keywords that should be highlighted in the current smart city concept, based on keywords appearing continuously. Firstly, a smart city also aims for sustainable development as a part of urban planning with sustainability. Secondly, open data, IoT, cloud computing, GIS, and smart grids as a basis for collecting big data can contribute to energy fields and governance. Thirdly, if all the secondarily mentioned words are considered as the basis for big data collection, they would all contribute to the smart city. In the end, big data will play the most important role in smart cities, however, if the condition of the environment and infrastructure varies from city to city, these above interpretations are debatable. However, we emphasize that the constantly used keywords should be reflected in the basic concepts and systems of a smart city.

3.9. The Flow of the Smart City

Considering various analyses based on keywords, this paper emphasized the following four points. First, the sustainable concept should be considered important in a smart city. Sustainability should be reflected not as a disparate concept to the smart city, but as the underlying concept that should be most fundamental. Sustainability has been a consistent keyword for a long time, and its role has increased further since 2016. Therefore, the controversy over sustainable smart cites and the smart sustainable city should be considered in each city's urban planning. In addition, renewable energy and energy efficiency should be considered important in maintaining urban sustainability. Second, as of 2016, the overall trend of research on the smart city has changed from urban development to urban planning. In the past, conceptual research on the smart city was undertaken to solve environmental challenges such as climate change or urban development. However, after 2016, the smart concept was more emphasized and detailed in urban planning, and the utilized and practical application of big data analytics. In addition, active words in the flow of adoption, such as open data and E-government, have been identified as keywords, and the role of governance is expected to change more significantly as it is linked to the innovation keyword. Third, in the past, the utilization of big data was concentrated in specific areas, such as ITS using GPS and smart devices. However, as of 2016, more technical flows with the advent of various big data collection and interpretation technologies were emphasized than in the past.

3.10. The Smart City policy in the Republic of Korea

South Korea has been leading U-City (Ubiquitous-city) policy based on ICT (Information Communication and Technologies) (Basiri, et al, 2017; Yigitcanlar, 2006). U-City policy refers to the exclusive brand in South Korea of early smart city policy that provide services such as administration, transportation and safety regardless of time and place to improve urban competitiveness and quality of life. For the first time in the world, the relevant "Ubiquitous City Construction Act (enacted in March 2008)" was implemented in September 2008 and included in National comprehensive urban planning. U-City has failed to escape the government-led top-down approach. As results, the distribution and construction of ICT services in existing cities have been delayed, and cooperation among the ministry has not been achieved. Accordingly, U-City has applied to only newly constructed new city (Table 5). U-City was based on Government Ver. 2.0, and smart city has implemented by Government Ver. 3.0 (MLIT, 2019).

In order to complement the limitations of U-City, the South Korea has made great efforts. National government established on dedicated department to the smart city in each ministry in May 2016. In December 2017, the smart city project was implemented as one of the key tasks of the government, and the "Act on the Promotion Smart city Development and Industry" was enacted by reorganized by "Ubiquitous City Construction Act" in September 2017. In November 2017, the 'Smart City Special Committee' was embarked under the '4th Industrial Revolution Committee' under the direct control of the President to promote inter-ministerial collaboration and professional-oriented policies. Accordingly,

the scope of application has been reorganized onto a policy that extends from the new city to the existing city (PCFIR, 2018).

The early days of smart city policy were led by the national government, a time when introduced the concept of change in U-City. Most of the project have provided infrastructure for efficient information and communication in the only new city. In the Second period, the national and local governments aimed to provide quality services to citizens with lower costs and higher efficient compared to the first period, and implemented public information and communication services in some existing cities and infrastructures built in the first period. In the current third period, the national and local governments emphasized two-way interaction of information, requiring purification by citizens and stakeholders in smart city policy. Under the newly enacted Smart City Act, the local government aims to overcome urban challenges and management of urban ecosystem by selecting part of existing cities and new towns as pilot city. The local governments are considered to approaching to building smart city that fit the region conditions and environment (MLIT, 2019) (Table 6).

The strategy of the smart city was introduced in January 2018 emphasized on- site data. This means that the cooperation of various stakeholders is absolutely necessary in the planning, decision and management of the city as a whole. Therefore, in the smart city, governance is composed of residents, companies and governments, and smart governance is considered to be most important role in managing cities.

Table 5. Comparison of the U-City and Smart city

	U-City	Smart City
object	Focusing to provision of infrastructure such as CCTV, telecommunication network	The Resolution of urban problem based on real-time data. Creating private services such as living, welfare, transportation etc..
Led-agent	National government (Ministry of Land, infrastructure and Transport)	Open governance (national government + local government + enterprise+ citizens)
ICT	Wired internet network, broadband communication system	Wired and wireless network, ICBM and AI technologies (IoT, Cloud, Big data, mobile)
Information	One-way, time constraint	Two-way, real-time information
Citizens' role	Information passive demander	information producer and supplier
Data utilization	Data is applied by location and function respectively Ex) no information in parking system. It is difficult to utilize the parking area even if there is room for parking	Interconnection between urban fields and implementation of data sharing platform Ex) collecting and sharing public and private parking area data on the platform to provide citizens with access to parking spaces.
Management	Limitations of efficient allocation of urban resources by information asymmetry. Top-down system involving only the government and others in reconcile urban challenges.	Efficient distribution of urban resources through sharing of data-based platforms. Bottom-up system involving the government, local governments, business and citizens.
Govern. Ver.	Government Ver. 2.0	Government Ver. 3.0

Table 6. Policy changes from the U-City to Smart city

	First period (~2013)	Second period (2014~2017)	Third period (2018~)
Object	New growth for integrated information and communication industry	Services for Low-cost, high-quality	Solving of urban problem and fostering innovate ecosystem management
Information	Vertical	Horizonal	Interrelationship
Platform	Close	Closed + open	Close + open (extended)
Policy	Act on U-City 1st U-City comprehensive plan	Act on U-City 2nd U-City comprehensive plan	Act on Smart City, 4th Smart City Promotion Strategy of National Industry Council
Main agent	National government (led on Ministry of Land, infrastructure and Transport)	National Government (individual) + Local government (partial)	National Government (Cooperation) + local government (expansion)
Aiming	New town (1.65million m2 or more)	New town + existing city (partial)	New town + existing city (expansion)
Projects	Building a physical infrastructure such as integrated management center communication network	Establishing an integrated public platform ensuring compatibility and promoting standardization	Building national model city, promoting various public projects.
Govern. Ver.	Government 2.0	Government 3.0	Government 3.0

Chapter 4. Study area

4.1. Shiheung city

4.1.1. Introduction of the study area

Shiheung is located to the midwest of Gyeonggi province, bordering the Bucheon, Ansan, Hwasung and Namdong districts of Incheon Metropolitan city, and was planned to distribute the population and industry in the metropolitan area. Development-restricted areas enacted by national law are the largest in the bordering districts, with most of this area being agricultural land and greenhouses, although the development-restricted area is decreasing (from 111.53 km2 in 2014 to 85.846 km2 in 2016) and the areas released for development are the highest within the province due to a policy enacted in 2015 (Figure 22). With the implementation of a new urban plan, new towns are being built. The total study area is 137,420 km2 and has a population of 461,815 in 187,572 households.

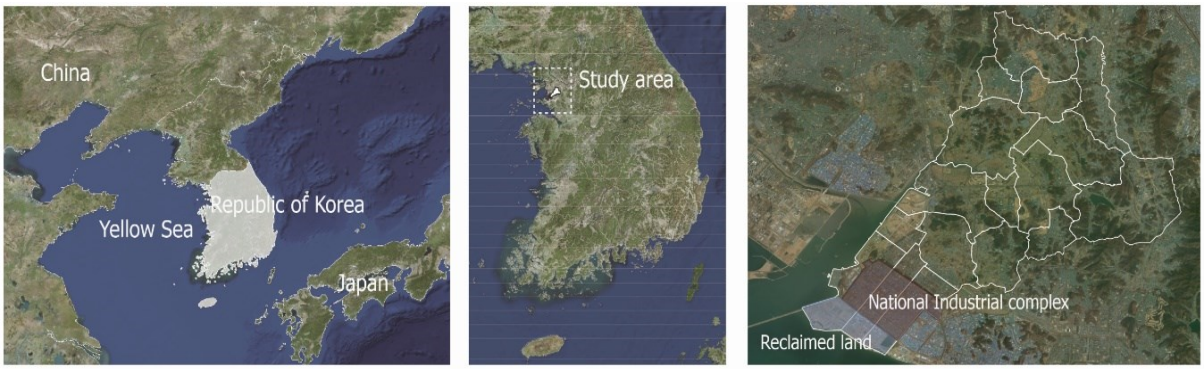

Figure 22. The study area in the Republic of Korea.

As one of the largest national complexes adjacent to the Yellow Sea in the country, their facilities area connected to the neighboring Ansan city in the southern area. Urbanized areas in the city are located near the industrial area in the southern area and the northbound area. Considerable amounts of green land remain within this city, especially when compared to other Korean cities. Of the total area of the city, 63% remains natural environment and green spaces are being created in cities under development. Forest land, paddy fields, and streams comprise a large proportion of this area (Figure 23).

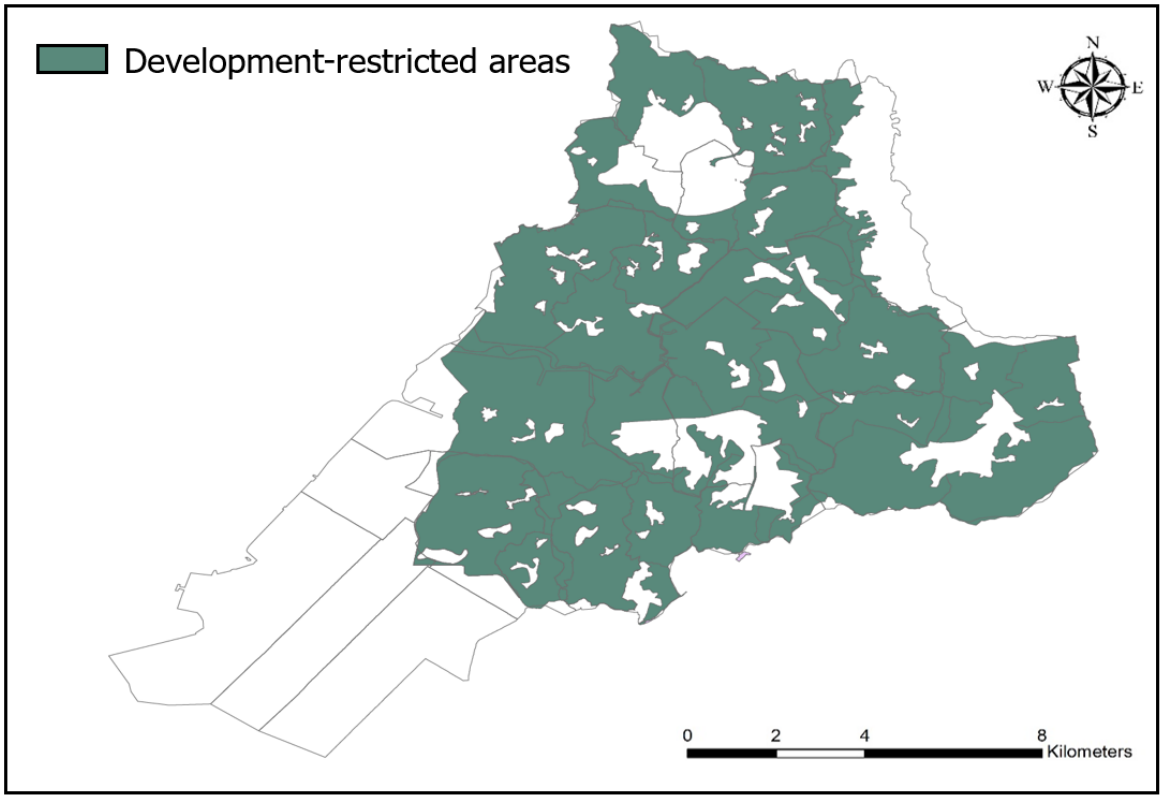

Figure 23. The development- restricted area of Shiheung city in 2016.

Until recently, residential areas have been affected by industrial complexes and the construction of the new town in the released development-restricted area. Since 1992, the

local government has built buffer green areas 4 km long and an area of 0.692 km2, extended by 0.03 km2 in 2016, between industrial complexes and residential areas to prevent the spread of air pollutants, the buffers have not had a significant effect of preventing contaminated materials from industrial areas. Other residential areas have been damaged by the construction of large-scale settlements. This has led to growing complaints from citizens related to these developments.

4.1.2. Administrative regions

The administrative district of study area is divided into 17 regions (called Dong in Korean). Since 1990s, as part of the National industrial city, residential areas and a national industrial complex were constructed as reclaimed areas above the Jeongwang 1,2,3 and 4 Dong (region14,15,16 and 17). In particular, Jeongwang 4 Dong (region17) was partially reclaimed as part of a new urban plan from 2014, and large residential areas are still under construction. Table 7 described the number of populations, households, households per population and areas of each regions within Shiheung City.

Mokgam dong (region 8) has the highest population, generation and area. The population per householders is the highest in Janggok Dong (region 10), but it takes up the smallest area within study area. Gwalim Dong has the lowest population, generation and population per householders, but sufficient area in the area. Figure 24 described the regional population distribution and Figure 25 described the regional population per households.

Table 7. The population of study area (May 2019).

Administration	Population	Households	Population per households	Areas (Km2)
sum	461,815	187,572	2.46	137,420
1. Daeyah-Dong	31,083	12,792	2.43	9,897
2. Gwalim-Dong	2,050	1,242	1.65	8,044
3. Shinchoen-Dong	38,355	15,858	2.42	3,498
4. Eunhaeng-Dong	45,569	15,893	2.87	5.870
5. Shinhyun-Dong	10,654	4,379	2.43	13,466
6. Maehwa-Dong	12,797	5,122	2.50	10,752
7. Yeonsung-Dong	23,312	8,266	2.82	10,584
8. Mokgam-Dong	41,532	16,133	2.57	17,861
9. Neunggok-Dong	15,460	5,921	2.61	4,088
10. Janggok-Dong	17,776	5,603	3.17	3,490
11. Wolgok-Dong	15,347	6,859	2.24	11,177
12. Gunja-Dong	23,741	9,750	2.43	7,377
13. Jeongwangbon-Dong	21,556	13,896	1.55	8,581
14. Jeongwang 1-Dong	23,765	13,032	1.82	8,213
15. Jeongwang 2-Dong	32,581	12,622	2.58	6,311
16. Jeongwang 3-Dong	23,843	10,877	2.19	10,564
17. Jeongwang 4-Dong	22,240	7,437	2.99	3,511

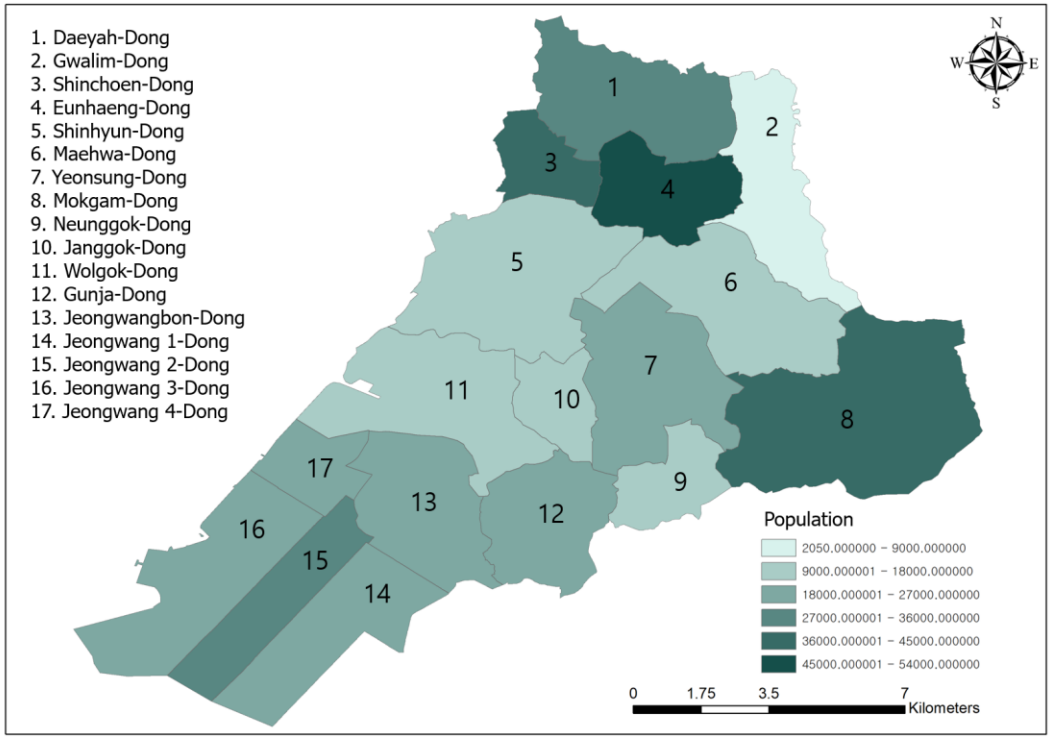

Figure 24. The population map of study area.

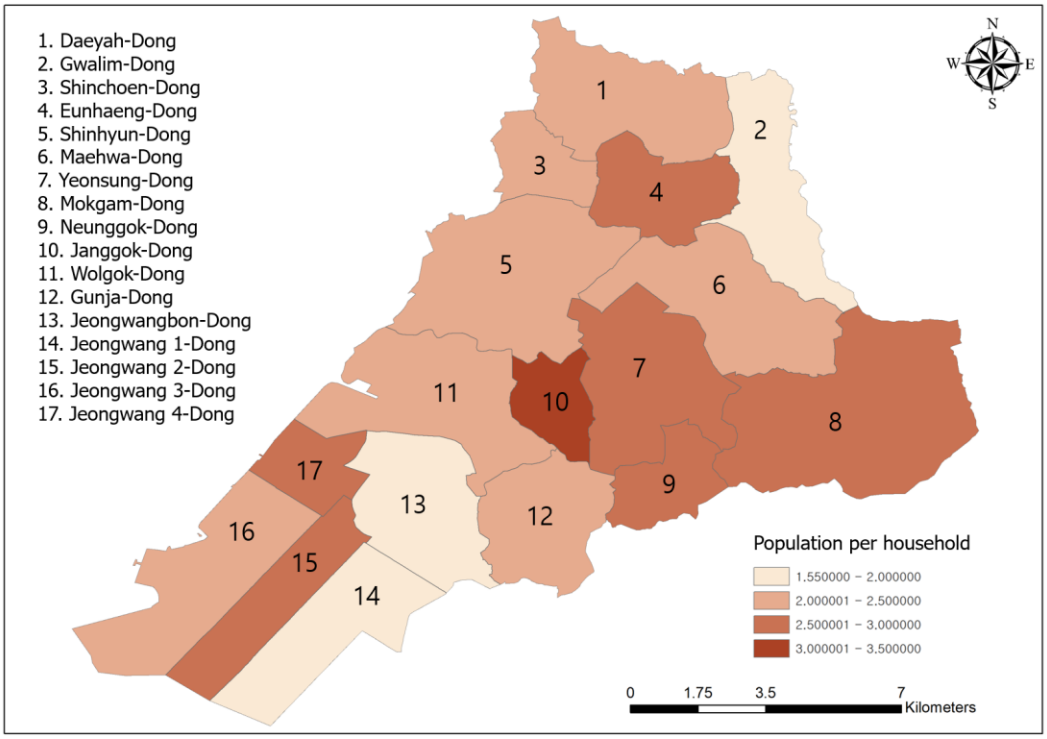

Figure 25. The population per householders' map of study area.

4.1.3. Land cover

The total area of study site is about 143.2 km2, of which agricultural area covers the widest area with 38.1 km2. Forest areas, including coniferous, deciduous forest and mixed forest, cover 23.3 percent of the total area as account for the second largest area. Agricultural areas account for about 10 percent of the whole area. The artificial grassland covers about twice the area of the natural grassland, and most artificial grassland are located near industrial and residential areas (Table 8) (Figure 26).

Table 8. The areas and ration for each land cover of the study area.

Land cover	Areas (km2)	Percent
sum	143.2	100
Settlement	7.9	5.5
Industrial area	13	9.1
Commercial area	2.9	2
Agricultural land	38.1	26.7
Natural grassland	7.7	5.4
Artificial grassland	13.5	9.4
Forest	34.8	24.3
Inland water	4.9	3.4
Sea water	0.15	0.1
Wetland	6.6	4.6
Public facilities	1.4	1.1
Roads	12	8.4

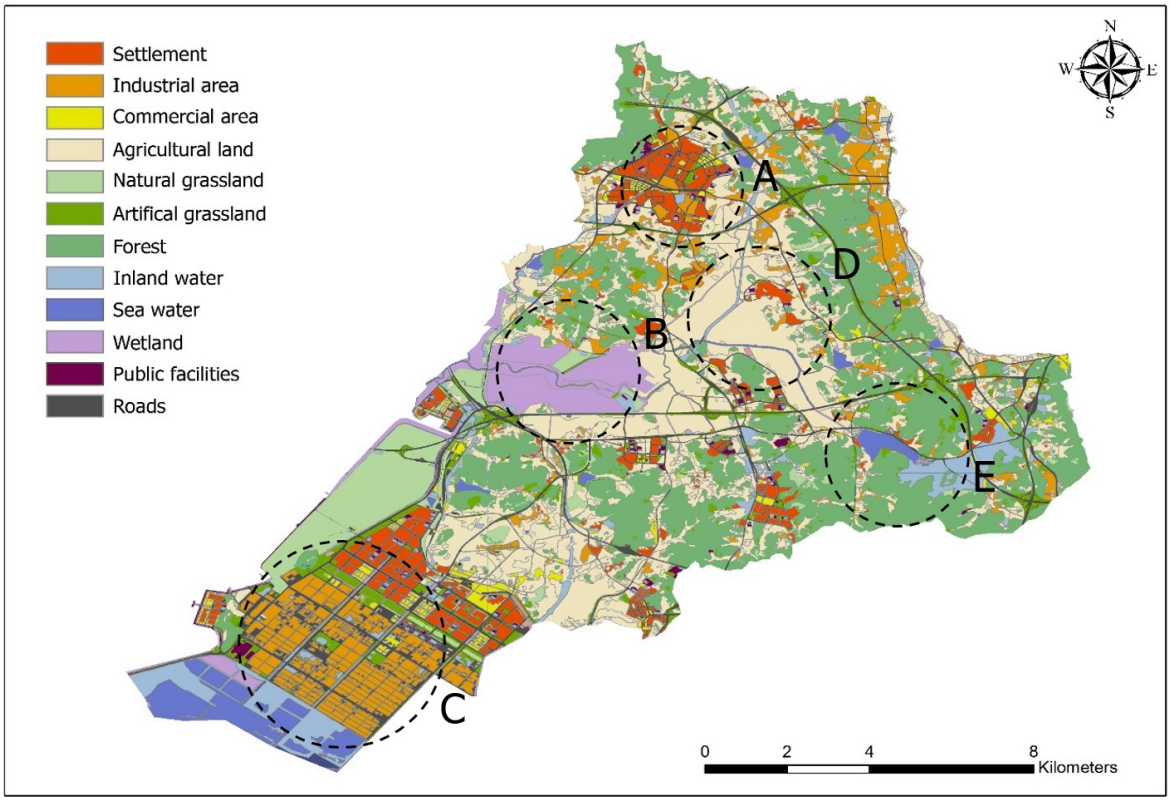

Figure 26. The 5 point and the land cover map of study area.

The study area of Shiheung city is largely divided into northern (region A), central (region B, D and E) and southern (region C) parts. The northern part adjacent to the big city has developed traffic system and large residential complexes were built (Figure 27). The central part has been created with large paddy lands of historic value reclaimed from the 18th century, which is still used by residents as a venue for the festival (Figure 31). The reservoir in the east is the starting point for a stream that crosses this city (Figure 32), and west part has located to the only inland mudflat in Korea at the point where the stream ends. The inland mudflats are designated as a wetland protection area by domestic law and has high ecological value due to the inflow of seawater (Figure 28). Finally, the southern part of the country has national industrial parks and residential complexes for workers (Figure

29), and long artificial Greenland located between the national industrial complex and the residential areas were also located in the Sothern region (Figure 30).

Figure 27. The Northern residential area.
Source: maps.naver.com

Figure 28. The inland mudflats in Central region
Source: maps.naver.com

Figure 29. The national industrial complex in Southern region.
Source: maps.naver.com

Figure 30. The artificial grassland between national industrial complex and residential areas.
Source: maps.naver.com

Figure 31. The large paddy in central region
Source: maps.naver.com

Figure 32. The reservoir in Eastern-central region.
Source: maps.naver.com

4.1.4. Cultural ecosystem service

Focusing on paddy lands and mudflats (Figure 28), the National Natural Trust project worked with a local government initiative to improve ecosystem services within the city. According to the ecosystem services assessment conducted by the National Institute of Ecology in the Republic of Korea, the study area was identified to providing high-quality cultural ecosystem services. In order to identifying the benefit of ecological assets, that study was analyzed based on accessibility by various cultural indices such as social relations, aesthetic, leisure, inspiration, cultural heritage, spiritual values.

Even though many ecological resources are evident, environmental ideas have not been considered since the 1980s due to development-oriented policies. National industrial complexes were built on reclaimed land via tide embankment construction, which impacted to marine and terrestrial ecosystems by destroying and damaging wildlife habitats. Without seawater circulation, the surrounding areas were affected by the excessive flow of contaminated wastewater from nearby industrial complexes. In the end, the emphasis on the development of urban policy provided poor services to the surrounding ecosystem.

As described Figure 33, the study analyzed three lodgment area that provided high cultural services in study area. Area 1 is an area with high population density and diverse ecological assets scattered around the mountain. Although the total value is not the highest, the area provides the most cultural services to the residents within in the Shiheung city. Area 1 described as Figure 25. Area 2 is an area with low population density but high culture service value. Programs such as various festivals are being around rice paddy fields that have a long history. Area 2 described as Figure 29. Finally, Area 3 is an area near city

hall where excellent road network including highway and subway has been formed. Although this area is not as densely populated as Area 1, this area has high cultural service value due to its ease of access to ecological assets (NIE, 2017).

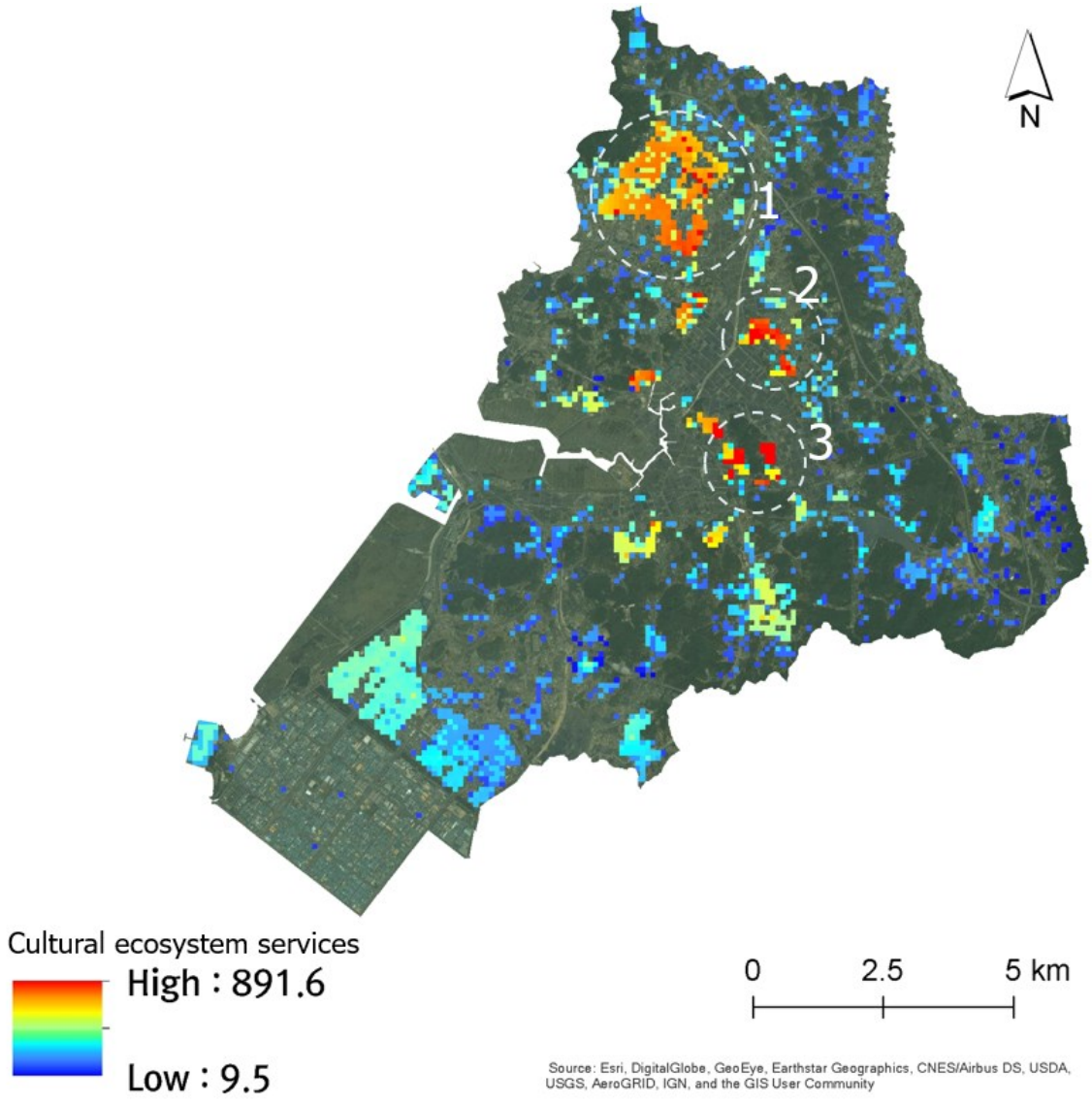

Figure 33. The cultural ecosystem services mapping
Source: Mapping and Assessment of Ecosystem Services (pp.165), National Institute of Ecology, South Korea.

4.2. Civil complaints of Shiheung city

The Shiheung city operates its own homepage of the electronic civil service online system (called Saewoljunjaminwonsystem in Korean) for citizens. The filed complaints will be transferred to the respective departments for processing, and the complaints from the Anti-Corruption and Civil Rights Commissions or the national department will be transferred to the respective departments. The civil complaints which reported by phone calling and visiting were processed by department complaints received. Figure 34 described the processing of the civil complaints in Shiheung city.

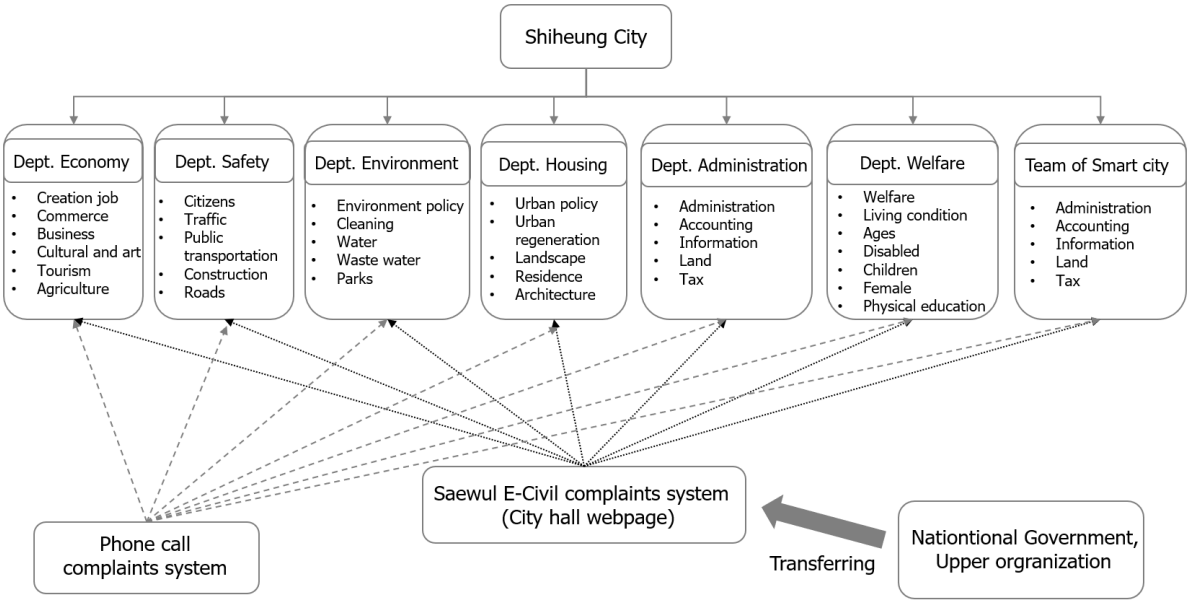

Figure 34. The civil complaints process system of the Shiheung city.

Citizens can call the departments directly to the department of city hall to file civil complaints. In general, civil complaints received are processed by the notified department. However, there are not enough dedicated staff members in each department to handle the complaints filed, and there is a shortage of staff who can respond immediately to problem resolution that requires a scientific or deeper explanation.

In addition, filed civil complaints using the homepage through the Internet are registered in the Saewul E-civil complaint system. Automatically registered civil complaints inform the administrator of the convenience and process of the handling complaints to the citizens. However, filed civil complaints with different reporting channels have the limitation that they can be duplicated because the processing is different.

Therefore, an integrated management system of civil complaints is required. An integrated management system is effective as an administrator because it can prevent duplicate complaints, when cooperation with other departments is required, the content and progress of complaints can be shared immediately. The resolution of civil complaints transferred from higher government or other agencies should also be included in the integrated management system. One complaint can have other adverse effects, and similar complaints can be used as references if reported.

4.3. The smart city project in Shiheung city

The Shiheung city has been selected in 2018 as a pilot city for the ‘data-based smart city” by national strategic project funded by Ministry of Land, infrastructure and Transport and Ministry of Science and ICT.

Shiheung-style smart cities are planned as four major strategies for promoting cities where anyone enjoys the benefits of smart cities, innovative service cities that enhance the quality and value of citizens' lives, platform cities that can be innovated continuously in cities, and civic participation cities that are created with citizens.

As a result, Shiheung city emphasizes the need to generate and build data and encourages citizen participation, which is at the core of smart governance. A foundation for civic participation living lab was established, and the knowledge and opinions of citizens are directly heard and reflected in policies. An open data hub was established to process, analyze and process collected data, and an action plan was launched for everyone to utilize by disclosing accumulated information.

In addition, Shiheung city emphasized the cooperation of various interested parties such as technical private companies, researchers, and entrepreneurs. In addition, the government is implementing a location-based map that can help the disabled move conveniently, and an environmental issue that has been a chronic problem.

The analysis of field data and various cooperation with stakeholders are absolutely necessary to build a successful smart city in the study area. Therefore, this study explores the availability of real-site civil complaints reported by voluntary citizens as data and how they influence the deployment of smart city and governance in Shiheung city.

4.4. The issues of Shiheung city

Although Shiheung city, which was planned as a national industrial city, has set up wide development-restricted areas, including many ecological and cultural resources, it has caused many environmental challenges.

In addition, with the launch of the new urban development plan in 2014, complaints from citizens continued to increase, but Shiheung City failed to solve the problem in a way that increased conflicts between citizens, businesses and local governments. The issues in Shiheung city are as follows;

1. Currently, Shiheung City is a city that leads the national smart city project, but at the same time, it is an area where many environmental chronic complaints are generated, and a model that sets an example for Korean urban society should be built.

2. Shiheung City is an area where the voluntary participation of local residents is active. Citizens voluntarily set up monitoring teams to measure odors and noise. As a result, citizens are strongly willing to participate in the policy as a result of civil complaints.

3. Since the industrial park is one of the major facilities in the city, it is necessary to look at environmental issues arising from the industrial park from the perspective of citizens.

4. There have not been many cases in which civil complaints on the scale of local governments have been studied. However, pursuing to smart city, analyzing and establishing civil complaints maps will play an important role in the policy decision-making process as data.

Chapter 5. Analyzing of Civil complaints

5.1. Data collection and methods

The data in this study included environmental civil complaints for 3 years (2014–2016), targeting Shiheung city. The data included date and time, occurrence location, and the unsatisfactory situation perceived by citizens. Since complaints were written in consideration of the reporter's perspective, prejudice or bias could exist, and thus the recorded complaints were collected and used in various ways. We analyzed a total of 1453 records; records with missing or mismatched geographic information were excluded (187 in 2014, 362 in 2015, and 324 in 2016) (Figure 35).

The data were categorized as 4 types based on reporting channel: phone calls, night-time phone calls, internet, and use of the smart phone app. Phone calls are used for the caller to directly report their complaint to government officials, whereas night-time is off-hours reporting. An opinion on the internet is reported via the government website signboard or upper level authorities, whereas opinions are directly reported using smartphone applications developed by each of the government authorities. Figure 36 described the contents of civil complaints as raw data; title, reported channels, opinion, time and geographic location.

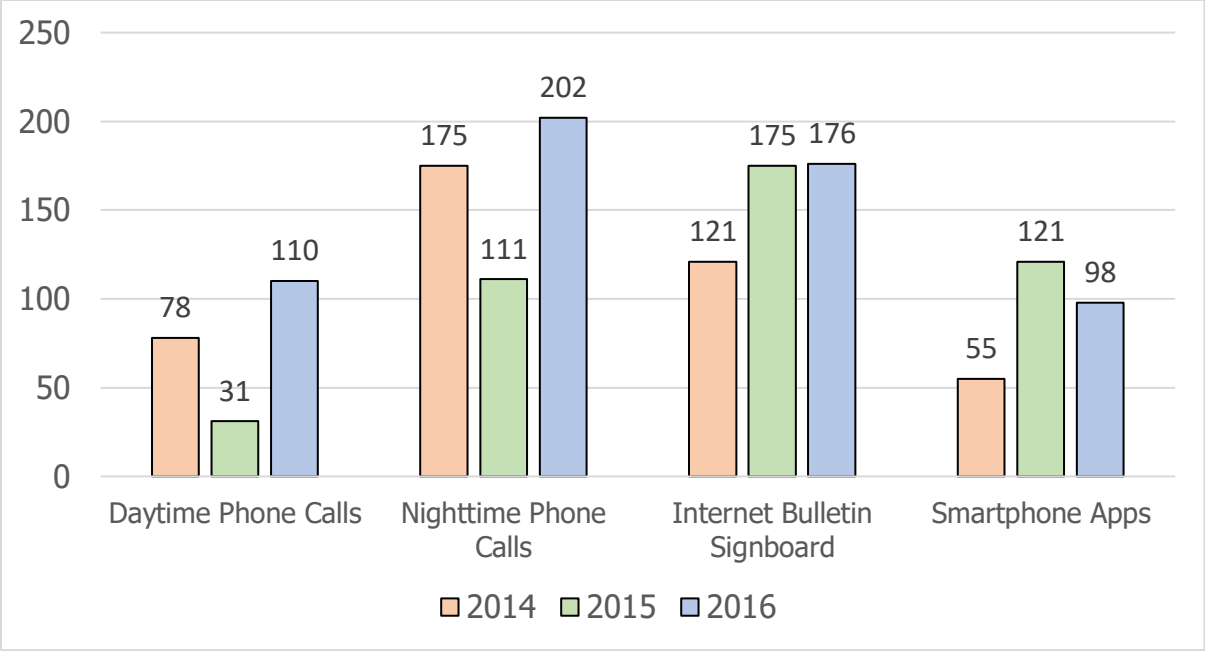

Figure 35. The collected data types from 2014 to 2016.

	B	C	D	E	F	G	H	I	J	K	L	M
1			series/complain title	complain opinion	report date	answer date	the person in charge of		response date	response content	address	
2	37930	'20140128010	[당직민원]2014-01-28 01:08 민	심한 악취가 풍겨온다는 민원 제보	2014-01-28	2014-02-07 18:00	환경국	박	2014-02-04	1. 시흥스마트허브 쾌적한 녹	경기도 시흥시 정왕동 1628	[답변완료]
3	37922	'20140127182	[인터넷]폐비닐 재활용업체 관	폐비닐 압축에 대한 인허가 부분비	2014-01-27	2014-02-07 18:00	환경국	임	2014-01-28	0. 우리시 수질 및 환경 보전	경기도 시흥시 정왕동 707-1	[자동답변완
4	37914	'20140127153	[이송이관] 시흥시 장곡동 소재	새벽까지 음악을 크게 틀어놓고 장	2014-01-27	2014-02-06 18:00	환경국	김	2014-02-03	1. 우리시 환경행정에 관심을	경기도 시흥시 장곡동 820-1	[자동답변완
5	37912	'20140127114	[인터넷]빌라에 소음 지도단속	새벽에 소음(북소리)으로 생활이 불	2014-01-27	2014-02-06 18:00	환경국	김	2014-02-03	1. 우리시 환경행정에 관심을	경기도 시흥시 신천동 876-15	[자동답변완
6	37857	'20140124134	[전화민원] 도로에 흙을 뿌리는	도로에 흙을 뿌리고 있음	2014-01-24	2014-02-04 18:00	환경국	김	2014-02-03	1. 우리시 환경행정에 관심을	경기도 시흥시 군자동 74번지	[자동답변완
7	37769	'20140118183	[인터넷]유흥주점의 심한 노래	까페가 있는데 시끄러워서 잠을 못	2014-01-18	2014-01-27 18:00	환경국	김	2014-01-24	1. 우리시 환경행정에 관심을	경기도 시흥시 정왕동 1742-1	[자동답변완
8	37764	'20140118155	[당직민원]2014-01-18 15:58 민	고물수집하시는 분이 금속 마그네슘	2014-01-18	2014-01-25 18:00	환경국	김	2014-01-21	민원인(김도윤)과 유선 통화	경기도 시흥시 거모동 1377번지	[답변완료]
9	37757	'20140118122	[당직민원]2014-01-18 12:29 민	주말인데도 공사를 하여 아침부터 소음이 심하고 아파트쪽으로 흙먼지가 많이 날림	2014-01-18	2014-01-25 18:00	환경국	김	2014-01-24	1. 우리시 환경행정에 관심을	경기도 시흥시 은행동 547-4	[자동답변완

Nighttime phone calls
Internet
Application
Internet
Daytime phone calls

Figure 36. The contents of civil complaints.

Our analysis was divided into two parts: extracting the considered keywords from the data, and creating a demand map of the keywords (Chapter 1.3). We created a network map for each year based on the selected words using a cleaning process with the top 10% of all nouns in the complaints using by R studio (statistics software, Boston, MA, USA) named KoNLP (Korean Natural Language Processing, R software packaged, Seoul, Korea) to exclude ambiguous and meaningless words. To understand the relationship between keywords, we performed network analysis to determine the connectivity of nodes and links between keywords. The keywords with high connectivity that were located in the core of the network were recognized as important issues through degree centrality analysis. Keywords that acted as bridges between keywords within the network were determined via betweenness centrality analysis, which affects the overall flow. Among them, meaningful keywords with geographical information were employed to create an issue map and determine the areas in which these words are concentrated. In doing so, Netminer 4 software and ArcGIS 10.5 (geographical information system, ERSI, Redlands, CA, USA) were used in the process (Figure 37).

Each complaint has merits and drawbacks depending on the reporting method: telephone calls immediately connect government servants with the caller and the report's exact intention can be easily understood, but records depend on government officials. The internet responses do not have a typical format because the reporter writes the content on their own, but accurate descriptions of the occurrence location and exact content are provided. The smartphone application automatically records information of the occurrence location and is efficient, but not free from the set format of the application.

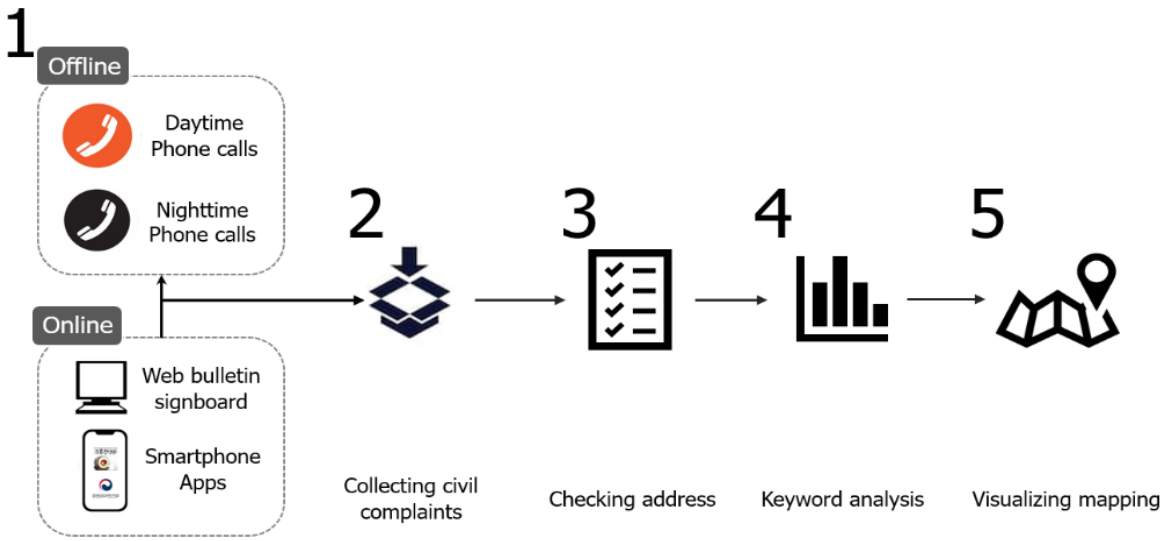

Figure 37. Flowchart of this study.

5.2. Relationship analysis between words

5.2.1. Relationship between words in 2014

We analyzed environmental complaints over three years by conducting networking analysis. Significant keywords were identified based on the node and links via degree and betweenness centrality analysis. In 2014, the frequency of the words in decreasing order was as follows: noise (344), stink (241), construction (141), dawn (106), dust (95), and nighttime (91). These words, except for dust, had high values of degree and betweenness centrality. They were recognized as an issue because other words were linked to them and these words were located in the center of the network map. The network map consists of different sizes of nodes and different length links. The node's size varies with the importance of word: the larger the size, the more important the word. The links' length denotes the association between each word: the shorter the distance, the more relevant the association (Table 9).

The network map could be categorized into two parts based on noise and stink words. Noise was directly interlinked to construction, dawn, night-time, and holiday, and stink was connected to factory, window, daily life, and livestock, and especially dawn and night-time words associated as a mediator. Considering the overall network flow, noise was recognized as a keyword for the main issue (Figure 38). We predicted noise was related to construction at night-time and dawn and everyday life, such as sleep and music.

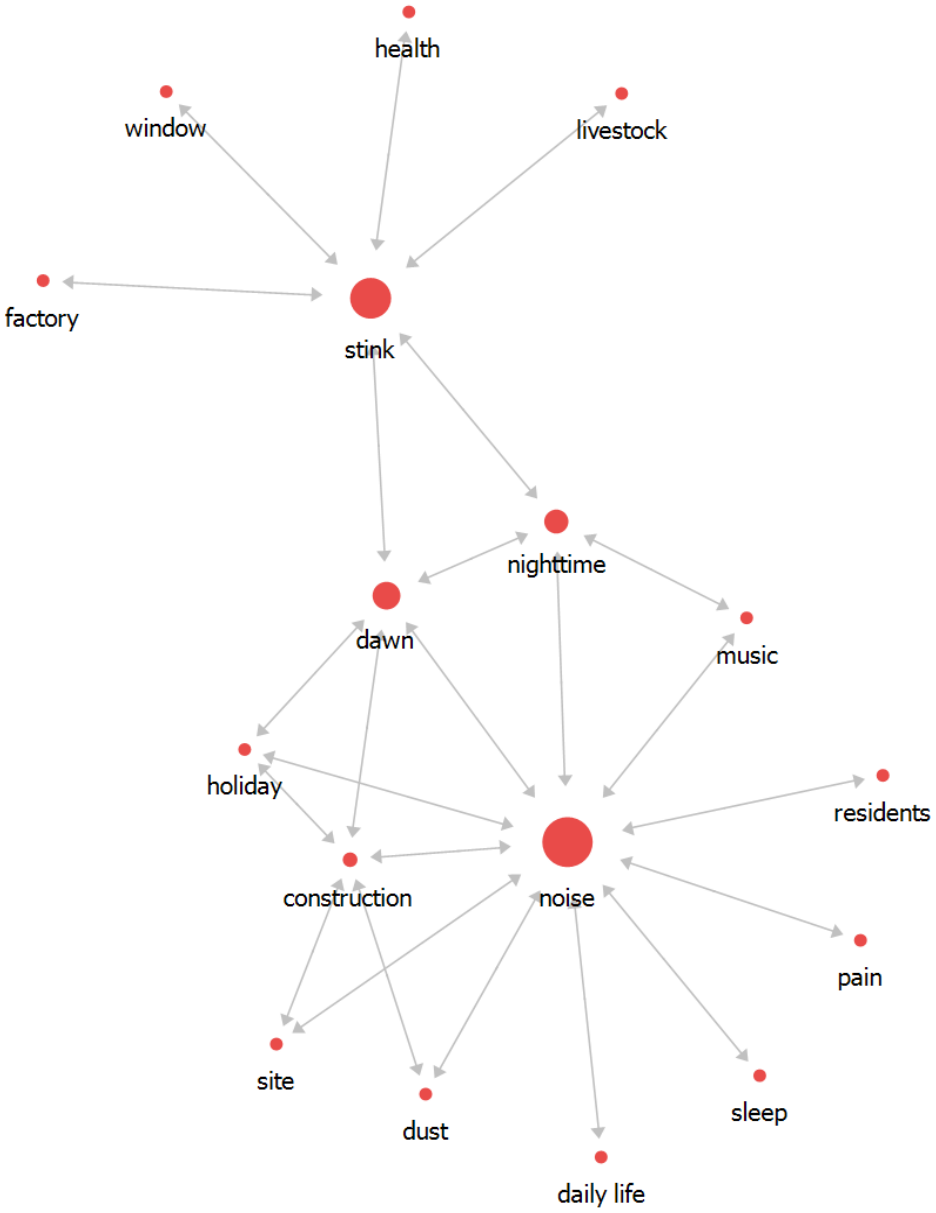

Figure 38. The relationship between words in 2014.

Table 9. The frequency and the centrality value of degree and betweenness of each word in 2014.

No	Words	Frequency	Degree Centrality	Betweenness Centrality
1	noise	344	0.6875	0.588889
2	stink	241	0.375	0.45
3	construction	141	0.3125	0.048611
4	dawn	106	0.3125	0.251389
5	night-time	95	0.25	0.177778
6	holiday	91	0.1875	-
7	dust	69	0.125	-
8	music	53	0.125	-
9	site	38	0.125	-
10	sleep	34	0.0625	-
11	factory	31	0.0625	-
12	window	31	0.0625	-
13	daily life	29	0.0625	-
14	livestock	24	0.0625	-
15	residents	24	0.0625	-
16	pain	20	0.0625	-
17	health	20	0.0625	-

5.2.2. Relationship between words in 2015

In 2015, in terms of frequency, stink words were the most frequent (451), followed by noise (241), dawn (152), and dust (115) words (Table 10). The stink words with the highest centrality value were directly connected to the words dawn, contaminant, incineration, gas, and fuel; and the contaminant words were interlinked with incineration, fuel, gas, pain, pollution, waste water, and maleficence words. The overall workflow was described with stink in the center of the network map, as shown in Figure 39.

Comparing the network map and the result of betweenness centrality, noise was strongly associated with construction and other words were interlinked to stink. Incineration, which was located stink and contaminant, had a connection with fuel and add facility. Considering the overall flow of the network map, stink was a keyword representing a main issue. Stink was associated with contaminant, gas, and incineration, and fuel, incineration, and add facility were also associated.

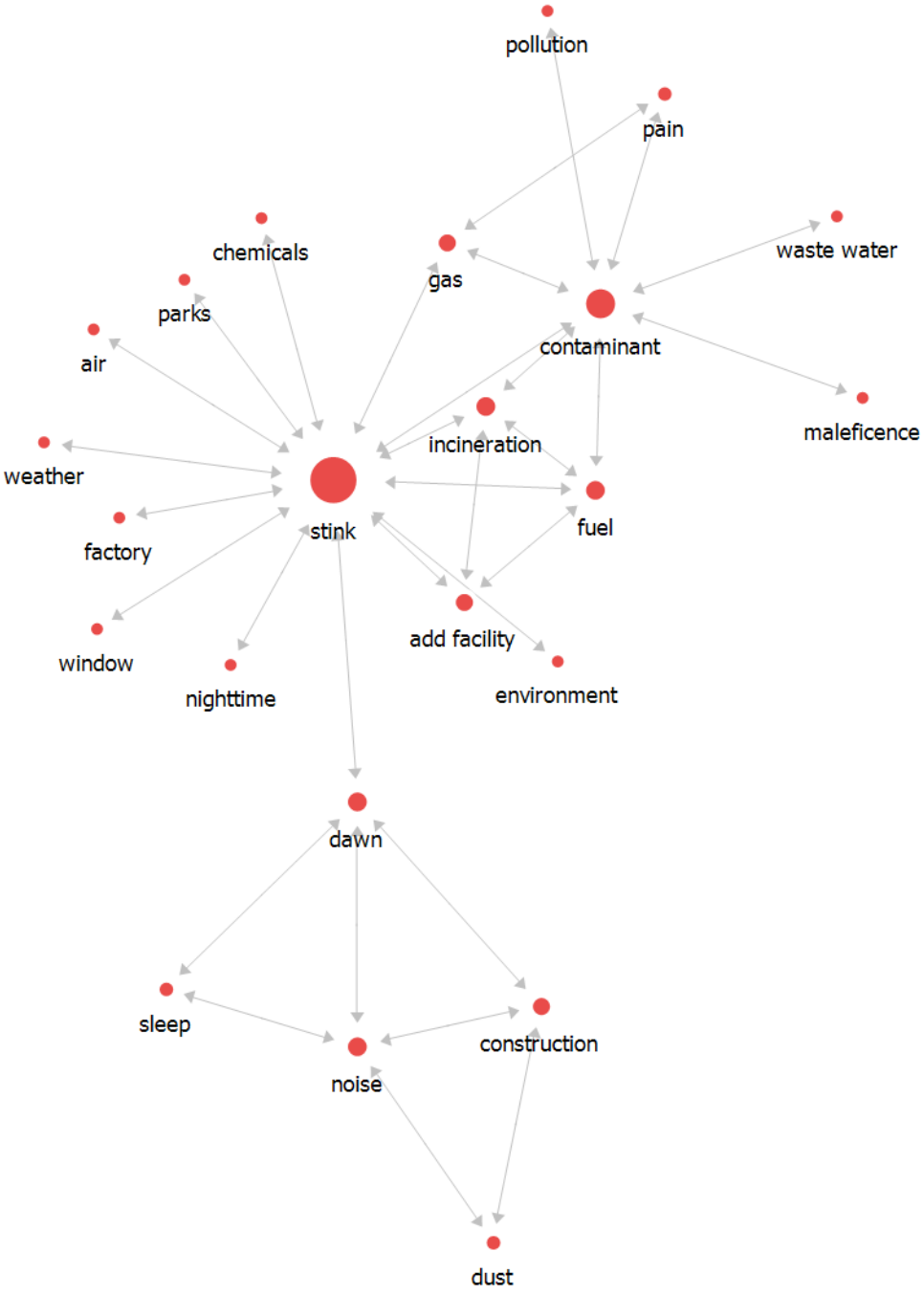

Figure 39. The relationship between words in 2015.

Table 10. The frequency and the centrality value of degree and betweenness of each word in 2015.

No	Words	Frequency	Degree Centrality	Betweenness Centrality
1	stink	451	0.636364	0.81746
2	noise	241	0.181818	0.047619
3	dawn	152	0.181818	0.313853
4	dust	115	0.090909	-
5	construction	103	0.136364	0.041126
6	add facility	78	0.136364	-
7	contaminant	77	0.363636	0.306277
8	nighttime	71	0.045455	-
9	sleep	60	0.090909	-
10	incineration	52	0.181818	0.006854
11	factory	52	0.045455	-
12	window	50	0.045455	-
13	fuel	48	0.181818	0.006854
14	weather	48	0.045455	-
15	pollution	38	0.045455	-
16	gas	38	0.136364	0.031385
17	chemicals	34	0.045455	-
18	parks	32	0.045455	-
19	air	31	0.045455	-
20	pain	30	0.090909	-
21	environment	30	0.045455	-
22	waste water	26	0.045455	-
23	maleficence	21	0.045455	-

5.2.3. Relationship between words in 2016

In 2016, the highest-frequency words in the complaints were noise (728), followed by stink (594), construction (255), night-time (173), and dawn (129) (Table 11). Most words were connected to the noise, which was directly interlinked to construction, dawn, nighttime, factory, sleep, residents, and window. Stink also was connected: dawn, factory, sleep, residents, and window, which were located between noise and stink. The overall flow was described, with noise in the center of the network map. Considering the overall network structure, the main issue keyword was noise. The words that had high betweenness degree that were interconnected with noise and stink were shown to play an important role in issue (Figure 40).

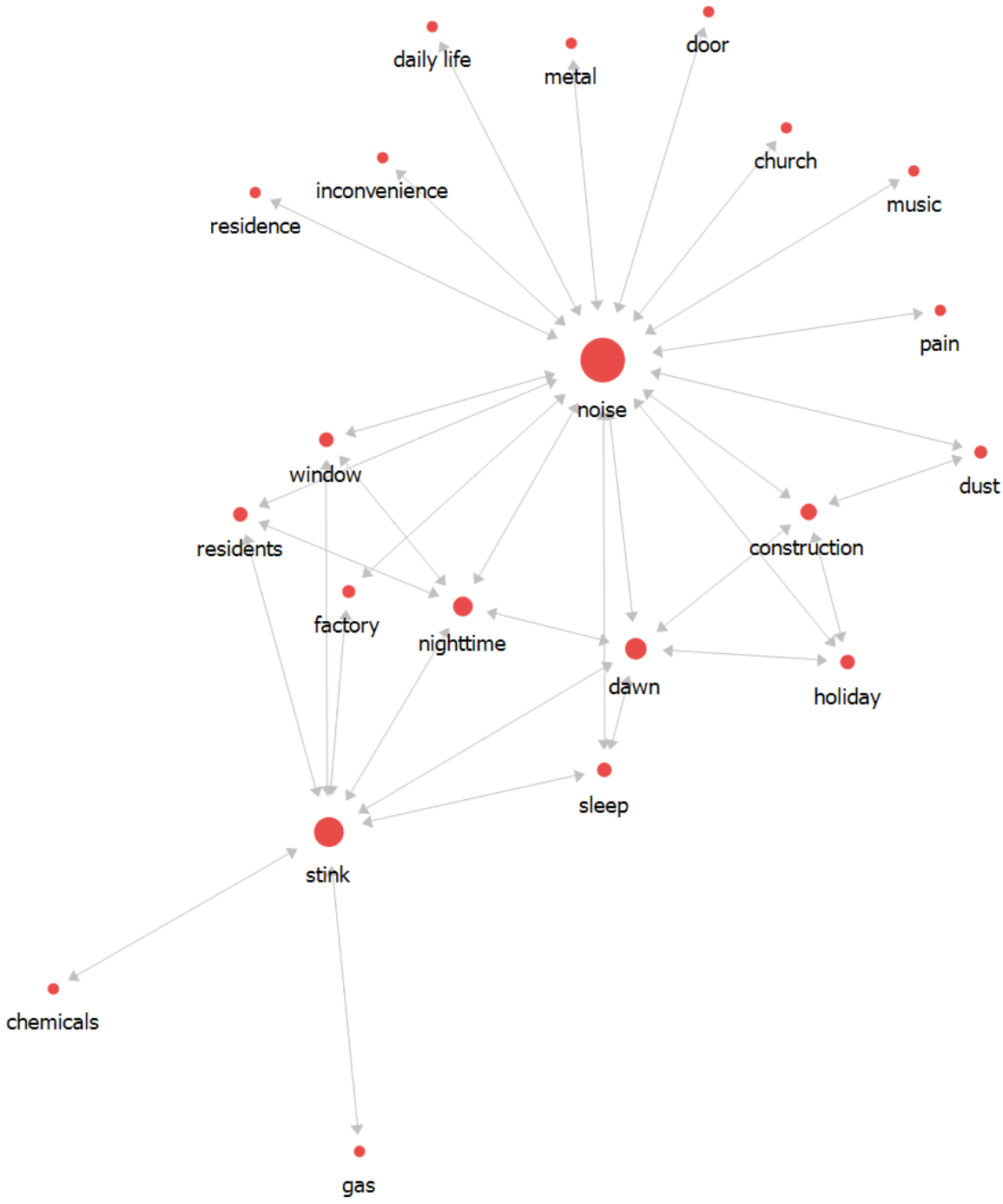

Figure 40. The relationship between words in 2016

Table 11. The frequency and the centrality value of degree and betweenness of each word in 2016.

No	Words	Frequency	Degree Centrality	Betweenness Centrality
1	noise	728	0.809524	0.749546
2	stink	594	0.380952	0.20873
3	construction	255	0.238095	0.102041
4	nighttime	173	0.238095	0.028231
5	dawn	129	0.285714	0.08424
6	dust	126	0.095238	-
7	factory	120	0.095238	0.023469
8	sleep	115	0.142857	-
9	residents	114	0.142857	0.023469
10	holiday	83	0.142857	-
11	inconvenience	72	0.047619	-
12	window	68	0.142857	0.023469
13	residence	68	0.047619	-
14	daily life	51	0.047619	-
15	chemicals	42	0.047619	-
16	door	37	0.047619	-
17	gas	36	0.047619	-
18	music	30	0.047619	-
19	church	27	0.047619	-
20	pain	21	0.047619	-
21	metal	19	0.047619	-

5.2.4. Comparison of words analysis for three years

We analyzed three years of data to determine the keywords that appeared every year. The keywords that were continually extracted were as follows: noise, smell, construction, nighttime, dawn, dust, factory, sleep, window, and pain. The frequency of most of these words was high in 2016 and they all increased after 2014. Noise and smell accounted for a fairly high proportion of the keywords; construction, dust, and factory were the causes; and night-time and dawn provide understanding of occurrence time; the effect on citizens was sleep and pain; and the window seemed to be the mediator (Figure 41).

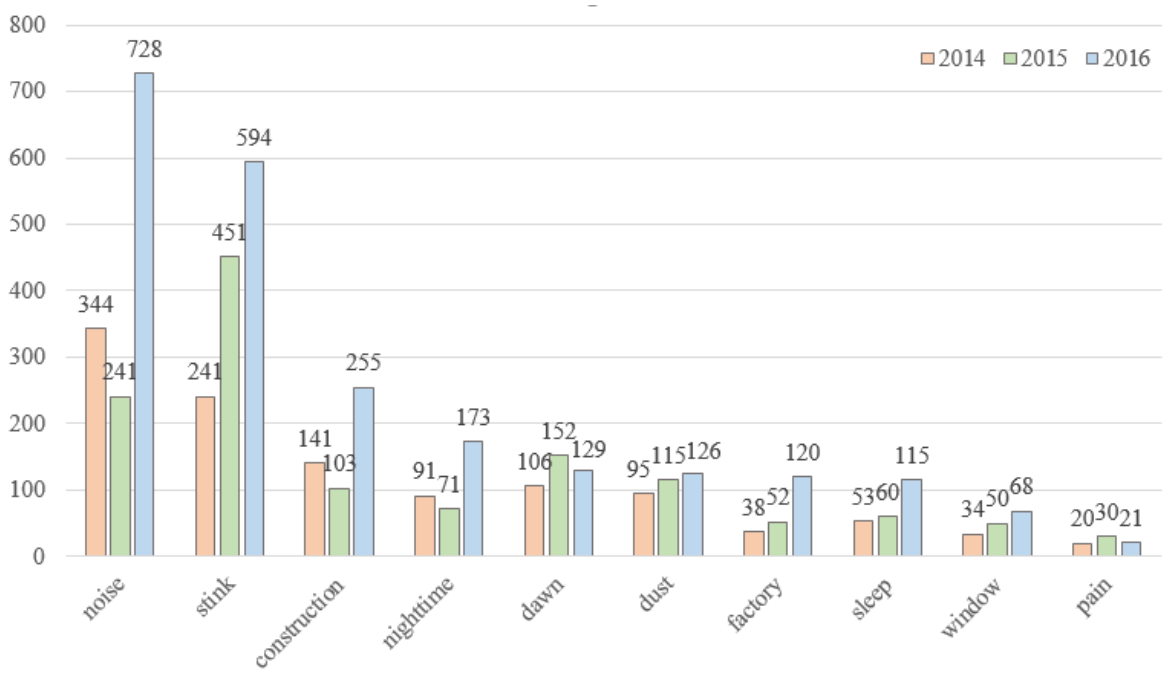

Figure 41. The frequency of words that have been appearing for three years.

Although words with high frequency and centrality values were important, analyzing the other words around the keywords was meaningful to help us understand

various words related to the keyword. Words excluding the main keywords were as follows: holiday, daily life, site, music, and residents in 2014; add facility, contaminant, incineration fuel, and weather in 2015; and residents, holiday, inconvenience, residence, and daily life in 2016. Overall, the number of keywords was increasing as of 2016. Residents, holiday, daily life, site, and music were extracted in 2014 and 2016, which appear to be related to noise, which was the main keyword for two of the studied years. Chemicals and gas appeared in two years, which also appear to be linked to smell as the main keyword in 2015 and noise in 2016 (Table 12).

Table 12. The frequency of all the words except for the words that have appeared for three years.

No	Keywords	2014	2015	2016	No	Keywords	2014	2015	2016
1	residents	24	0	114	15	incineration	0	52	0
2	holiday	69	0	83	16	fuel	0	48	0
3	inconvenience	0	0	72	17	weather	0	48	0
4	residence	0	0	68	18	pollution	0	38	0
5	daily life	31	0	51	19	gas	0	38	0
6	chemicals	0	34	42	20	chemicals	0	34	0
7	site	31	0	42	21	parks	0	32	0
8	door	0	0	37	22	air	0	31	0
9	gas	0	38	36	23	environment	0	30	0
10	music	29	0	30	24	waste water	0	26	0
11	church	0	0	27	25	maleficence	0	21	0
12	metal	0	0	19	26	livestock	24	0	0
13	add facility	0	78	0	27	health	20	0	0
14	contaminant	0	77	0	-	-	-	-	-

5.3. Local keyword issues

5.3.1. Noise keyword issue

Noise is one of the most common environmental problems, and its occurrence frequently occurs within the city (Krishna et al, 2017). Noise is a temporary or permanent harmful sound that affects human hearing and causes discomfort (Gupta, 2018; Hong et al, 2019), and might pose threats to human mental state. Because it threatens human life constantly, noise must be managed comprehensively.

We identified that noise was the key challenge in 2014 and 2016. Although noise was not a keyword in 2015, it was necessary to analyze the data for all three years since frequency and centrality play important roles in issue analysis. Overall, the reported complaints were mostly concentrated in the summer season, from June to September, and the proportion of noise complaints was the highest in 2016, and decreased slightly in 2015, but increased sharply in 2016 (Figure 42).

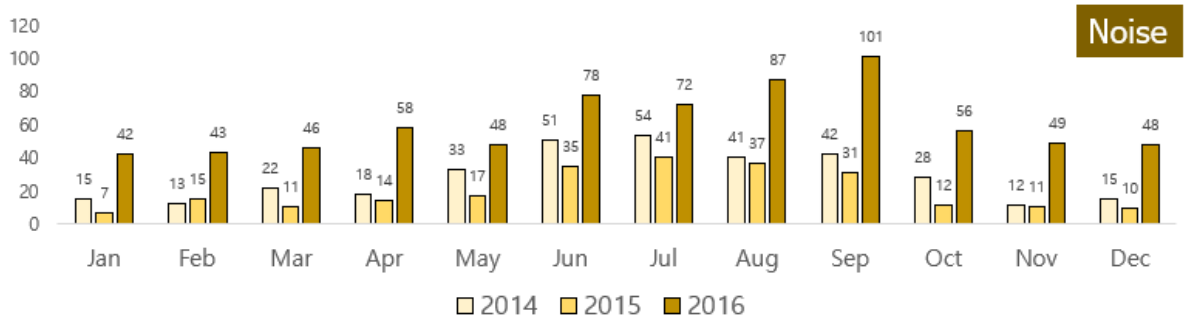

Figure 42. Monthly frequency of noise complaints

Comparing the noise map with population density, the most reported complaints came from urbanized residential areas, where much of the noise was concurrent with population distribution. Considering the overall the noise map for the three years, most noise reporting occurred near residential areas. The northern area reported the most complaints in 2014 (Figure 43), which then decreased in the next two years, but new noise complaints in the eastern region were reported, and those in the southern region decreased (Figure 44, 45).

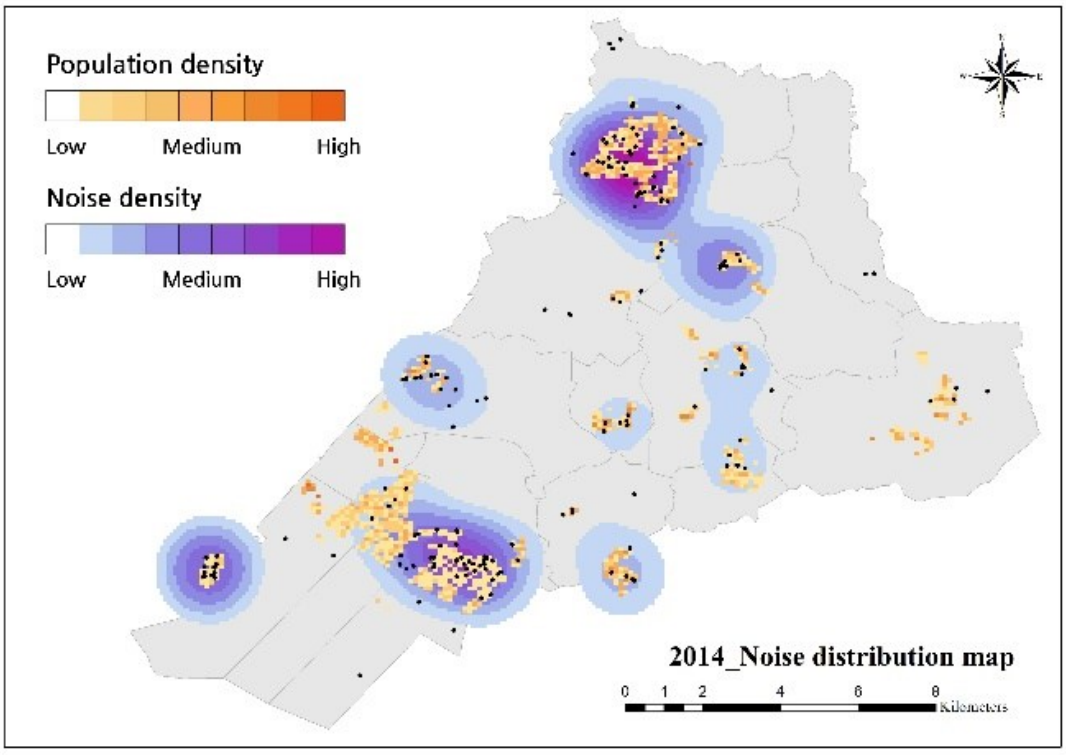

Figure 43. The Noise distribution map in 2014.

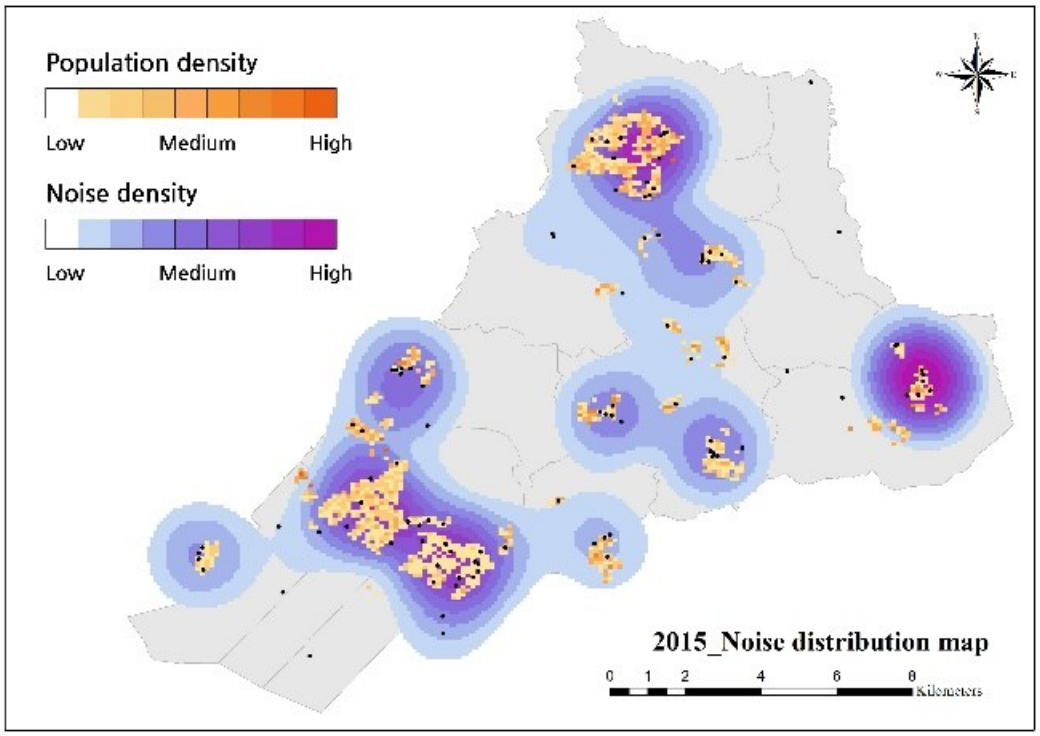

Figure 44. The Noise distribution map in 2015.

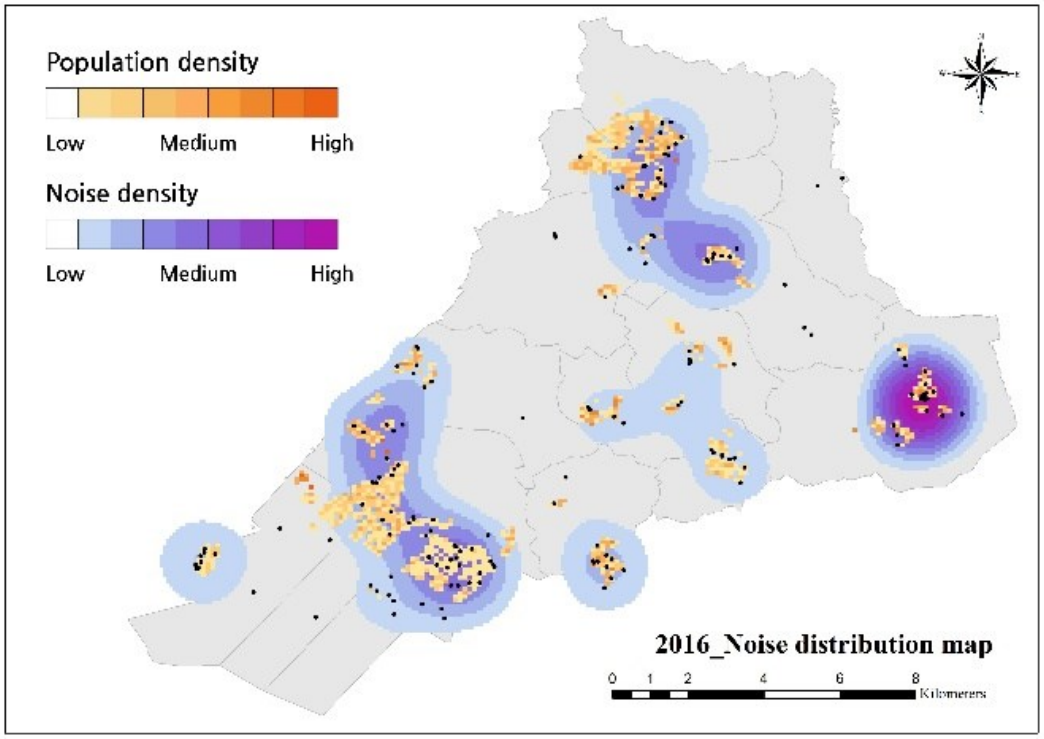

Figure 45. The Noise distribution map in 2016.

As described in Chapter 5.2, noise was identified as having a strong connection to construction, dawn, night-time, holiday, and music. Many complaints were reported during the summer season such as, “Please take action because remodeling work in front of my house is underway on a holiday”, “The store’s music is so loud that we cannot sleep at night-time” and “The building near my home has been under construction since early dawn on the holiday, please settle it quickly”. As a result, the noise complaints in 2014 mainly reflected the impact on living. In 2015 and 2016, complaints in new areas emerged. These were perceived as the development of the eastern region was beginning with the construction of the new town at the end of 2014. The noise complaints in 2015 included, “Noise interfered with sleeping due to the construction of an apartment building that began at dawn”, “Adults could not breathe because of the dust from the apartment construction and vehicles, but children are more worried”, and “The noise of the machinery in the next door factory is so loud”. Most of the 2015 noise complaints were due to the large apartment construction sites and industrial complexes. In 2016, the noise complaints were more concentrated in the eastern region. There were many complaints in 2016, such as, “We could not sleep because of the hymns that come from the church every Sunday at dawn”, “It is inconvenient to open the window because of the constant dust from large scale construction”, and “The noise of metal falling from the construction site at night-time is painful”.

Through analysis of the occurrence location and content of the complaints, the noise could be divided into temporary noise, such as a living noise, and continuous noise, such as development and construction noise. Temporary noise can be addressed immediately and quickly, but complaints of continuous noise might be further exacerbated by ignoring

citizens' opinions on urban policy. Through the complaints' content, we identified that citizens demand systems and facilities to reduce discomfort and pain and demand the halting of construction. The complaints that windows and doors cannot be opened in the summer season support the reason why complaints were concentrated in summer from June to September.

When noise is reported, the government official measures noise on the reported spot. In the case of living noise, more effective measurement methods or safe solutions are required because the complainants may not want to report because of the risk of personal information being exposed. In the case of construction noise, more thorough management and prevention required, such as the installation of a sound barrier and compliance with regulated construction hours. Other cities in Korea have noise-free days or monitoring on site as a measure to reduce noise (Ministry of Environment, 2016). Noise distribution maps can help identify noise-sensitive areas and reduce additional costs and time delays due to noise measurements.

5.3.2. Stink keyword issue

As a result of increased industrialization and awareness of people's demands for a clean environment, there is increasing interest in stink. Odours have a profound effect on humans because they are a feature of harmful or toxic substances in the air (Quercia et al, 2015), which have adverse effects on quality of life and entire communities (ATSDR, 2017). There are various artificial causes of odours, but thorough regulation and control are required before the damage increases to citizens.

Stink was the main keyword in 2015 and continued to appear as meaningful word along with noise. The reports of stink increased every year, with the highest proportion in August, but with different patterns in each month and year. February 2015 had the highest number of complaints due to smell in the three years, far higher than 2014 and 2016 in the same month (Figure 46).

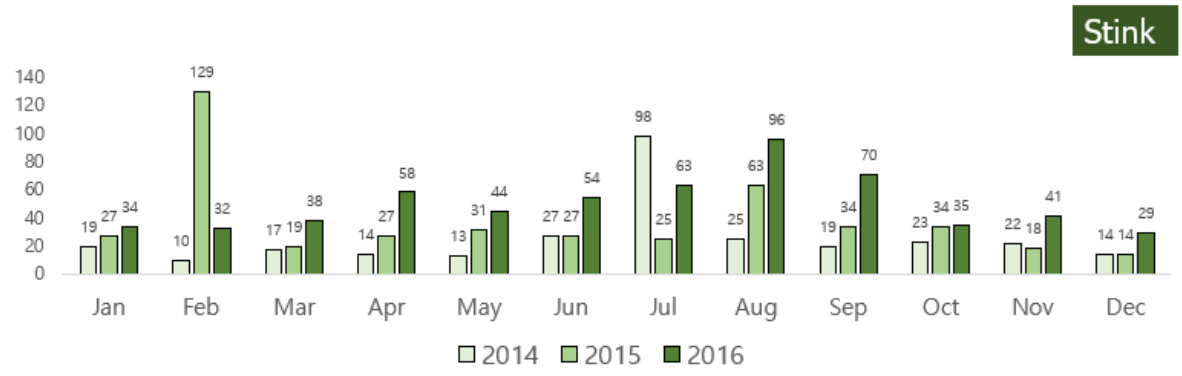

Figure 46. Monthly frequency of noise complaints.

As described in Section 3, smell was strongly association with factory, contaminant, gas, incineration, fuel, chemical, and livestock. Viewed in terms of spatial distribution in 2014 (Figure 47), smell complaints were distributed near industrial complexes in the southern regions, and residential areas in the northern region. The reported complaints stated, “I cannot open the window because the nearby factory smells like burning rubber at nighttime”, “The livestock around agricultural land smells too bad. When windy or raining, the smell is worse”, and “It smells at dawn, but I think it is coming from near the factory, please check”. Bad smells were reported in residential areas in 2014. However, the reported locations in 2015 were unusual. Although there were many reported locations in 2015 (Figure 48), most of the reported complaints were concentrated in one location. The reports from this location included, “I cannot take a rest with my family in the park because of the smoke and stink from the nearby paper factory”, “I am against the idea that the paper factory will be expanded. Even now, the incinerator facility smells like chemicals, and the expansion does not make sense”, and “I have no idea that what fuel they burn in incinerators and what is the identity of the gas, but it stinks every dawn”. The complaints in February were mostly about the paper factory. In 2016, there were many complaints related to this factory and reports from dwellings compared with 2015 (Figure 49). Complaints in 2016 included, “There is constant gas coming out the factory that smells like chemicals”, “The smell of the factory is damaging to all the residents of the apartment. We would like to find out why it smells every night or at dawn”, and “I closed the window because of the chemical smell, but it still smells. I cannot sleep at all”.

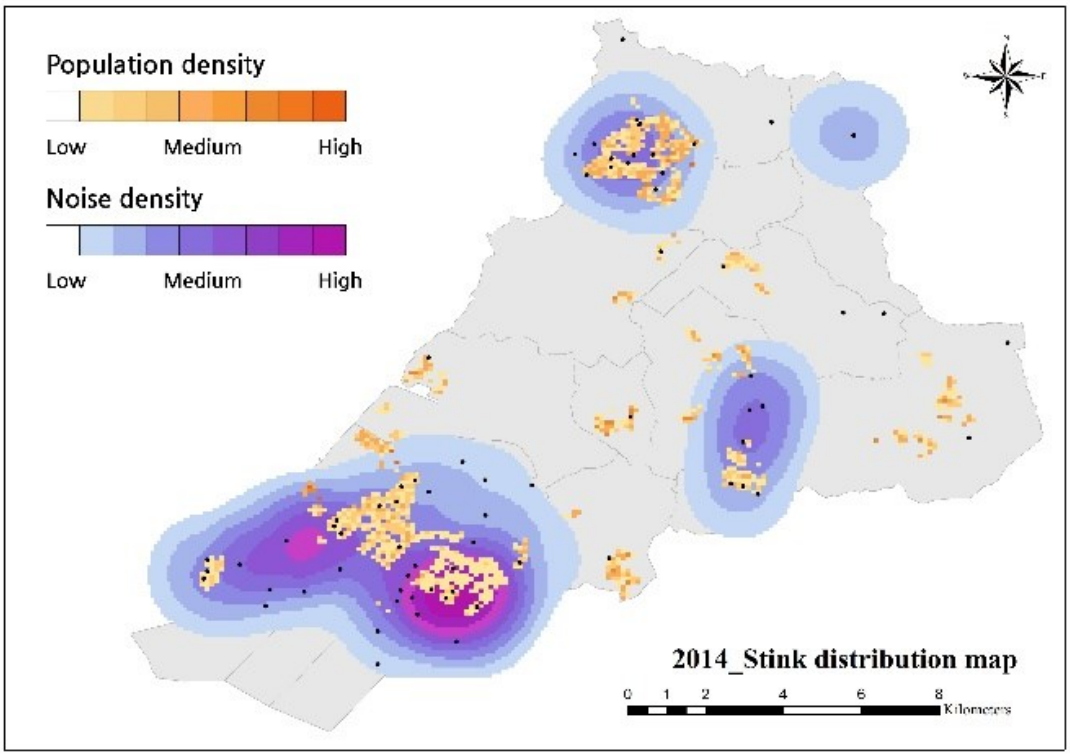

Figure 47. The Stink distribution map in 2014.

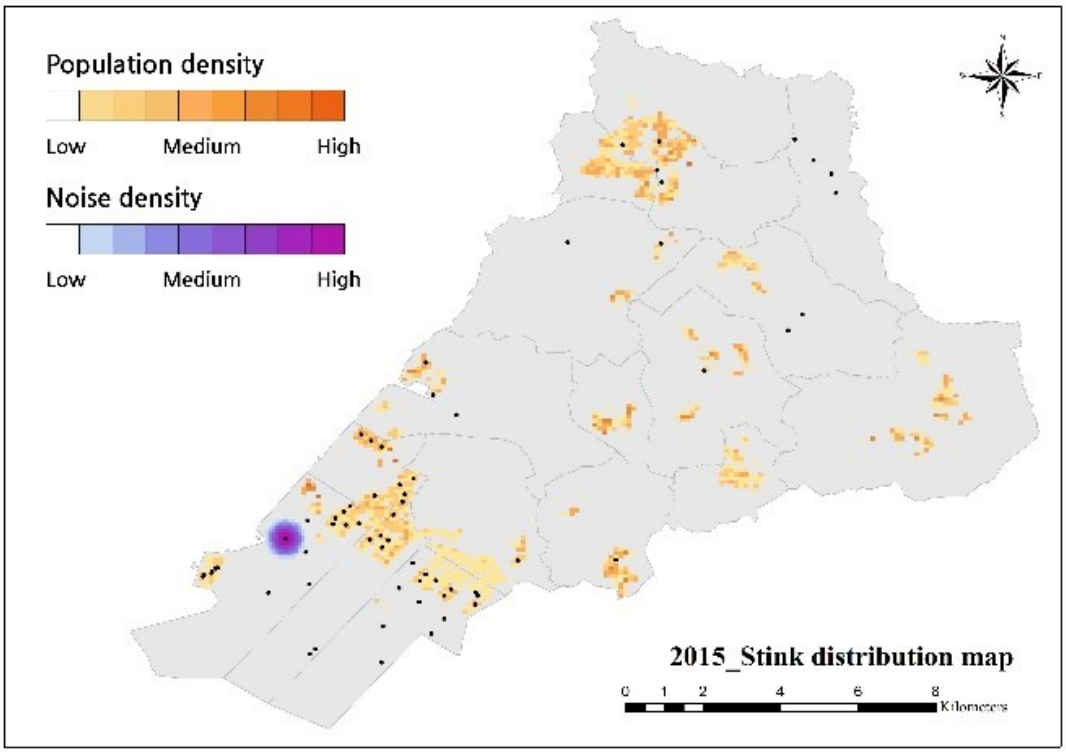

Figure 48. The Stink distribution map in 2015.

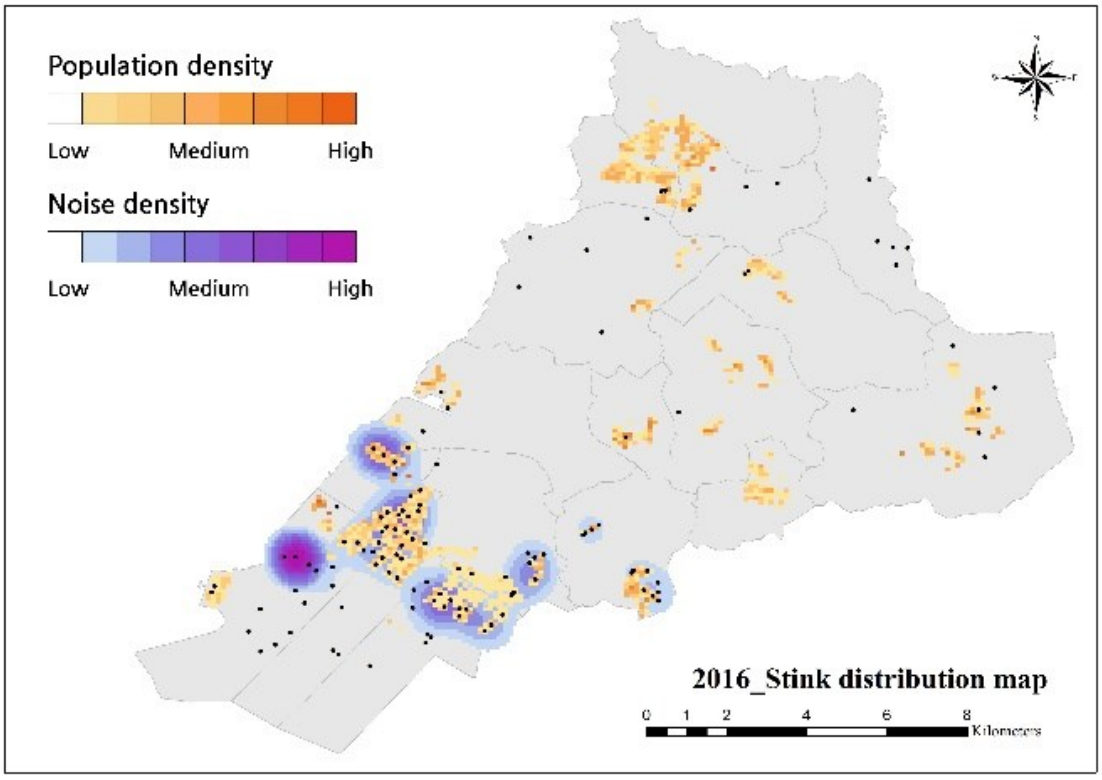

Figure 49. The Stink distribution map in 2016.

Unlike distribution of the noise complaints, smell complaints were concentrated in one location with particular words. The location of the main cause of smell generation was predicted by a particular factory. Although the factory was approved by upper government including establishing stink-reducing measures, the smell is still bothering residents because the plan has not been implemented. The factory owners, citizens, and local government are still negotiating, but no resolution had been reached at the time of publishing this report (Figure 48).

5.4. Reporting channels and continuous local issues

As described in Chapter 5.1, there are four available reporting channels: daytime phone calls, night-time phone calls, Internet bulletin signboards, and smartphone apps. The overall reporting frequency increased, but each channel has pros and cons. The day and night phone calls, as offline channels, are convenient for reporting complaints immediately because reporters talk directly with the person in charge, so the reporters can realistically convey their feelings and the situation causing dissatisfaction at the time. However, the subjectivity of the person in charge might affect the content of the recorded complaint, and it is difficult for the complainants to check the process or the result in real-time. In addition, if the person in charge does not understand the exact occurrence location being reported, or if the reporter does not describe its location correctly, the process of solving the problem could be difficult and time-consuming. Reporting via Internet bulletin and apps on smartphones, as online channels reported on the Internet, are not tied to place or time. Photos and videos can be attached to provide evidence of the issue, which can be released to other citizens through bulletin board homepages and apps. Although online methods enable convenient monitoring of the process, immediately provide results, and the location of problem can be automatically transmitted from apps or described in detail by the reporter, these methods can be abused or misused by a particular person or a specific problem. The person in charge may struggle to interpret or understand complaints because of the free form nature of the process. Online channels are useful for real-time analysis and mapping compared to offline channels because information is more open and reporting is

independent of time and place. In particular, a more well-organized online platform will help citizens report complaints and gather information, enabling managers to easily obtain and analyze data.

5.4.1. Noise issue as reporting channels

The frequency of complaints filed by each reporting channels on the noise was developed to the thematic maps. The maps described on each channel can be predicted for future regional civil complaints and can be efficiently utilized in the regional management planning. The noise reported by daytime phone calling was highest in Jeongwangbon Dong (region 13), and Gwalim Dong (region 2) was the lowest. Jeongwang 2 Dong (region 16) was also reported more than 10 times by daytime phone call (Figure 50). On the other hand, Mokgam Dong (region 8) was the highest with 38 cases by nighttime phone calling. This area has a low reporting rate during the daytime but is high at nighttime and will be need to crackdown by government officials (Figure 51).

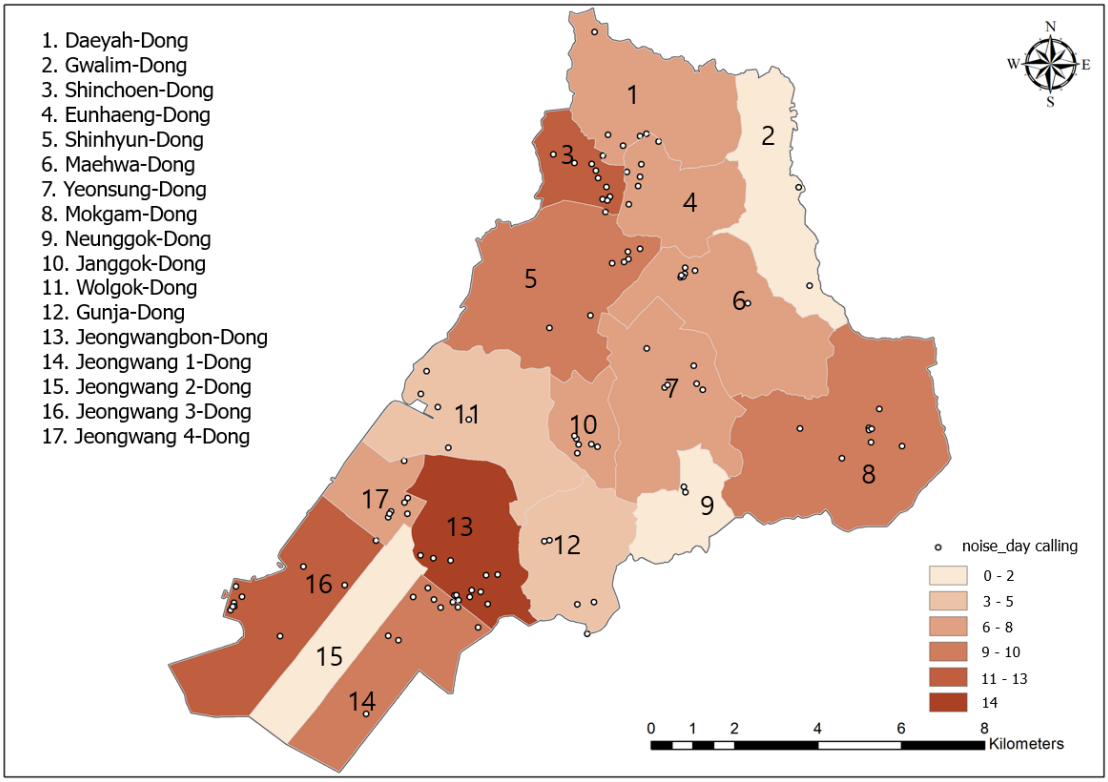

Figure 50. The regional noise complaints by daytime phone calling for 3 years.

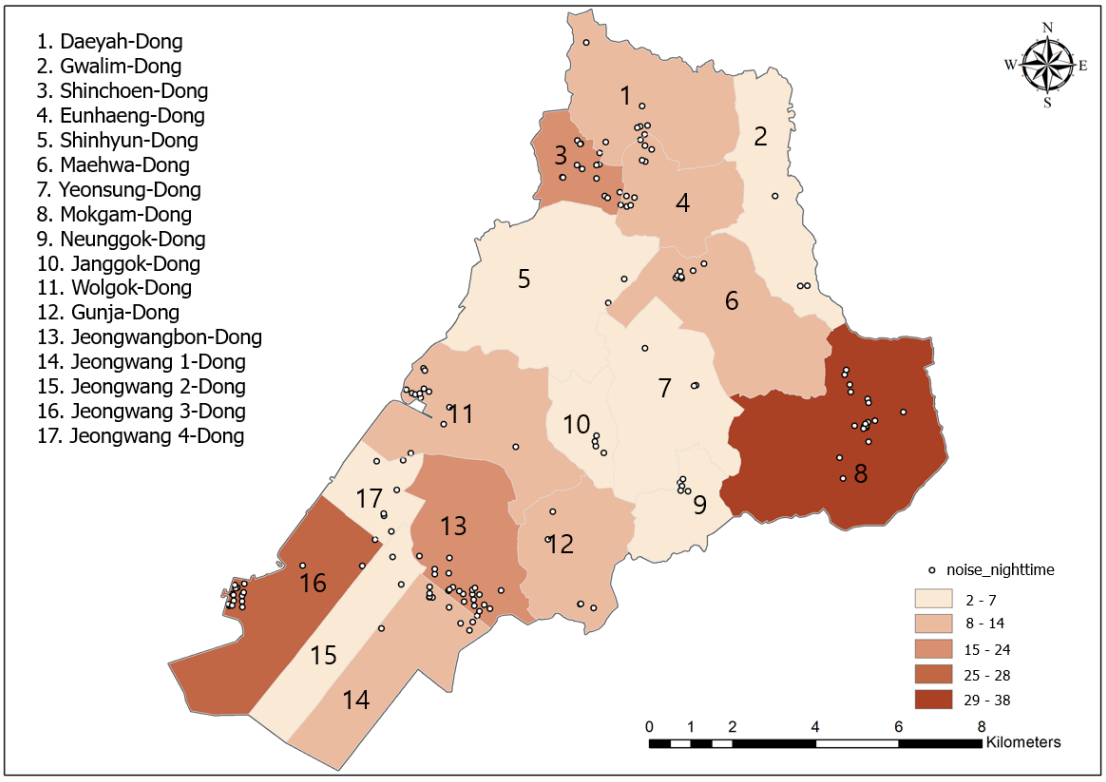

Figure 51. The noise complaints by nighttime phone calling for 3 years.

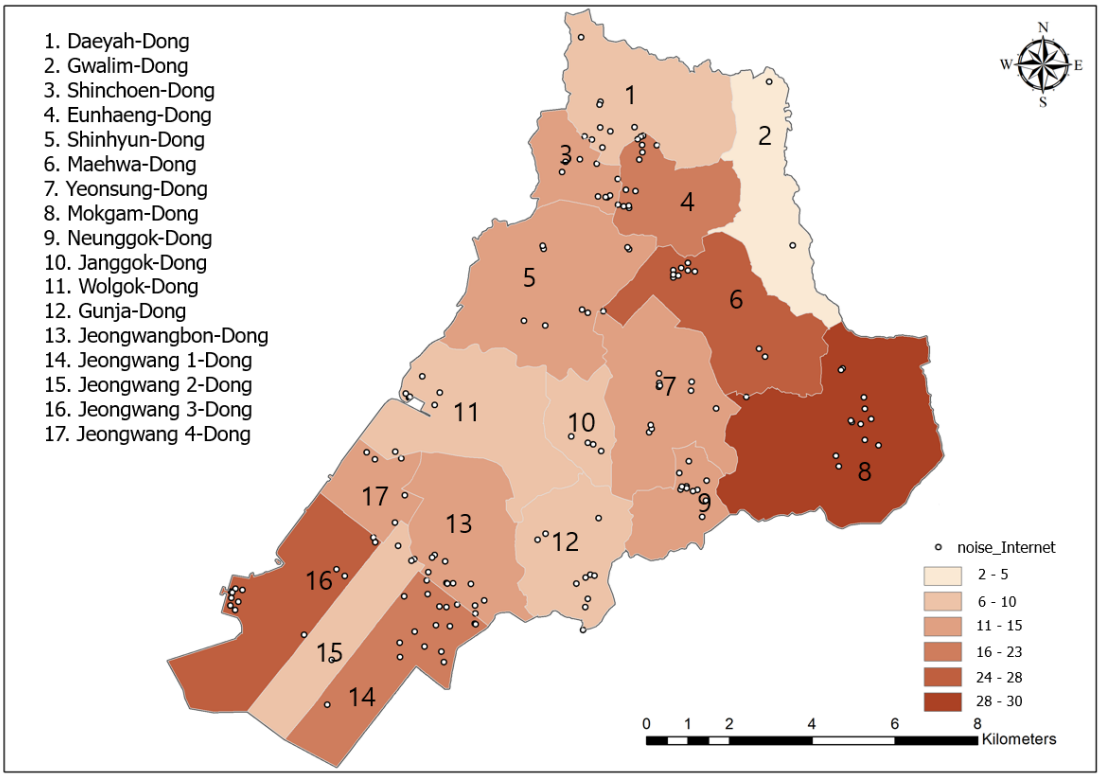

Figure 52. The regional noise complaints by the Internet for 3 years

The Mokgam Dong (region 8) was also the highest within the Shiheung city. Although it is not exactly known when to report the complaint on the Internet webpage, because of personal information, it is similar to nighttime phone calling. However, although nighttime phone calls were reported concentrated in a specific region, it is indicated that reporting by the internet throughout the study area (Figure 52).

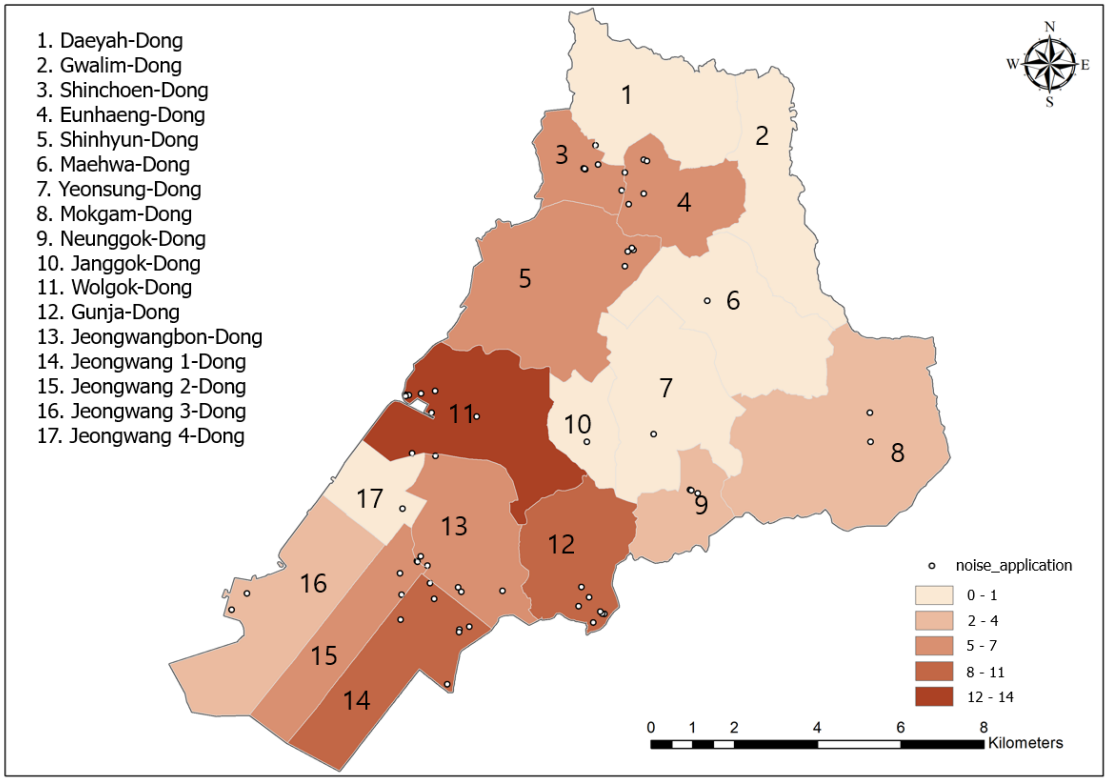

Figure 53. The regional noise complaints by application on smartphone.

The Wolgot Dong (region 11) has the highest application reporting rate (Figure 53), but not many reports of Makgam Dong (region 8), which had a high rate of reporting at nighttime phone calling and the Internet (Figure 52). On the other hand, Wolgot Dong recorded a low reporting rate on other channels.

In summary, Mokgam dong recorded the highest rate of overall reported frequencies, and Gwalim dong recorded the lowest reported rate. Compared with the annually noise distribution map in Chapter 5.3, the civil complaints on the Mokgam Dong increased from 2015 although the reporting rate was not high in 2014.

The Internet distribution map was similar to nighttime calling map on a channel-specific map in Mokgam Dong. Besides, when compared to daytime phones, night calls were reported more than twice as high. Therefore, it is not possible to conclude that the report was concentrated at nighttime since civil complaints in Mokgam Dong have been reported frequently during night hours since 2015, but Internet reporting is higher than those in other channels. Most of all, Mokgam dong is required to conduct closely crackdown at nighttime.

5.4.2. Stink issue as reporting channels

The frequency of complaints filed by each reporting channels on the stink was developed to the thematic maps. Stink is more climate-affected, unlike noise, and have a health impact on residents, it should be more required to manage locally and thoroughly. The stink reported by daytime phone calling was highest in Jeongwang 3 and 4 Dong (region 16,17), and Enhaeng Dong (region 4) and Shinhyun Dong (region 5) were the lowest. Most of the stink complaints has occurred in and around the national industrial complex (region 12, 13, 14, 15 and 16). The stink complaints within Yeonsung Dong (region 7) was caused by other causes because this region was location far from the national industrial complex (Figure 54).

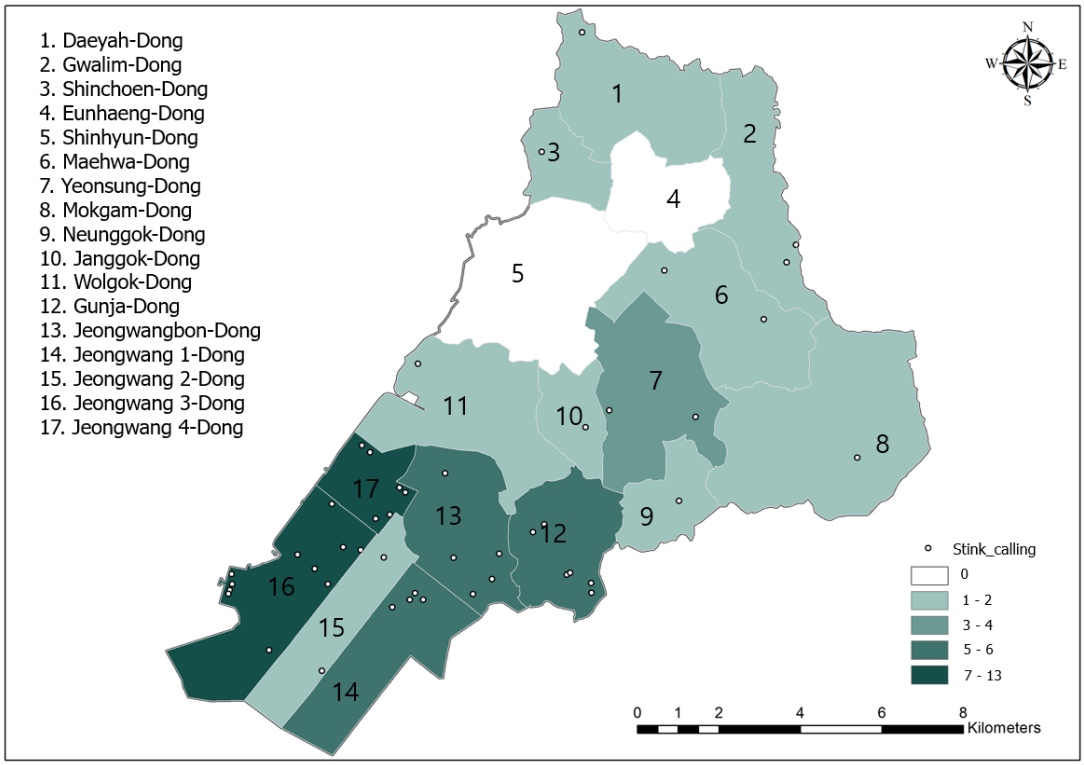

Figure 54. The regional stink complaints by daytime phone calling for 3 years

The number of the stink reported by nighttime phone calling was much higher than daytime, and was concentrated in and around the industrial park. There were 63 reports of stink reported in Jeongwang 1 Dong (region14) at nighttime. On the other hand, Yeonseong Dong (region 7), which had a bad smell during the day, had no nighttime reports. This means that the odour that occurs in Yeonseong Dong is not deeply related to the smell of the industrial park, and the area is also far from the industrial park (Figure 55).

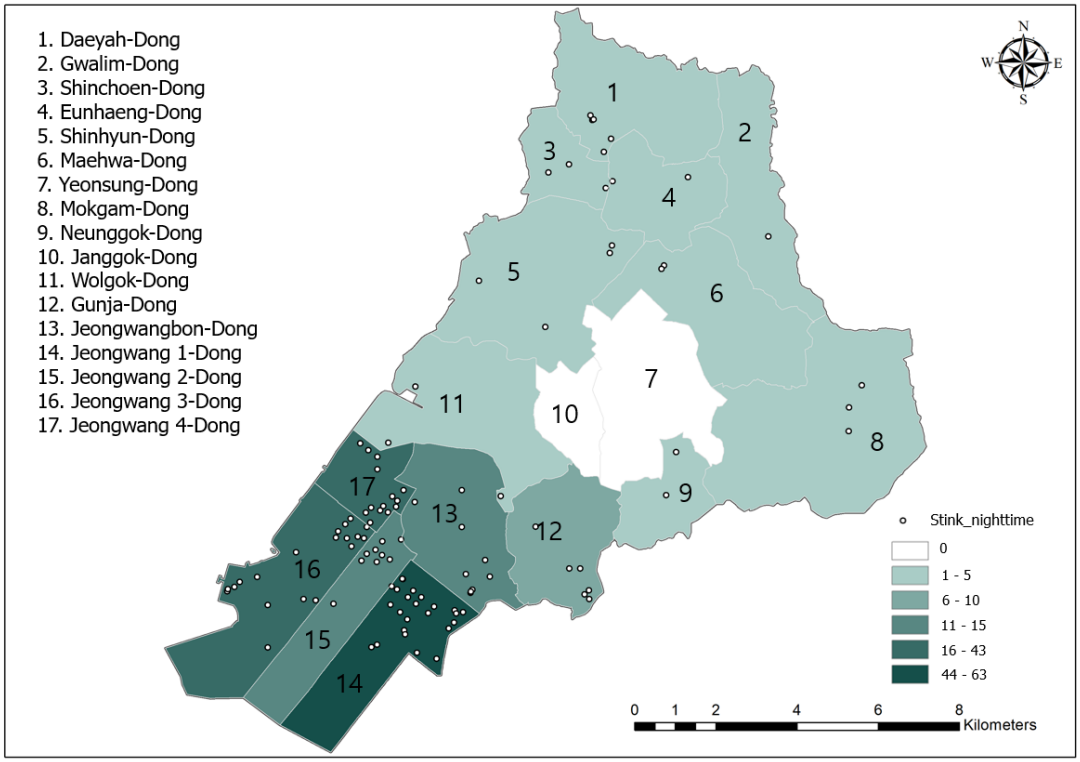

Figure 55. The regional stink complaints by nighttime phone calling for 3 years.

Stink complaints reported on the Internet were also mostly reported in and around the national industrial complex. The smell was most frequently reported in Jeongwang 3 Dong (region 16). Gwalim Dong (region 2) was also very far from the industrial complex,

so there is no deep connection with the stench of the national industrial complex (Figure 56).

Civil complaints reported by applications were also concentrated around the national industrial complex, and the highest number of complaints are included in Jeongwang 3 Dong (region 16). In particular, the region has 95 reported cases. There were also reports in Gwalim Dong (region 2) and Shincheon Dong (region 3), but the ratio is not high (Figure 57).

Unlike noise reports, the stink reports were concentrated in and around the national industrial complex. In addition, unreported areas exist, and the comparison of day and night calls shows that the stink only occur at certain times. In particular, 180 stink cases were reported in Jeongwang 3 Dong (region 16) online channels alone, requiring more precise analysis to investigate the cause.

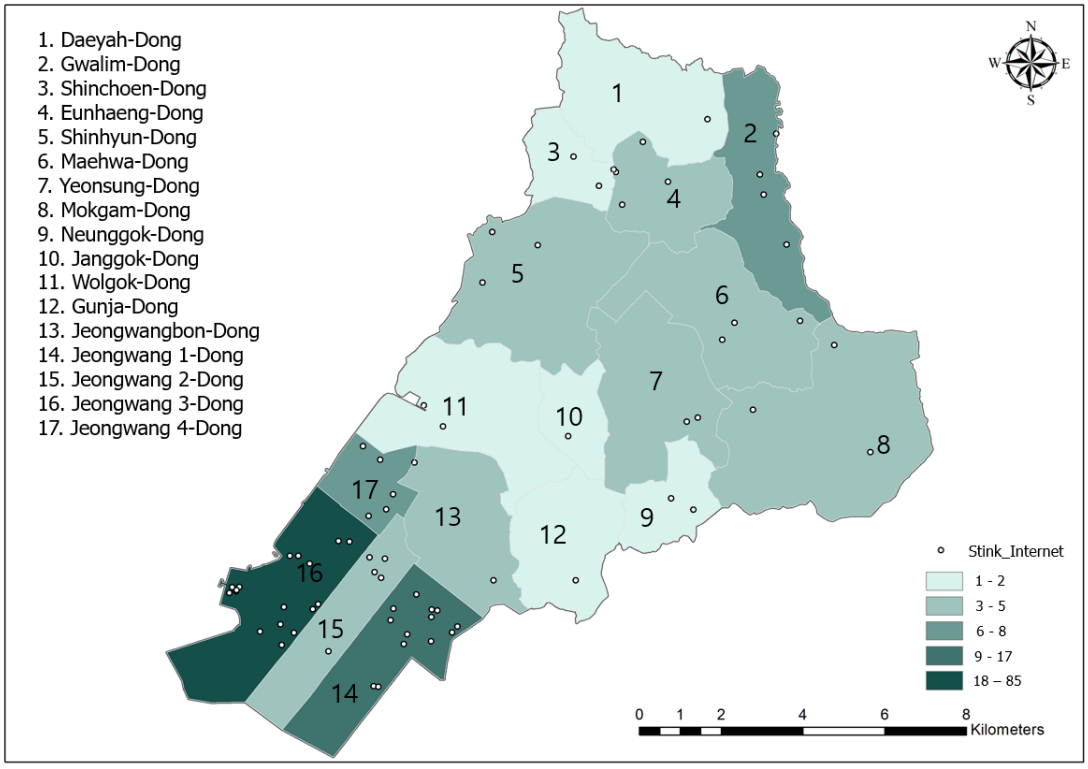

Figure 56. The regional stink complaints by the Internet for 3 years

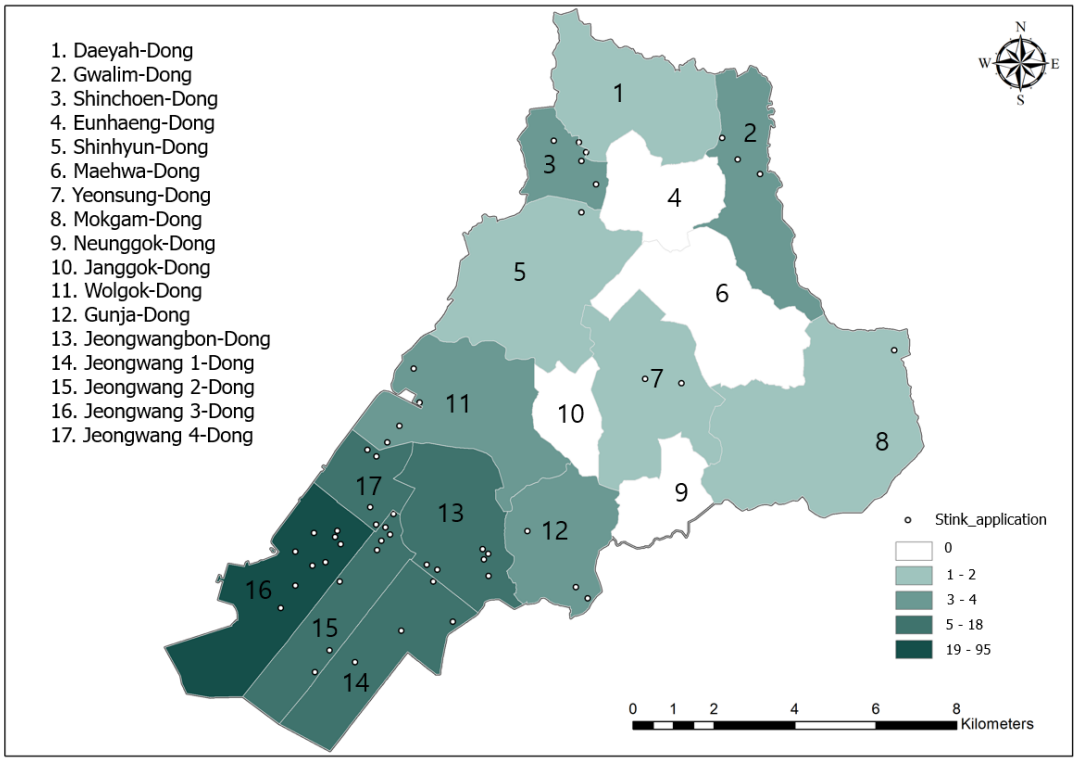

Figure 57. The regional stink complaints by the application for 3 years

5.5. Local issues mapping with the noise and stink complaints for three years

In this part, the most frequently reported areas were analyzed by integrating noise and stink, which were the most issued keywords from 2014 to 2016 in Shiheung city. Figure 58 described the occurrence frequency of the noise and stink for three years, which were the most prominent complaints in Shiheung city at least 21 cases occurred in each region up to 305. Most complaints are concentrated in the southern part where the national industrial complex was located, and in particular, there were 305 complaints in Jeongwang 3 Dong (region 16). This may be expected to extend the issues of the National Industrial complex to the surrounding areas. In the east, a considerable number of complaints have also occurred. The area is currently being constructed with the lifting of the development-restricted areas, but is expected to reduce after the construction is completed. In addition, Gwalim Dong (region 2) and Janggok Dong (region 10) have the least number of civil complaints. These areas are areas that are relatively low in population density and are less likely to generate civil complaints, but are under constant pressure to develop under urban development policies.

Figure 59 described the occurrence location of the noise and stink based on geographical information. This map enables to easily understand in the administrative region where civil complaints have occurred. It will help solve the problems, and prevent future complaints because it facilitates to understand the causes and location of related complaints beyond the administrative area.

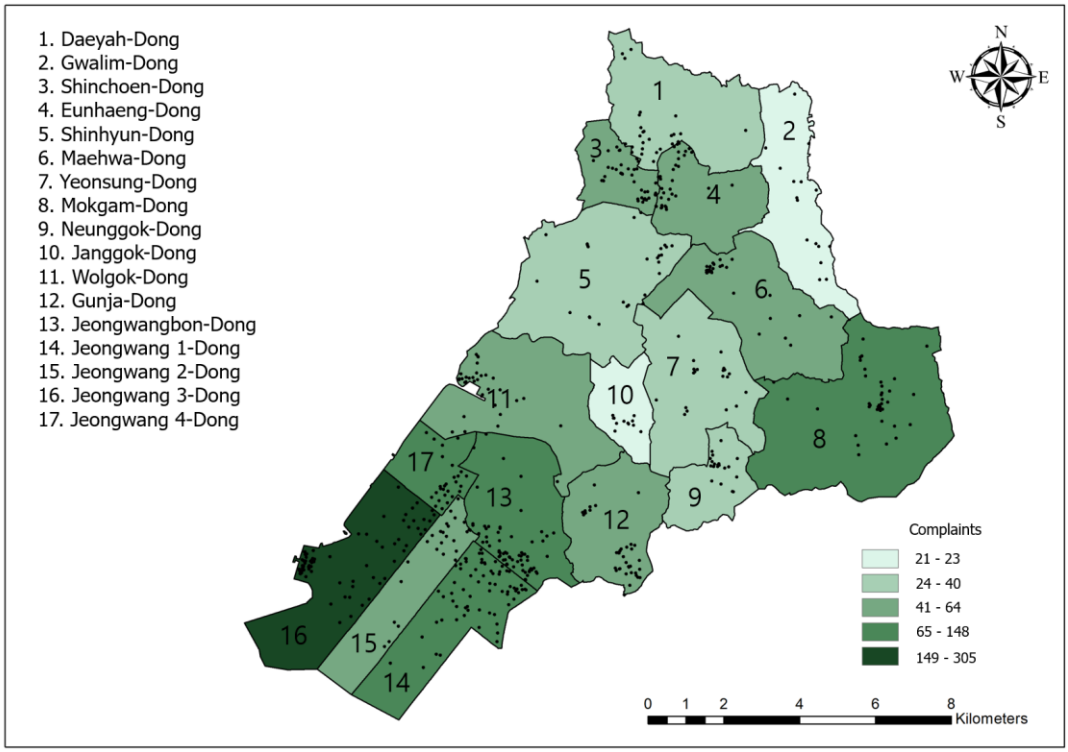

Figure 58. The noise and stink complaints in each administrative region.

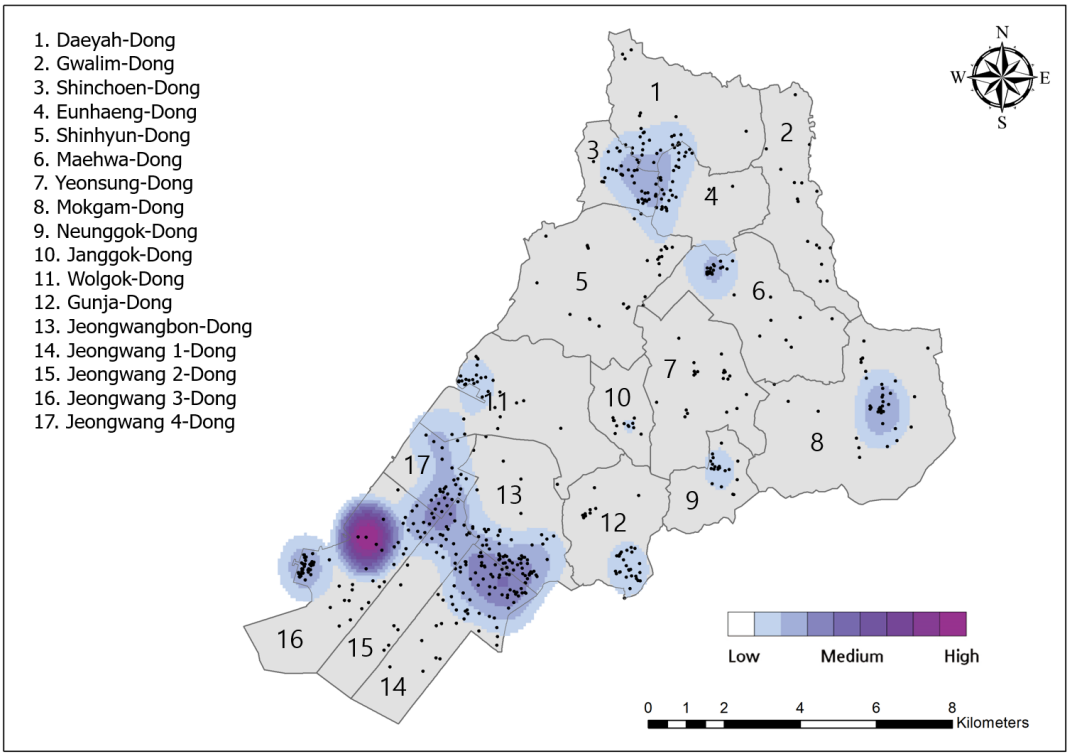

Figure 59. The distribution map of civil complaints for three years in the Shiheung city.

5.6. Nighttime and chronic issues

This part noted that nighttime phone calls had the highest reporting rates and that the words reported then were associated with a particular time: night-time and dawn. Night-time phone calls mean that a complaint was filed by telephone outside regular business hours—a complaint reported at nighttime or dawn. Night-time and dawn frequently appeared around the keywords for all three years, and were mentioned often in the content of actual complaints. It could be inferred that many problems occur at these times, so accordingly, many complaints were reported. This hypothesis is supported by the fact that the number of reports at nighttime is much higher than during the day. In this respect, based on civil complaints, some factories or companies in industrial complexes may be illegally discharging waste or gas, which was the cause of the smell at night-time or dawn. In the past 20 years, stink complaints have intensified every year, and these complaints continue to increase. In 2018, local governments launched a civil environmental watchdog initiative based on citizens to ensure monitoring and crackdown. Further scientific analysis is required as the initiatives included normal non-expert with subjectively assessing the stink.

The large-scale residential area behind the industrial complex in the southern region poses a social problem. Because this residential area is only 200 m away from the industrial complex, it is easily exposed to noise and smell, as frequently reported in civil complaints. After the construction of the complex as part of the industrial city plan, this residential area was built for workers, but the construction of residential areas near the complex was initially deemed inappropriate.

Chronic problems such as noise and smell are difficult to respond to immediately. The speed with which complaints are addressed varies depending on reporting channels, but the transfer process takes time if the complaint is filed elsewhere than with the local government. Each local government attempts to speed up the processing of civil complaints by granting incentives to officials or notifying officials a few days before the expiration of the processing period limitation. The local governments should regularly analyze the handling status of local civil complaints and predict future civil problems. This process contributes to solving the fundamental cause of the complaint, and is not temporary problem solving that is likely to cause the recurrence of complaints.

5.7. Comparison with another civil complaint research

So far, not many studies on civil complaints have been published. We discussed process improvements and the applicability of civil complaints by comparing our study with a recently published paper about civil complaints.

Hong et al., (2019) studied crowdsourced big data based on noise complaints from the 311 system, which is the full-time non-emergency telephone services and online platform, in Vancouver, British Columbia, Canada. The utilized 311 data were classified as either "noise complaint case" or "general noise inquiry case" from 2011 to 2016, and were compared with the location and geographic information of noise. More detailed analyses of the possibilities of bias in the data, such as superuser, confirmed that the data was not affected by a small number of specific variables. They found that noise is associated with constriction activities, which are part of urban development. In particular, construction activities hinder the sleep of residents, reflected in the large number of after-hours complaints compared to those during regular hours. The results of the mapping were strongly related to construction and noise in similar locations. Finally, the authors suggested that crowdsourcing based on civil complaints in an open government framework with smart cities can contribute to local and national interests.

Firstly, considering the similarity between the two studies, both identified the value of civil complaints. The data are based on information generated by citizens' voluntary participation, such as online-based crowdsourcing and big data, and offline data gathered by telephone and direct visits. Secondly, visualized the analyzed data on maps is to identify realistic locations of civil complaints. These annual maps provide an understanding of

where occur to these complaints throughout the city. Thirdly, both studies confirmed that civil complaints are strongly related to night-time (night-time and dawn in our case, after-hours in the other study case). Finally, this process suggested that the civil complaints analysis contributes to government and urban policy in smart cities.

There are differences in the studies as well. The approximate work flow is similar in both studies, but the methods are different. In our study, data were analyzed and verified using a high centrality of keywords analysis, whereas the other case applied covariate analysis on the basis of demographics (Figure 60). In addition, in the process of mapping, we used the geographical information of each keyword; however, the other study completed a comparison by reflecting the locations of the complaint occurrences and the construction locations.

In conclusion, this study facilitates understanding the issues experienced by citizens throughout the entire city area, whereas the other study is more useful for concentrating on one issue and analyzing it closely. It is expected that our study process will realistically and clearly help with future applications to statistics or demographics.

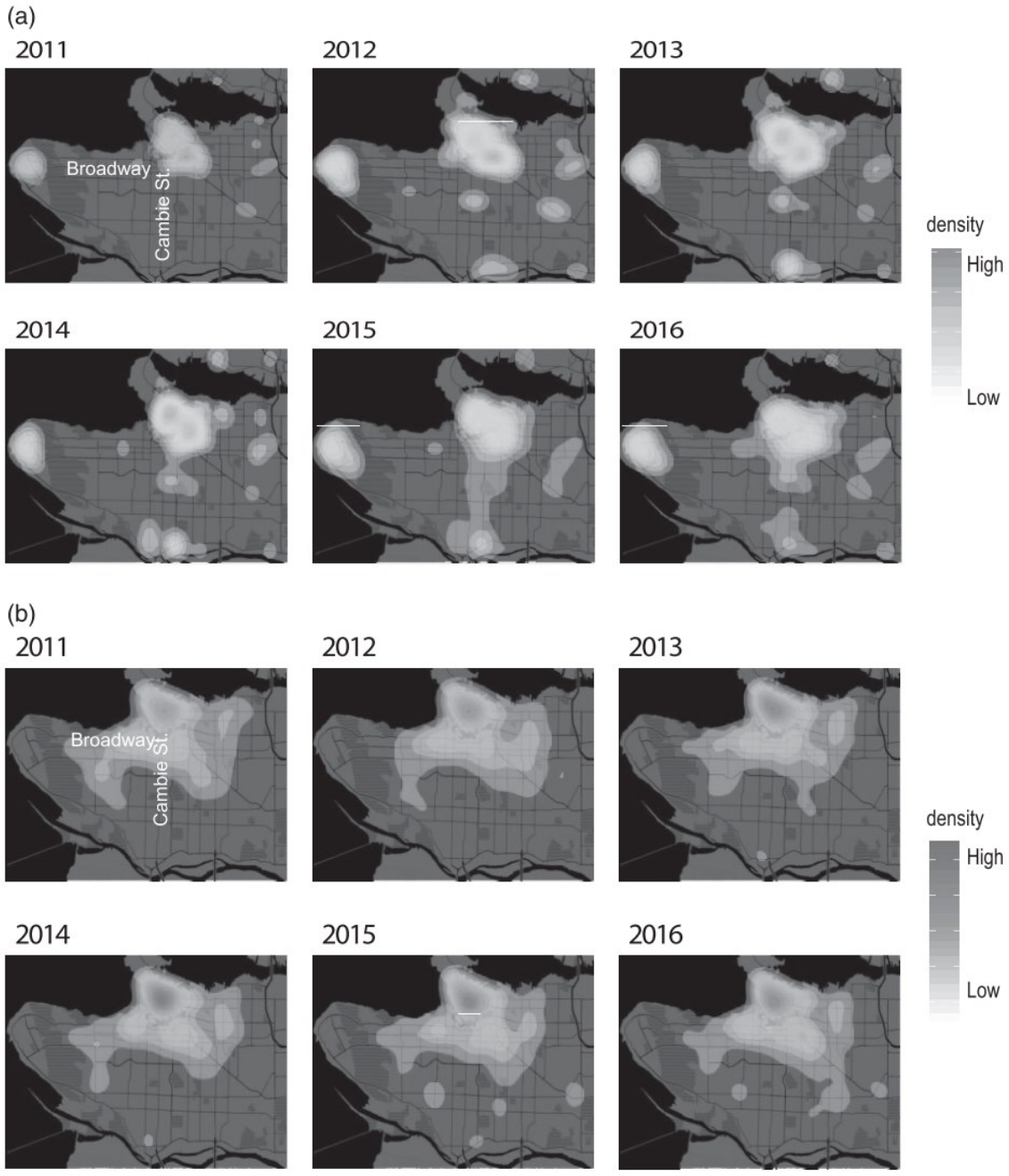

Figure 60. The Noise map applied covariate analysis
(a: Spatiotemporal patterns of construction point, b: Noise complaints)

Source: Hong et al., (2019), Noise and the city: Leveraging crowdsourced big data to examine the spatio-temporal relationship between urban development and noise annoyance, Figure 1.

Chapter 6. Discussion

City planning in Shiheung is being implemented by smart cities and government version 3.0. These two policies emphasize the analysis and utilization of field data and the active participation of citizens. Therefore, the study explains how civil petitions analysis can be reflected in the two policies. Site-centric data can build policy support maps and can accumulate more on-site information through improved civil service. The active engagement of citizens is the most important part of smart governance. Therefore, it is emphasized that the analysis of complaints is necessary for a smart city that is exciting (Figure 61).

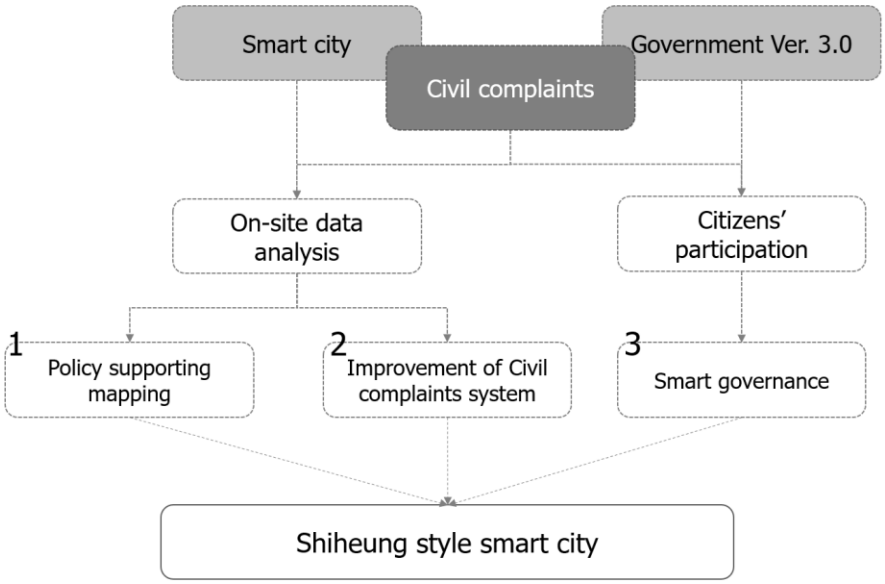

Figure 61. Government and smart city policy have been implemented for study area

6.1. Policy support mapping

This part considered the analysis of onsite-based civil complaints data created and usability of their maps in this study to real-world policies. Since the implementation of the government Ver. 3.0 policy, Korea government has emphasized a data-driven society, active civic engagement and smart governance. In addition to scientific data, the data produced by citizens, such as the political and social, can be said to be provided by citizens, and the data produced by citizens can be valuable. In response, the government is also listening to opinions and advice voluntarily offered by citizens.

The recent paradigm of smart concepts has led to the development of data and information environments across society. Publicizing, sharing and communicating administrative and policy information to citizens is being emphasized, and a variety of civic policy participation channels such as citizen policy proposals and data-based policy offerings are increasing (Min et al, 2019a). Accordingly, the government collects, analyzes and reflects data on policies to satisfy citizens. In particular, 36.1% of the results of the civil complaints analysis were reflected in improvements to the policy system by analyzing 2 million civil complaints cases per year (ACCRC, 2018). The government is trying to communicate with citizens by encouraging them to participate in policy creation and change through various channels. In fact, as a benefit of ICT (Information Communication and Technologies), the amount and quality of data that can be reflected in policies through big data, IoT (Internet of Things) and public data are improving and generating real-time (Andrienko et al, 2013).

In other countries, policy support mapping is also produced for various classes, including international organizations, policymakers, researchers and citizens, but it is often used as an indicator to evaluate the achievement of a specific policy (Sokol and Fischer, 2015; Ward, 2015). Thus, professionalism has been given to policy guidance, which limits citizens' understanding.

In united states, the PolicyMap offers easy-to-use online mapping with data on demographics, real estate, health, jobs and more in communities across the United States. From the classroom to the boardroom, thousands of organizations trust PolicyMap to find the right data for their research, market studies, business planning, site selection, grant applications and impact analysis. In addition, users have the advantaged of uploading the desired data set with the data served in the policy map (Figure 62).

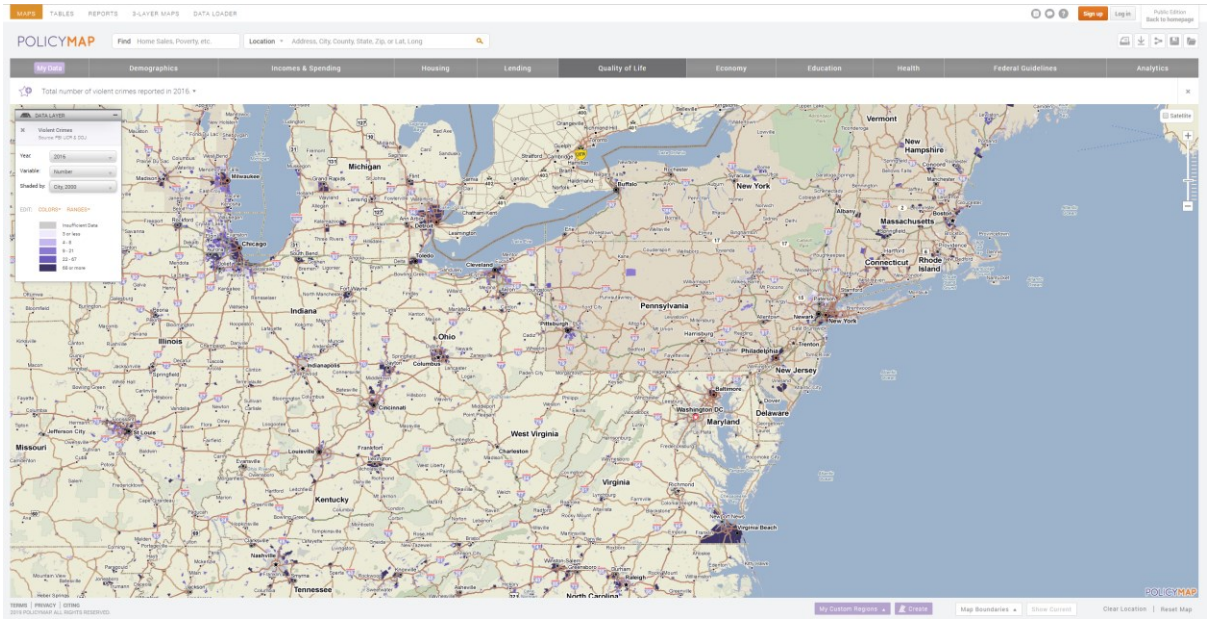

Figure 62. The number of violent crimes reported in 2016 on PolicyMap.
Source: www.policymap.com/maps

The government of Maryland, United States, has provided iMap services to integrated public data into local universities, public institutions, and local government. The iMap service is useful when policy-makers and local residents want to monitor the statues of their regions in real-time and identify the progress of regional development projects in achieving performance (Figure 63). Neighborhood Nexus is a regional information system that provides detailed neighborhood indicators for Atlanta and its adjacent areas as an interactive map service. It combines administrative data, regional and social survey data to provide detailed spatial units with indicators such as the number of emergency 911 calls by population statistics, event type, number of criminal acts, and education and achievement level. Major target users include regional policy officials, NGOs, and residents (Figure 64) (Hwang et al., 2015).

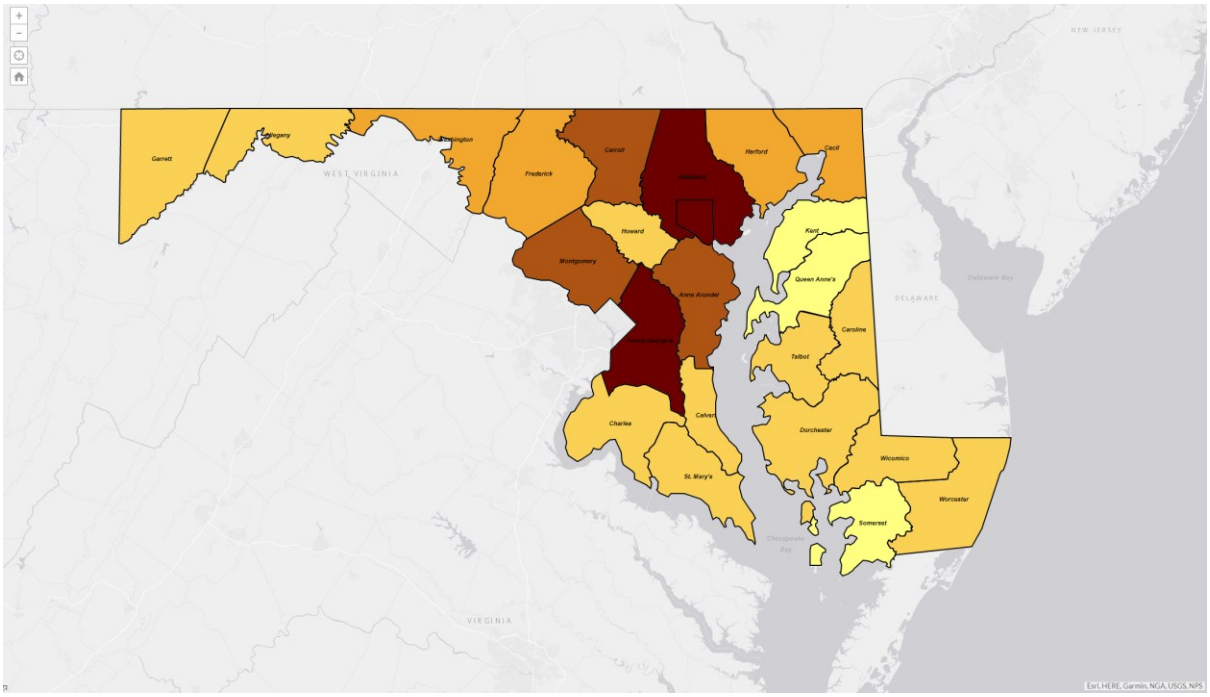

Figure 63. Carbon monoxide related emergency department visits (2000~2009) on iMap.
Source: maps.health.maryland.gov

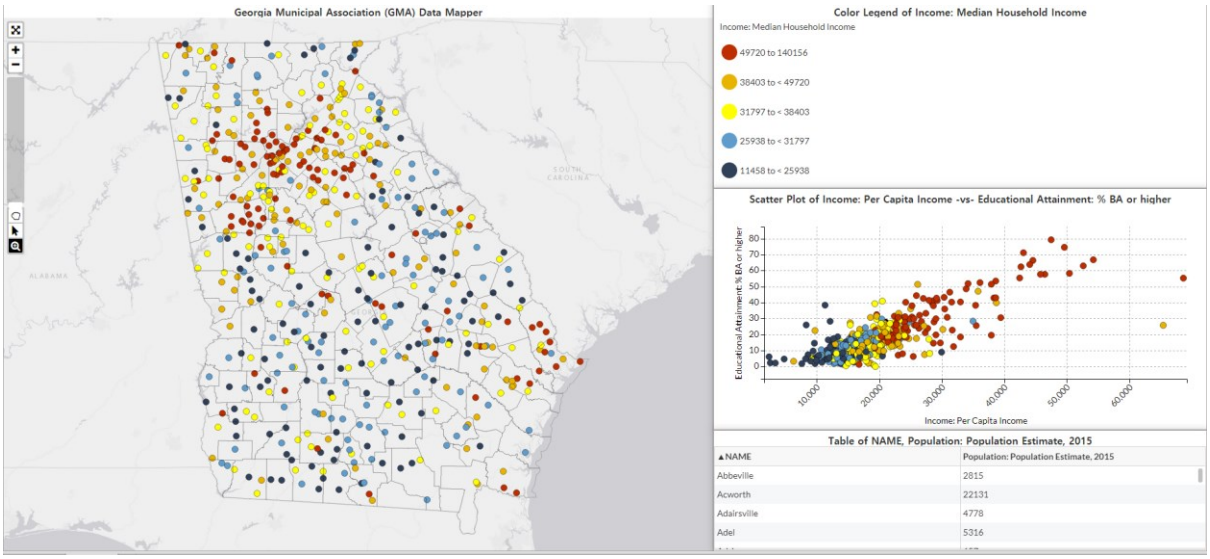

Figure 64. The ongoing projects by Georgia Municipal Association on Neighborhood Nexus. Source: neighborhoodnexus.org/maps-and-data/maps/georgia-cities/

The 311 website of New York city website has implemented a system that allows citizens to file complaints based on their zip code on the Web. Civil complaints written by the web format are Web-mapped in real time, and officials in charge go through the process of resolving registered complaints. Since the place of origin of civil complaints is automatically registered based on the postal code, the time for processing complaints can be saved (Figure 65).

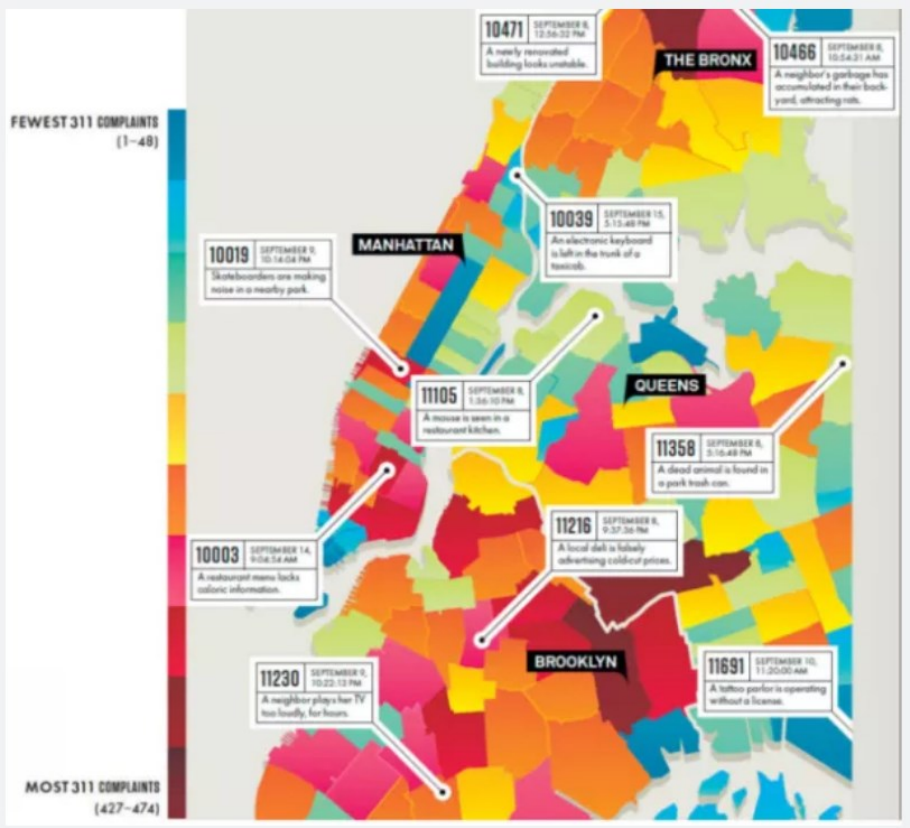

Figure 65. The New York 311 complaints system
Source: studentwork.prattsi.org/infovis/visualization/lab4-mapping-nyc-311-complaint-data/

After reviewing several examples, the civil information covered by the data in this study identified the potential for policy utilization. However, it has not been long since South Korea recognized civil complaints as data and studied them. If the information is handled as a policy guide, citizens will feel that their opinions are reflected in the policy. If the policy information implemented by local governments or national governments is shared with the mapping reflected in their information, the communication with citizens will increase and contribute to version 3.0 and also the smart city policy.

6.2. Relationship analysis between words

6.2.1. Improvement of current system

As Chapter 2 and 4 described, this part suggested to improve the two type of civil complaints management system; One was the improvement of the current system, and the other was the establishment of the new system.

The biggest drawback of current system is that various agencies received civil complaints by citizens, but only local governments actually deal with them. Moreover, the current system takes a lot of time to process civil complaints due to the lack of specialized department and expertise. Therefore, this system should be necessary to prevent overlapping complaints, reduce the process time of them, and cooperate between department within city hall (Figure 65).

Phone calling complaints are diverse in reporting channels to local government departments, local government call centers, Provincial call centers and national call centers, which can cause confusion among citizens. In addition, each department that manages reported complaints has different processing speed, and it is difficult to identify itself until it receives notification of the processes and results of handling citizens.

This study proposes an integrated management system that can be reported by a single phone number. When citizens report complaints, they are automatically linked to call centers of a local administrative agency that manage the location of the calls. If the scale and conditions of the complaints exceed those of the local governments, they shall be transferred to the upper government. However, once received and records of the integrated management system are stored, citizens can understand how their complaints are handled.

At nighttime, all telephone complaints respond to civil applications from the integrated management system.

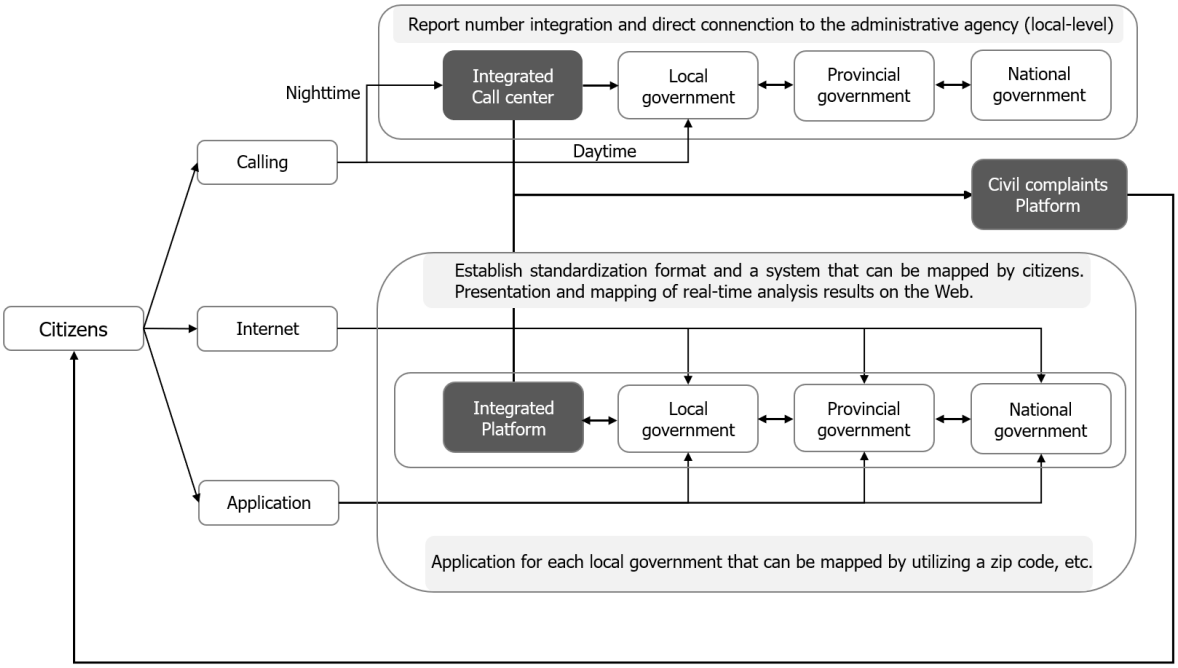

Figure 66. Improvement of the integrated civil complaints management system.

In the case of the Internet, an integrated platform is proposed. This is because cooperation between agencies may be required depending on the size and content of the complaints. Standardized forms are needed to report complaints on the web pages of the local, provincial and national government. The reporter can write the contents freely compared to other reports channels, but the person in charge may misunderstand the content or the occurrence location. In fact, if the reporter does not know the exact address, it will also be necessary to establish a mapping service that can be directly mapped by the

reporter. Standardized forms and mapping services will be stored as data for the integrated platform, which will greatly assist in real-time civil complaints analysis and mapping. When the processing of civil complaints is delayed or limited, data can be shared on an integrated platform with higher departments or related departments and can cooperate with each other.

Reporting applications should also be managed by integrated platforms, such as the Internet. Compared to other reports channels, it is not free from formatting, but they are free of time or place when complaints are reported by citizens. At any time, they can check the processing process and the results of the complaints they reported. The GPS is automatically set up and the address is entered, but if an error occurs, the person in charge may misunderstand the occurrence location of the complaint. Therefore, application reporting will also require supplementation of location information. The means of using the postal code system is also a good way. Also, photos and videos can be uploaded, which is a useful channel for government staff to check for problems. However, continuous application management is required to match frequently updated smartphone software.

All reported complaints shall be recorded in detail from report to process, and it should be shared to related department and citizens. Civil complaints reported offline and online are operated by the integrated civil complaints management system as data, and management is done by the national government. Eventually, local governments and provincial-level agencies will have to work hard on civil service records and management, and national governments will have to closely analyze the results and reflect them in their national policies for citizens. By analyzing the integrated system, if future civil issues and chronic complaints and their locations are analyzed, they will contribute to the promotion

of urban services. Also, if the results are made public to everyone via the website or application in real time, it will serve the purpose of the government Ver. 3.0 implemented by the South Korean government and smart city policy of Shiheung city.

The suggested improvement of the current system can save time and money compared to building a new system, and will be effectively utilized in the filing and mapping of civil complaints regarding the various reporting channels.

6.2.2. Suggestion of new integrated system

The improvement to the current system proposed in Chapter 6.2.2. may be effective in regional management, but are considered to lack links between local and national government. To overcome these limitations, a new platform will be required such as New York 311 system.

Currently, Shiheung city is running the Saeul E-civil complaints system, but it does not have much effect. The Korean government launched to the big data civil complaints management system in 2019. The integrated platform of the two civil complaints systems will contribute to solving existing problems (Figure 66).

Civil complaints reported by various channels as integrated platforms are automatically registered and transmitted to systems in the country and region according to the content and scope of civil petitions. The platform registers a full-time process of civil complaints, and the analyzed results are disclosed in the integrated platform website. Thus, the integrated platform manages civil complaints across the country, and citizens can identify their own complaints processes. Part of the result is reflected in national and local policies.

Civil complaints were transferred from the integrated platform will be assigned to the relevant ministries and departments regarding their nature. In the process, a person in charge can access the integrated platform in real-time and enter the progress. Local-level complaints transferred to the local government and the relevant departments, and the processing process of complaints can be completed on the integrated platform. Therefore,

all complaints and processing processes can be accessed by both the citizens and the administrator.

The greatest feature of this system is the dichotomy of the management and processing system of the civil complaints. Through this process, the management department can focus on citizens' voices by analyzing real-time complaints to applicating on policies, and the processing department can focus on solving complaints only, thereby reducing the burden of other tasks.

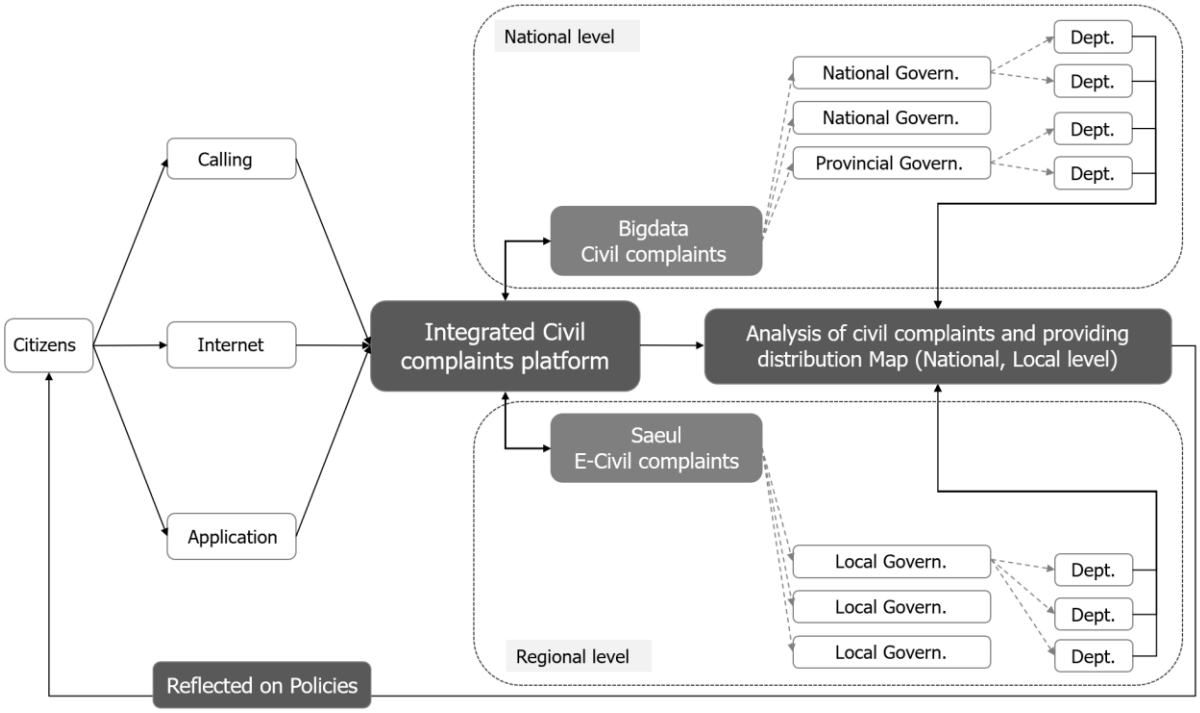

Figure 67. Suggestion the integrated between national and local civil complaints management system.

6.3. Smart governance

6.3.1. The role of Smart governance

The Shiheung city has been selected as a pilot city for smart cities and is currently implementing various projects. Shiheung City plans to establish an integrated urban information management system to solve urban problems such as traffic and safety, and applicate various living lab centered on smart governance for citizens to participate in energy and environment fields.

The participation of citizens and participatory urban structure have been important in the history of urban planning and has been discussed as a universally meaningful subject. Deakin (2014) argued that the most important virtue of smart city is to transform the urban government-led policy-making process into civil-led policy-making. He emphasized the active involvement of citizens in the practice of social equality and environment justice in cities by using such methods as advisory groups, discussion sessions, civil participation budgets and civil complaints. The participation and discussion of various stakeholders is known to have the effect of spreading the public cutback on the final decision and promoting a sense of responsibility. Hollands (2008) argued that smart cities should start with human capital, and technologies would only help them. Nam and Pardo (2011) mentioned theologies and citizens as the most important components of the smart city and emphasized the importance of the cooperative system as a governance operating system. Kitchin (2014) argued that smart cities are to use smart technology to create a system that can more actively embrace the needs of citizens, and smart governance should attract

citizens to more governmental policymaking processes. These arguments are complex networks where smart cities are based on high-tech devices, but they are important as a space for citizen's daily life. Although technologies are backed by capital are likely to be introduced at any time, it will be difficult to improve the fundamental quality of life of citizens and change the urban environment when the governance and cooperation system based on citizens is not viable or inoperable (Cho et al, 2018). Therefore, the smart governance based on citizens is considered in smart city policy.

6.3.2. Smart governance in Shiheung city

As many studies argued, smart governance is a key to managing smart cities. The joint goals, participation and cooperation of governments, companies and citizens play a big role in overall smart city management.

The goal of smart governance in Shiheung city is to build and share data, and the analyzed data is reflected in the policy. Citizens, private companies and the government will have to do their part to build an integrated data platform.

Barcelona in Spain was recently introduced at “The Web Conference 2018 held on April 23-27, 2018 at Lyon, France” by developing a platform that integrated data source within the city and its utilization. The platform service provides users the desired information on the web. The data used is based on public open data such as buildings from ASIA (Aplicatiu de Sistemes Integrats d’Atenció), Bike sharing data from ODI (open data Infrastructure) by city council, Sensors data from Sentilo (IoT sensor platform), CityOS which provides currently development stage of the city and Citizens’ complaints by city council. Among them, Civil complaints mapping system named IRIS (Incidències, Reclamacions i Suggeriments) used by the “citizen relation system” where all demands and requirements are stored and classified according to a predefined ontology. In addition, some external data sources of private cooperates is involving in integrated data platform such as sensor data from the SmartCitizen platform and Airbnb scarped data from InsideAirbnb. What's notable in this regard is that citizens, businesses and governments are all involved in building integrated data (Bass et al, 2018).

IRIS system is leveraging the described functionalities and data sources, users can create the widget shown below by geographically aggregating noise sensor measurements, as an example. In this way, users can quantify the average noise level by district during a given time interval and identify the city areas more affected by noise pollution (Marras and Laniado, 2018) (Figure 68).

Figure 68. Explore temporal noise patterns on IRIS system.
Source: https://decodeproject.eu/

Users can also compare and visualize more data sources within the same widget, representing them in diverse layers and with diverse visual models. For instance, the widget below shows noise levels from SmartCitizen platform and noise complaints distribution from IRIS system (Bass et al, 2018) (Figure 69).

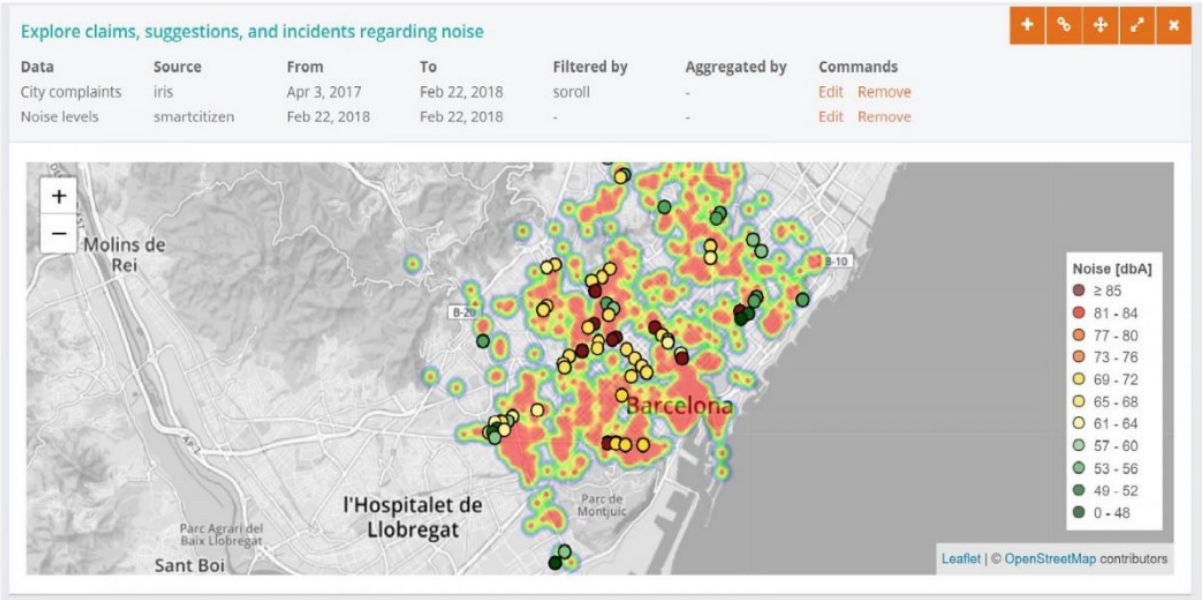

Figure 69. Comparing civil complaints(density on background) and sensor data(point) about noise map. Source: https://decodeproject.eu/

The Shiheung city also emphasized “Living Lab.” in promoting smart city policy. The living lab is an R&D (Research and Development) mythology to effectively carry out social solving problems citizens-led. This involves citizens and stakeholders in the whole process; discovering problems, exploring alternatives and experimenting and demonstrating. The living lab, unlike the research group such as volunteer and hobby club, can propose research result to policies such as improvement of the legal system, service implementation, practical use and public procurement as well as technological alternatives. In addition, this is currently being applied as a new open and public participatory innovation model involving civil society-industry-academic cooperation to solving the regional problems in the smart city. Therefore, the role of Living Lab is increasing even more because, above all, citizens are required to participate in policies in a smart society.

The living labs are important in smart cities because they study the space where citizens actually live. For example, living labs for civil complaints will be able to process the complainants more accurately and quickly in the process of complaints and will provide citizens with a high level of satisfaction in resolving complaints. It will be possible to solve the problem with a professional researcher in civil complaints requiring chronic and scientific knowledge such as the stink complaints (Chapter 5.5). Therefore, living labs for civil complaints will have a positive effect, composed of processing staff (civil servants), experts (business and research institutes) and citizens. In addition, the living labs are considered as the smallest unit of the smart governance.

However, the living map can have limitations in which the effects may be different depending on the participants' will and their knowledge. Local government should continuously provide education and lecture for citizens who are willing to participate.

Shiheung city will continue to encourage living labs the successful goals of the smart city policy, and should establish programs and support systems for them.

To achieve the goals of smart governance more comprehensively, the fulfillment of each role is required by citizens, local government and business corporations (Figure 70). Citizens are required to participate in public hearings, lectures, and various education programs which the local government or companies are being provided. Complaints or improvements in the living environment can be requested from the government through civil complaints, and their ideas can be proposed as policies. They can also provide feedback or on products from companies that are developing smart technologies. Citizens are required to actively participate in the development of the region where they live.

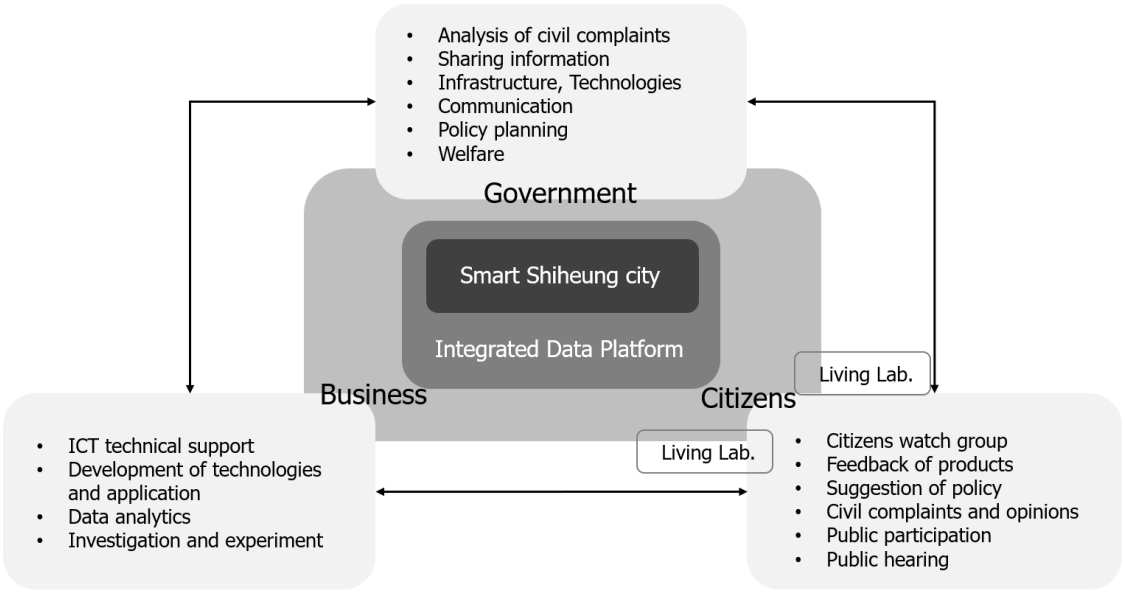

Figure 70. The smart governance of the Shiheung city.

Private companies have more expertise than citizens and governments in terms of technology. Therefore, the companies will have to provide various technical support and technology development to the governance. In line with policies implemented or planned, the government should contribute to solving problems by developing technologies, analyzing data, investigating and experimenting with them. The government will have to enact policies for citizens and private companies to support and encourage. The opinions of citizens and entrepreneurs should be carefully reviewed and implemented in policy. In the case of complaints that require a chronic or scientific interpretation, a private enterprise may be requested and resolved together.

Chapter 7. Conclusion

As cities grow, various challenges develop. Good urban development planning contributes to an improvement in the city image by providing higher-quality urban services to citizens; poor urban management policy increases complaints by citizens and environmental problems resulting from development. Urban planning requires the active participation of the citizens, and city managers should listen to their opinions to identify any problems.

Advances in technology have enabled citizens to participate in policy development and change and allowing participants to occur faster and more conveniently. Citizens can express their dissatisfaction through various means, both online and offline, to communicate ideas to local governments about urban development and management. A systemic analysis plays important roles in urban policy as citizens' complaints are continuously generated every day.

The smart city has been regarded as an ideal city for solving the challenges that have arisen in various fields, such as the environment, energy, and transportation, within existing cities. However, many scholars and papers have questioned the difference between a smart city and a sustainable city, the latter of which many cities in the world have been pursuing. In order to introduce the concept of a smart city, various questions around the

challenges to be reconciled have first been addressed as an agenda in international society. This is a result of the unclear definition and concept of the smart city, and it is necessary to grasp and understand the flow of research that has been carried out so far, because the smart city is related to various urban elements.

Smart cities, which have been heavily researched for conceptual introduction in the past, are increasingly being studied in terms of sustainable urban planning. In particular, with advanced ICT, much research is being carried out on the utilization aspects of big data. However, because the research fields of the smart city concept are wide and diverse, it requires governance based on communication and cooperation of citizens, governments, stakeholders and private companies. All must think together to promote higher urban services, and should work hard to apply smart concepts that are appropriate for each city.

The Shiheung city, designated as a national pilot smart city in 2018, emphasizes citizen participation and on-site data created in the city planning. In the meantime, citizens participated in the policy through civil complaints regarding the problems and improvements of the cities in which they live. Therefore, this study explored the complaints that the citizens voluntarily filed in the field.

The data used in the analysis are based on three years of civil complaints received both offline and online. This study identified the keywords in the complaints for each year using semantic network analysis to extract nouns from the data and analyzed the words associated with the issues. Based on the geographical information of the keywords, thematic maps were established to understand the spatial distribution of the issues. By understanding the areas where the issues were concentrated, we identified temporary and

continuous issues. The particular time and location of the chronic problems were discovered.

Noise and stink were identified as the main keywords for the social issues based on the distribution map of the issues. Most of the complaints were filed in and around residential areas. In 2014, the noise was associated with living noise and construction, and in 2016, it was strongly related to a large-scale construction area. In 2015, the stink was identified that was associated with an industrial complex, and particularly in one area. At that time, the plan for the extension of the factory within the area ceased for a while, but the dispute has not yet been resolved.

Viewed from each network and distribution map, the noise that affects those living in the northern part of the city decreased, the construction noise increased in the eastern part, and smells continued to cause complaints in the southern part. In addition, we confirmed that stink cases at night-time and dawn were associated with stink cases in residential areas around industrial complexes. This result means more crackdowns and thorough management are required in these industries, as it might be illegal for factories to operate after civil servants or managers have left the office, or after certain hours. This study confirmed the civil complaints and the high rate of reporting at nighttime and dawn, but this requires more scrutiny.

This research suggested a new complaints system process to overcome the problems of duplicate complaint handling and resolution process. We emphasized the necessity of a data platform in which countries and regions are linked and shared in the smart society, introduced the policy support mapping, and the smart governance that is centered on the living lab.

This study suggests that the analysis of civil complaints can help improve city management. Thus, Shiheung city the smart city with particular characteristics and civil complaints based on the on-site and citizens' participation, will contribute to analyzing and understanding the Shiheung city. The distribution map analyzed by month and year will be used as basic data in the policy decision-making process, and citizens will more easily understand the areas where they live. An integrated civil complaints system shared with national and local-level data is required to analyze complaints periodically to effectively reflect in policies. In doing so, civil complaints will be integrated and managed in detailed. In addition, Shiheung city is actively encouraging Living Lab group, citizens study local issues and suggest their solutions themselves, as the smallest unit of smart governance. Living Labs will contribute to giving opportunities for policy participation to private companies and other stakeholders

Urban policies addressed by including communication with citizens and enterprises will be more successful than government-led policies.

This study is meaningful in confirming that civil complaints can be used as data in the Korean government version 3.0 and smart city planning in Shiheung City. In addition, it is differentiated from previous research such as complaints distribution map of regional level through keyword network analysis and proposal of an integrated data platform of country and region.

The limitations of our study are that, firstly, it does not contain data that have been scientifically investigated, such as noise and smell levels, in the analysis of the issues. That is, the subjective experiences of problems are different based on the individual. Secondly, analysis based on occurrence time is also insufficient because complaints filed by Internet

bulletin signboards and applications on smartphones do not verify a reported time, and occurrence time might be inconsistent with reported time. For example, a problem that occurred at night-time might be reported next day. Finally, not all citizens file complaints in the city, nor are the complaints representative of the complaints of all citizens. Nevertheless, the number of civil complaints is continuously increasing, and citizens demand that their complaints be addressed and resolved. These complaints are not representative of all the issues that occur within the city, but civil complaints might be considered typical samples that can be used to improve the flow of urban services or planning for citizens.

References

Abilhoa, W.D.; De Castro, L.N. A keyword extraction method from twitter messages represented as graphs. Appl. Math. Comput. 2014, 240, 308–325.

Ahvenniemi, H.; Huovila, A.; Pinto-Seppä, I.; Airaksinen, M. What are the differences between sustainable and smart cities? Cities 2017, 60, 234–245.

Albino, V.; Berardi, U.; Dangelico, R.M. Smart cities: Definitions, dimensions, performance, and initiatives. J. Urban Technol. 2015, 22, 3–21.

Allam, Z.; Newman, P. Redefining the Smart City: Culture, Metabolism and Governance. Smart Cities 2018, 1, 4–25.

Andersson, E. Urban Landscapes and Sustainable Cities. Ecol. Soc. 2006, 11, 34.

Andrade Guerra, J.B.S.O.; Ribeiro, J.M.P.; Fernandex, F.; Bailey, C.; Barbosa, B.S.; Neiva, S.S. The adoption of strategies for sustainable cities: A comparative study between Newcastle and Florianópolis focused on urban mobility. J. Clean. Prod. 2015, 113, 681–694.

Andrienko, N.; Andrienko, G.; Bosch, H.; Ertl, T.; Fuches, G.; Jankowski, P.; Thom, D. Thematic Patterns in Georeferenced Tweets Through Space-Time Visual Analytics. Computing in Science & Engineering 2013, 15(3), 72-82.

Angelidou, M. Smart city policies: A spatial approach. Cities 2014, 41, S3–S11.

Anti-Corruption and Civil Rights Commission (ACCRC). The Business Report in 2018: Anti-Corruption and Civil Rights Commission; Anti-Corruption and Civil Rights Commission: Sejong special self-governing city, Korea, 2018; pp. 1–51. (In Korean)

Anti-Corruption and Civil Rights Commission (ACCRC). Big data civil complaints webpage (accessed on 22 July 2019), bigdata.epeople.go.kr/

Alawadhi, S.; Aldama-Nalda, A.; Chourabi, H.; Gil-Garcia, J.R.; Leung, S.; Mellouli, S.; Nam, T.; Pardo, T.A.; Scholl, H.J.; Walker, S. Building Understanding of Smart City Initiatives. In Proceedings of the 11th IFIP WG 8.5 International Conference,

EGOV 2012, Kristiansand, Norway, 3–6 September 2012; Scholl, H.J., Janssen, M., Wimmer, M.A., Moe, C.E., Flak, L.S., Eds.; Springer: Berlin/Heidelberg, Germany, 2012; pp. 40–53.

Alizadeh, T. An investigation of IBM's Smarter Cites Challenge: What do participating cities want? Cities2017, 63, 70–80.

Alkhamisi, A.O.; Monowar, M.M. Rise of Augmented Reality: Current and Future Application Areas. Int. J. Internet Distrib. Syst. 2013, 1, 25–34.

Arroub, A.; Zahi, B.; Sabir, E.; Sadik, M. A literature review on Smart Cities: Paradigms, opportunities and open problems. In Proceedings of the 2016 International Conference on Wireless Networks and Mobile Communications (WINCOM 2016), Morocco, Russia, 26–29 October 2016; IEEE: Danvers, MA, USA, 2016; pp. 180–186.

ASCIMER. Governance and Implementation of Smart City Projects of Smart City Projects in the Mediterranean Region Deliverable 3; European Investment Bank Institiue: Kirchberg, Luxembourg, 2017; pp. 1–88.

Ash, C.; Jasny, B.R.; Roberts, L.; Stone, R.; Sugden, A.M. Reimagining cities. Science 2008, 319, 739–769.

ATSDR. Safeguarding Communities from Chemical Exposures; Department of Health and Human Services: Atlanta, GA, USA, 2009; pp. 1–35.

Basiri, M.; Azim, A.Z.; Farrokhi, M. Smart City Solution for Sustainable Urban Development. Eur. J. Sustain. Dev. 2017, 6, 71–84.

Bass, T.; Sutherland, E.; Symons, T. (Nesta) Reclaiming the Smart City: Personal data, trust and the new commons. European Commission. Belgium, 2018; pp.1-76.

Barth, J.; Fiekiewicz, K.; Gremm, J.; Hartmann, S.; Iigan, A.; Manika, A.; Meschede, C.; Stock, W.G. Informational urbanism. A conceptual framework of smart cities. In Proceedings of the 50th Hawaii International Conference on System Sciences, Hilton Waikoloa Village, HI, USA, 4–7 Janunary 2017.

Batty, M.; Axhausen, K.W.; Giannotti, F.; Pozdnoukhov, A.; Bazzani, A.; Wachowicz, M.; Ouzounis, G.; Portugali, Y. Smart cities of the future. Eur. Phys. J. Spec. Top. 2012, 214, 481–518.

Benckendorff, P. Themes and trends in Australian and New Zealand tourism research: A social network analysis of citations in two leading journals (1994–2007). J. Hosp. ManaG. Tour. 2009, 16, 1–15.

Bettencourt, L.M.A.; Lobo, J.; Helbing, D.; Kühnert, C.; West, G.B. Growth, innovation, scaling, and the pace of life in cities. Proc. Natl. Acad. Sci. USA 2007, 104, 7301–7306.

Bibri, S.E. The IoT for smart sustainable cities of the future: An analytical framework for sensor-based big data applications for environmental sustainability. Sustain. Cities Soc. 2018, 38, 230–253.

Bibri, S.E.; Krogstie, J. Smart sustainable cities of the future: An extensive interdisciplinary literature review. Sustain. Cities Soc. 2017, 31, 183–212. (2017a)

Bibri, S.E.; Krogstie, J. ICT of the new wave of computing for sustainable urban forms: Their big data and context-aware augmented typologies and design concepts. Sustain. Cities Soc. 2017, 32, 449–474. (2017b)

Bibri, S.E.; Krogstie, J. On the social shaping dimensions of smart sustainable cities: A study in science, technology, and society. Sustain. Cities Soc. 2017, 29, 219–246. (2017c)

Bibri, S.E.; Krogstie, J. Big data and context-aware computing applications for smart sustainable cities. In Proceedings of the 2nd Norwegian Big data Sysmposium, Trondheim, Norway, 15 November 2016; Gulla, J.A., Svendsen, R.D., Ozgobek, O., Marco, C., Eds.; CEUR Workshop Proceedings: Trondheim, Norway, 2017; Volume 1818, pp. 4–17. (2017d)

Bilbao-Jayo, A.; Almeida, A. Political discourse classification in social networks using context sensitive convolutional neural networks. In Proceedings of the Sixth International Workshop on Natural Language Processing for Social Media, Melbourne, Australia, 20 July 2018; ACL: Stroudburg, PA, USA, 2018; pp. 76–85.

Bolívar, M.P.R.; Meijer, A.J. Smart Governance: Using a Literature Review and Empirical Analysis to Build a Research Model. Soc. Sci. Comput. Rev. 2016, 34, 673–692.

Bornmann, L.; Haunschild, R.; Hug, S.E. Visualizing the context of citations referencing papers published by Eugene Garfield: A new type of keyword co-occurrence analysis. Scientometrics 2018, 114, 427–437.

Burnap, P.; Williams, M.L. Cyber hate speech on twitter: An application of machine classification and statistical modeling for policy and decision making. Policy Internet 2015, 7, 223–242.

Caird, S.P.; Hallett, S.H. Towards evaluation design for smart city development. J. Urban Des. 2018, 24, 188–209.

Caragliu, A.; Bo, C.D.; Nijkamp, P. Smart cities in Europe. J. Urban Technol. 2011, 18, 65–82.

Castelnovo, W.; Misuraca, G.; Savoldelli, A. Smart Cities Governance: The Need for a Holistic Approach to Assessing Urban Participatory Policy Making. Soc. Sci. Comput. Rev. 2016, 34, 724–739.

Chen, X.; Chen, J.; Wu, D.; Xie, Y.; Li, J. Mapping the Research Trends by Co-word Analysis Based on Keywords from Funded Project. Procedia Comput. Sci. 2016, 91, 547–555.

Chen, F.; Deng, P.; Wan, J.; Zhang, D.; Vasilakos, A.V.; Rong, X. Data mining for the internet of things: Literature review and challenges. Int. J. Distrib. Sens. Netw. 2015, 11, 431047.

Chen, X.; Li, G.; Hu, Y.D.; Li, Y. How anonymity influence self-disclosure tendency on Sina Weibo: An empirical study. Anthropologist 2016, 26, 217–226.

Cho, Y. T; Park, S. W.; Lee, S. H/; Oh, M. T. and Lee J. H. The future visions and action plan of the LH smart cities, Korea Land and Housing Corporation (LH), Daejeon Metropolitan city, 2018 South Korea; pp:1-224. (In Korean)

Chourabi, H.; Nam, T.; Walker, S.; Gil-Garcia, J.B.; Mellouli, S.; Nahon, K.; Pardo, T.A.; Scholl, H.J. Understanding smart cities: An integrative framework. In Proceedings of the 45th Hawaii International Conference on System Sciences, Maui, HI, USA, 4–7 January 2012; IEEE: Danvers, MA, USA, 2012; pp. 2289–2297.

Chung, C.J.; Park, H.W. Textual analysis of a political message: The inaugural addresses of two Korean presidents. Soc. Sci. Inf. 2010, 49, 215–239.

Chungnam Institute. A Study on the Analysis of Chungnam Civil Complaints Data and Policy Implications for the 4th Industrial Revolution Era; Chungnam Institute: Gongju, Korea, 2017; pp. 1–38. (In Korean)

Cocchia, A. Smart and Digital City: A Systematic Literature Review. In Smart City: How to Create Public and Economic Value with High Technology in Urban Space; Dameri, R.P., Rosenthal-Sabroux, C., Eds.; Springer International Publishing: Cham, Switzerland, 2014; Volume 2, pp. 13–43.

Cretu, L.G. Smart Cities Design using Event-driven Paradigm and Semantic Web. Inform. Econ. 2012, 16, 57–67.

D'Auria, A.; Tregua, M.; Vallejo-Martos, M.C. Modern conceptions of cities as smart and sustainable and their commonalities. Sustainability 2018, 10, 2642.

De Jong, M.; Joss, S.; Schraven D Zhan, C.; Weijnen, M. Sustainable-smart-resilient-low carbon-eco-knowledge cities; Making sense of a multitude of concepts promoting sustainable urbanization. J. Clean. Prod. 2015, 109, 25–38.

Deakin, M. Smart Cities: Governing, Modelling and Analyzing the Transition. Routledge. 2014, New York, USA.

Deloitte. Smart Cities Big Data; Deloitte and Touche: London, UK, 2015; pp. 1–8.

DiNapoli, T.P. Noise in New York City Neighborhoods: Assessing Risk in Urban Noise Management; New York State Comptroller: New York, NY, USA, 2018.

Elgazzar, R.F.; El-Gazzar, R.F. Smart Cities, Sustainable Cities, or Both?—A Critical Review and Synthesis of Success and Failure Factors. In Proceedings of the 6th International Conference on Smart Cities and Green ICT Systems, Porto, Portugal, 22–24 April 2017; Smartgreens: Setúbal, Portugal, 2017; Volume 1, pp. 250–257.

European Commision. Anlysing the Potential for Wide Scale Roll Out of Integrated Smart Cities and Commnunites Solution Final Report; European Union: Brussels, Belgium, 2016; pp. 1–100.

Fang, Z. E-Government in Digital Era: Concept, Practice, and Development. Int. J. Comput. Internet Manag.2002, 10, 1–22.

Finfgeld-Connett, D. Twitter and Health Science Research. West. J. Nurs. Res 2015, 37, 1269–1283.

Forghani, M.; Delavar, M. A Quality Study of the OpenStreetMap Dataset for Tehran. ISPRS Int. J. Geo-Inf.2014, 3, 750–763.

Frumkin, H. Healthy Places: Exploring the Evidence. Am. J. Public Health 2003, 93, 1451–1456.

Giffinger, R.; Fertner, C.; Kramar, H.; Kalasek, R.; Pichler-Milanovic, N.; Meijers, E. Smart Cities Ranking of European Medium-Sized Cities; Vienna University of Techology: Vienna, Austria, 2007; pp. 1–12.

Global e-Sustainbility Initiative (GeSI). GeSI SMARTer2020: The Role of ICT in Driving a Sustainable Future; GeSI: Brussels, Belgium, 2012; pp. 1–244.

Golbeck, J. Analyzing the Social Web, MK pulbications, 2013, MA 02451, USA; pp.1-290.

Golbeck, J. Benford's Law Applies to online Social Networks, PLoS ONE 2015, 10(8): e0135169

Grandjean, M.; Mauro, A. A social network analysis of Twitter: Mapping the digital humanities community, Journal Cogent Arts & Humanities 2016, 3(1), 1-14.

Guenduez, A.A.; Mettler, T.; Schedler, K. Smart Government—Partizipation und Empowerment der Bürger im Zeitalter von Big Data und personalisierter Algorithmen. HMD Praxis der Wirtschaftsinformatik 2017, 54, 477–487.

Gudes, O.; Kendall, E.; Yigitcanlar, T.; Pathak, V.; Baum, S. Rethinking health planning: A framework for organising information to underpin collaborative health planning. Health Inf. Manag. J. 2010, 39, 18–29.

Harrison, C.; Eckman, B.A.; Hamilton, R.; Hartswick, P.; Kalagnanam, J.; Paraszczak, J.; Williams, R.P. Foundations for Smarter Cities. IBM J. Res. Dev. 2010, 54, 1–16.

Hashem, I.A.T.; Chang, V.; Anuar, N.B.; Adwole, K.; Yaqoob, I.; Gani, A.; Ahmed, E.; Chiroma, H. The role of big data in smart city. Int. J. Inf. Manag. 2016, 36, 748–758.

Hwang, M.H.; Iim, E.S.; Jeon, S.J. A study of developing and applying Geoinfographics to improve communication capability of policy support mapping, Korea Research Institute for Human settlements, 2015, Sejong special self-governing city, South Korea. (In Korean)

Hollands R.G. "Will the real smart city please stand up? Intelligent, Progressive or entrepreneurial?" City 2018, 12(3), 303-320.

Hong, A.; Kim, B.; Widener, M. Noise and the city: Leveraging crowdsourced big data to examine the spatio-temproral relatiohship between urban development and noise annoyance. Environ. Plan B 2019, 0, 1–18.

Hong, S. E. Sentimental & Pattern Analysis of Environment Complaint by Big Data Mining, Master Dissertation, 2018, Inha University, South Korea.

HUAWEI Enterprise. UK Smart Cities Index 2017 Assessment of Strategy and Execution for the UK's Leading Smart Cities; Navigant Consulting Inc.: Boulder, CO, USA, 2017; pp. 1–72.

Hubacek, K.; Kronenberg, J. Synthesizing different perspectives on the value of urban ecosystem services. Landsc. Urban Plan. 2013, 109, 1–6.

IBM. Smarter Cities: New Cognitive Approaches to Long-Standing Challenges. Available online: https://www.ibm.com/smarterplanet/us/en/smarter_cities/overview/ (acces sed on 4 May 2019).

Iglesias, J.A.; Garcia-Cuerva, A.; Ledezma, A.; Sanchis, A. Social network analysis: Evolving Twitter mining. In Proceedings of the 2016 IEEE International Conference on Systems, Man, and Cybernetics (SMC), Budapest, Hungary, 9–12 October 2016; IEEE: Danvers, MA, USA, 2016; p. 149.

Inchoen Metropolitan city. Civil Complaints Analysis Report; Incheon metropolitan city: Incheon metropolitan city, Korea, 2015; pp. 1–124. (In Korean)

Jung, K.; Park, H.W. A semantic (TRIZ) network analysis of South Korea's "Open Public Data" policy. Gov. Inf. Q. 2015, 32, 353–358.

Kibria, M.G.; Nguyen, K.; Villardi, G.P.; Zhao, O.; Ishizu, K.; Kojima, F. Big Data Analytics, Machine Learning, and Artificial Intelligence in Next-Generation Wireless Networks. IEEE Access 2018, 6, 32328–32338.

Kim, B.-J.; So, S.-C. An assessment of seoul metropolitan government reform strategies. IRPA 2004, 8, 77–894.

Kim, H.; Lee, T.; Ryu, S.; Kim, N. A Study on Text Mining Methods to Analyze Civil Complaints—Structured Association Analysis. J. Korea Ind. Syst. Res. 2018, 23, 13–24. (In Korean)

Kim, S.; Cho, K. Achiving Administrative Transparency through Information Systems: A Case Study in the Seoul Metropolitan Government. EGOV 2005, 3591, 113–123.

Kitchin, R. The real-time city? Big data and smart urbanism. Geojournal 2014, 79(1), 1-14.

Komninos, N. Intelligent cities: Variable geometries of spatial intelligence. Intell. Build. Int. 2011, 3, 172–188.

Korean Ministry of Government Legislation, https://www. moleg.go.kr (accessed on 23 July, 2019)

Kramers, A.; Höjer, M.; Lövehagen, N.; Wangel, J. Smart sustainable cities—Exploring ICT solutions for reduced energy use in cities. Environ. Model. Softw. 2014, 56, 52–62.

Krishna, I.V.M.; Manickam, V. Envrionmental Management: Science and Engineering for Industry; Butterworth-Heinemann: Oxford, UK, 2017; ISBN 9780128119907.

Gupta, A.; Gupta, A.; Jain, K.; Gupta, S. Noise Pollution and Impact on Children Health. Indian J. Pediatr.2018, 85, 300–306.

Landherr, A.; Friedl, B.; Heidemann, J. A Critical Review of Centrality Measure in Social networks. Business & Information Systems Engineering 2010, 2(6), 371- 385.

Lara, A.P.; Da Costa, E.M.; Furlani, T.Z.; Yigitcanlar, T. Smartness that matters: Towards a comprehensive and human-centered characterization of smart cities. J. Open Innov. Technol. Mark. Complex. 2016, 2, 8.

Lazaroiu, G.C.; Roscia, M. Definition methodology for the smart cities model. Energy 2012, 47, 326–332.

Le-Dang, Q.; Le-Ngoc, T. Internet of Things (IoT) Infrastructures for Smart Cities. In Handbook of Smart Cities; Maheswaran, M., Badidi, E., Eds.; Springer International Publishing: Cham, Switzerland, 2018; Volume 1, pp. 1–30.

Lechman, E.; Marszk, A. Information and Communication Technologies for Economic Development. In Catalyzing Development through ICT Adoption; Kaur, H., Lechman, E., Marszk, A., Eds.; Springer International Publishing: Cham, Switzerland, 2017; Volume 1, pp. 3–14.

Lederbogen, F.; Kirsch, P.; Haddad, L.; Streit, F.; Tost, H.; Schuch, P.; Wüst, S.; Pruessner, J.C.; RietSchel, M.; Deuschle, M.; et al. City living and urban upbringing affect neural social stress processing in humans. Nature 2011, 474, 498–501.

Leydesdorff, L.; Vaughan, L. Co-occurrence matrices and their applications in information science: Extending ACA to the web environment. J. Am. Soc. Inf. Sci. Technol. 2006, 57, 1616–1628.

Lin, Y.; Wang, P.; Ma, M. Intelligent Transportation System (ITS): Concept, Challenge and Opportunity. In Proceedings of the IEEE International Conference on Big Data Security on Cloud, Beijing, China, 26–28 May 2017; IEEE Computer Society: Washington, DC, USA, 2017; pp. 167–172.

Liu, J.S.; Ho, M.H.C.; Lu, L.Y.Y. Recent themes in social networking service research. PLoS ONE 2017, 12, e0170293.

Lopes, N.V. Smart governance: A key factor for smart cities implementation. In Proceedings of the 2017 IEEE International Conference on Smart Grid and Smart Cities, ICSGSC 2017, Singapore, 23–26 July 2017; IEEE: Danvers, MA, USA, 2017; pp. 277–282.

Luederitz, C.; Brink, E.; Gralla, F.; Hermelinmeire, V.; Meyer, M.; Niven, L.; Panzer, L.; Partelow, S.; Rau, A.-L.; Sasaki, R.; et al. A review of urban ecosystem services: Six key challenges for future research. Ecosyst. Serv. 2015, 14, 98–112.

Mach, M.E.; Martone, R.G.; Chan, K.M.A. Human impacts and ecosystem services: Insufficient research for trade-off evaluation. Ecosyst. Serv. 2015, 16, 112–120.

Maiello, A.; Battaglia, M.; Daddi, T.; Frey, M. Urban sustainability and knowledge: Theoretical heterogeneity and the need of a transdisciplinary framework. A tale of four towns. Futures 2011, 43, 1164–1174.

Marras, M; Laniado, D. BarcelonaNow at “The Web conference 2018”. London: DECODE/ Nesta. Available from: https://www.decodeproject.eu/blog/barcelonanow-%E2%80%9C-web-conference-2018%E2%80%9D (accessed 18 July 2019).

Matas, N.; Martincić-Ipšić, S.; Meštrović, A. Comparing network centrality measures as tools for identifying key concepts in complex networks: A case of wikipedia. J. Digit. Inf. Manag. 2017, 15, 203–213.

Meijer, A.; Bolívar, M.P.R. Governing the smart city: A review of the literature on smart urban governance. Int. Rev. Adm. Sci. 2016, 82, 392–408.

Metcalf, J.; Crawford, K. Where are human subjects in Big Data research? The emerging ethics divided. Big Data & Society 2016, 10. https://doi.org/10.1177/2053951716650211.

Ministry of Environment. The Report of Control Policy with Noise and Vibration in 2015; Ministry of Environment: Sejong special self-governing city, Korea, 2016; pp. 1–133. (In Korean)

Min, K.; Jun, B.; Lee, J.; Kim, H.; Furuya, K. Analysis of Environmental Issues with an Application of Civil Complaints: The Case of Shiheung City, Republic of Korea. Int. J. Environ. Res. Public Health 2019, 16, 1018. (2019a)

Min, K; Yoon, M.; Furuya, K. A comparison of a Smart City's Trends in Urban Planning before and after 2016 through Keyword Network Anlysis. Sustianability 2019, 11(11), 3155. (2019b)

Ministry of Environment (ME) (2016), The Report of Control Policy with Noise and Vibration in 2015; Ministry of Environment: Sejong special self-governing city, Korea, 2016; pp. 1–133. (In Korean)

Ministry of the Interior and Safety (MIS) (2017), Explanation of the Act on Civil complaints. Sejong special self-governing city, South Korea. (In Korean)

Ministry of the Interior and Safety (MIS) (2016), E-Government Fundmental Plan 2020: E-government that delights the people with the new digital experience. Sejong special self-governing city, South Korea; pp.1-12 (In Korean)

Ministry of Land, Infrastucture and Transport (MLIT) (2019), Comprehensive Smart City Planning (2019-2023) Ver. 3. Sejong special self-governing city, South Korea. (In Korean)

Mora, H.M.; Pont, M.T.S.; Casado, G.D.M.; Iglesias, V.G. Management of social networks in the educational process. Comput. Hum. Behav. 2015, 51, 890–895.

Mora, H.; Pérez-delHoyo, R.; Paredes-Pérez, J.; Mollá-Sirvent, R.A. Analysis of Social Networking Service Data for Smart Urban Planning. Sustainability 2018, 10, 4732.

Nam, T.; Pardo, T.A. Conceptualizing smart city with dimensions of technology, people, and institutions. In Proceedings of the 12th Annual International Conference on Digital Government Research, College Park, MD, USA, 12–15 June 2011; ACM: Ney York, NY, USA, 2011; pp. 282–291.

National Institute of Ecology (NIE). Mapping and Assessment of Ecosystem Services; National Institute of Ecology: Seochoen, Korea, 2017; pp. 1–403. (In Korean)

Neirotti, P.; Marco, A.D.; Cagliano, A.C.; Mangano, G.; Scorrano, F. Current trends in Smart City initiatives: Some stylized facts. Cities 2014, 38, 25–36.

Newman, M. E. J. Finding community structure in networks using the eigenvectors of matrices. Physical Review 2006, E 74, 036104, 1-19.

Nuaimi, E.A.; Neyadi, H.A.; Mohamed, N.; Al-Jaroodi, J. Applications of big data to smart cities. J. Internet Serv. Appl. 2015, 6, 25.

Oberti, I.; Pavesi, A.S. The triumph of the smart city. TECHNE J. Technol. Archit. Environ. 2013, 5, 117–122.

Odendaal, N. Information and communication technology and local governance: Understanding the difference between cities in developed and emerging economies. Comput. Environ. Urban 2003, 27, 585–607.

Park, H.J. Pattern Analysis of Environment Compliant Using the Spatial Big Data Mining, Master Dissertation, 2015, Inha University, South Korea.

Paskaleva, K.A. Enabling the smart city: The progress of city e-governance in Europe. Int. J. Innov. Reg. Dev. 2009, 1, 405–422.

Patil, A.S.; Nadaf, M. Study on ICT, IoT and Big Data Analytics in smart city application. IRJET 2017, 4, 59–64.

Pereira, G.V.; Parycek, P.; Falco, E.; Kleinhans, R. Smart governance in the context of smart cities: A literature review. Inf. Polity 2018, 23, 1–20.

Peter, B.M; Slatkin, M. The effective founder effect in a spatially expanding population, Evolution 2015, 69(3): 721-734.

Pla-Castells, M.; Martinez-Dura, J.J.; Samper-Zapater, J.J.; Cirilo-Gimeno, R.V. Use of ICT in Smart Cities. A practical case applied to traffic management in the city of Valencia. In Proceedings of the In Smart Cities Symposium Prague, Prague, Czech Republic, 24–25 June 2015; SCSP: Danvers, MA, USA, 2015.

Porumbescu, G.A. Comparing the Effects of E-Government and Social Media Use on Trust in Government: Evidence from Seoul, South Korea. Public Manag. Rev. 2016, 18, 1308–1334.

Preseidnetial Committee on the Fourth Industrial Revolution (PCFIR) (2018), The strategies for the promotion of smart city toward urban innovation and creation of future growth engines. Sejong special self-governing city, South Korea. (In Korean)

Quercia, D.; Schifanella, R.; Aiello, L.M.; McLean, K. Smelly Maps: The Digital Life of Urban Smellscapes. In Proceedings of the 9th International AAAI Conference on Wed and Socail Media, Oxford, UK, 26–29 May 2015; The AAAI Press: Palo Alto, CA, USA, 2015; pp. 327–336.

Ra, H.M.; Kim, M.K.; Song, C.S. An Analysis of the Civil Service System for Quality Improvement of Civil Service and its Development Direction. Korean journal of policy analysis and evaluation 2006, 16(3), 244. (In Korean)

Radhakrishnan, S.; Erbis, S.; Isaacs, J.A.; Kamarthi, S. Novel keyword co-occurrence network-based methods to foster systematic reviews of scientific literature. PLoS ONE 2017, 12, e0185771.

Ribeiro, F.; Ferraz, F.S.; Carolina, M.; Henrique, G.; Alexandre, S. Big Data Solutions For Urban Environments A Systematic Review. In Proceedings of the ALLDATA 2015, The First International Conference on Big Data, Small Data, Linked Data and Open Data, Barcelona, Spain, 19–24 April 2015; IARIA: New York, NY, USA, 2015; pp. 22–28.

Riva Sanseverino, E.; Riva Sanseverino, R.; Anello, E. A Cross-Reading Approach to Smart City: A European Perspective of Chinese Smart Cities. Smart Cities 2018, 1, 26–52.

Ruhlandt, R.W.S. The governance of smart cities: A systematic literature review. Cities 2018, 81, 1–23.

Rowe, G.; Frewer, L.J. Public participation methods: A freamework for evaluation. ST&HV 2000, 25, 3–29.

Shen, L.; Zhou, J. Examining the effectiveness of indicators for guiding sustainable urbanization in China. Habitat Int. 2014, 44, 111–120.

Shelton, T.; Zook, M.; Wiig, A. The 'actually existing smart city'. Camb. J. Reg. Econ. Soc. 2015, 8, 13–25.

Shichiyakh, R.A.; Klyuchnikov, D.A.; Balashova, S.P.; Novoselov, S.N.; Novosyolova, N.N. Smart city as the basic construct of the socio-economic development of territories. Int. J. Econ. Financ. Issues 2016, 6, 157–162.

Silva, B.N.; Khan, M.; Han, K. Towards sustainable smart cities: A review of trends, architectures, components, and open challenges in smart cities. Sustan. Cities Soc. 2018, 38, 697–713.

Silva, B.N.; Khan, M.; Han, K. Integration of Big Data analytics embedded smart city architecture with RESTful web of things for efficient service provision and energy management. Future Gener. Comput. Syst. 2017. (2017a)

Silva, B.N.; Khan, M.; Han, K. Internet of Things: A Comprehensive Review of Enabling Technologies, Architecture, and Challenges. IETE Tech. Rev. 2017, 35, 205–220. (2017b)

Silva, B.N.; Khan, M.; Han, K. Big data analytics embedded smart city architecture for performance enhancement through real-time data processing and decision-making. Wirel. Commun. Mob. Comput. 2017, 2017, 9429676. (2017c)

Simonofski, A.; Asensio, E.S.; De Smedt, J.; Snoeck, M. Citizen participation in smart cities: Evaluation framework proposal. In Proceedings of the 2017 IEEE 19th Conference on Business Informatics, Thessaloniki, Greece, 24–27 May 2017; IEEE: Danvers, MA, USA, 2017; Volume 1, pp. 227–236.

SmartResults Research Team, University of Ottawa. Smart Capital Evaluation Guidelines Report; University of Ottawa: Ottawa, ON, Canada, 2003; pp. 1–125.

Sun, Y.; Du, Y. Big data and sustainable cities: Applications of new and emerging forms of geospatial data in urban studies. Open Geospat. Data Softw. Stand. 2017, 2, 2–24.

Suthaharan, S. Big data analytics: Machine learning and Bayesian learning perspectives—What is done? What is not? WIREs Data Min. Knowl. Discov. 2019, 9, e1283.

Trindade, E.P.; Hinnig, M.P.F.; Moreira da Costa, E.; Marques, J.S.; Bastos, R.C.; Yigitcanlar, T. Sustainable development of smart cities: A systematic review of the literature. J. Open Innov. Techol. Mark. Complex.2017, 3, 11.

Turner, S.W.; Uludag, S. Intelligent transportation as the key enabler of smart cities. In Proceedings of the IEEE/IFIP Network Operations and Management Symposium, Istanbul, Turkey, 26–29 April 2016; IEEE: Danvers, MA, USA, 2016; pp. 1261–1264.

United Nations. World Urbanization Prospects: The 2018 Revision, Key Facts; United Nations: New York, NY, USA, 2018.

Vanolo, A. Smartmentality: The Smart City as Disciplinary Strategy. Urban Stud. 2014, 51, 883–898.

Vermesan, O.; Friess, P.; Guillemin, P.; Fiaffreda, R.; Grindvoll, H.; Eisenhauer, M.; Serrano, M.; Moessner, K.; Spirito, M.; Blystad, L.-C.; et al. Internet of Things beyond the Hype: Research, Innovation and Deployment. In Building the Hyperconnected Society—IoT Research and Innovation Value Chains, Ecosystems and Markets; Vermesan, O., Friess, P., Eds.; River Publishers: Aalborg, Denmark, 2015; Volume 3, pp. 15–85.

Votsis, A.; Haavisto, R. Urban DNA and Sustainable Cities: A Multi-City Comparison. Front. Environ. Sci.2019, 7, 4.

Wang, Y.; Zheng, Y.; Liu, T. A noise map of New York city. In Proceedings of the 2014 ACM International Joint Conference on Pervasive and Ubiquitous Computing

Adjunct Publication, Seattle, WA, USA, 13–17 September 2014; ACM: New York, NY, USA, 2014; pp. 275–278.

Wan, L.; Ye, X.; Lee, J.; Lu, X.; Zheng, L.; Wu, K. Effects of urbanization on ecosystem service values in a mineral resource-based city. Habitat Int. 2015, 46, 54–63.

Ward, M. O.; Grinstein, G.; Keim, D. Interactive Data Visualization: Foundations, Techniques and Applications. Boca Raton: CRC Press, 2015, Florida, USA; pp: 1-578.

Wilkinson, C.; Saarne, T.; Peterson, G.D.; Colding, J. Strategic spatial planning and the ecosystem services concept—An historical exploration. Ecol. Soc. 2013, 18, 37.

Wu, J. Landscape sustainability science: Ecosystem services and human well-being in changing landscapes. Landsc. Ecol. 2013, 28, 999–1023.

Wu, S.M.; Chen, T.-C.; Wu, Y.J.; Lytras, M. Smart cities in Taiwan: A perspective on big data applications. Sustainability 2018, 10, 106.

Yang, K.; Holzer, M. The performance-trust link: Implications for performance measurement. Public Adm. Rev. 2006, 66, 114–126.

Yigitcanlar, T. Australian Local Governments Practice and Prospects with Online Planning. URISA J. 2006, 18, 7–17.

Yigitcanlar, T.; Kamruzzaman, M.; Buys, L.; Ioppolo, G.; Sabatini-Marques, J.; Costa, E.; Yun, J. Understanding 'smart cities': Intertwining development drivers with desired outcomes in a multidimensional framework. Cities 2018, 81, 145–160.

Yigitcanlar, T.; Kamruzzaman, M.; Foth, M.; Sabatini-Marques, J.; Costa, E.; Ioppolo, G. Can cities become smart without being sustainable? A systematic review of the literature. Sustain Cities Soc. 2019, 45, 348–365.

Yovanof, G.S.; Hazapis, G.N. An architectural framework and enabling wireless technologies for digital cities & Intelligent urban environments. Wirel. Pers. Commun. 2009, 49, 445–463.

Zhang, J.; Xie, J.; Hou, W.; Tu, X.; Xu, J.; Song, F.; Wang, Z.; Lu, Z. Mapping the knowledge structure of research on patient adherence: Knowledge domain visualization-based co-word analysis and social network analysis. PLoS ONE 2012, 7, e34494.

Zheng, Y.; Capra, L.; Wolfson, O.; Yang, H. Urban Computing: Concepts, Methodologies, and Applications. ACM Trans. Intell. Syst. Technol. 2014, 5, 38–55.

Appendix 1.

CIVIL PETITIONS TREATMENT ACT

[Enforcement Date 23. Mar, 2013.] [Act No.11690, 23. Mar, 2013., Amendment by Other Act]

행정안전부(민원제도혁신과) 044-205-2449

CHAPTER I GENERAL PROVISIONS

Article 1 (Purpose)

The purpose of this Act is to provide for basic matters concerning the handling of civil petitions, thereby promoting the fair handling of civil petitions and reasonable improvement of the civil petition administrative system and protecting the rights and interests of the people.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 2 (Definitions)

The definitions of terms used in this Act shall be as follows:

1. The term "civil petitioner" means an individual, corporation or organization requesting that an administrative agency take a disposition or do any other specific act;

2. The term "civil petition affairs" means administrative affairs in regards to a disposition or any other specific act that a civil petitioner requests an administrative agency to take or do (hereinafter referred to as "civil petition");

3. The term "complex civil petition" means a civil petition handled with a permission, authorization, approval, recommendation, consultation or confirmation by several related institutions (including an organization, association, etc. related to the civil petition; hereinafter the same shall apply) or related offices pursuant to applicable Acts and subordinate statutes, directives, established rules, notifications, etc. (hereinafter referred to as "related Acts, subordinate statutes, etc.") in order to realize the purpose of a single civil petition;

4. The term "window for electronic civil petitions" means a window for electronic civil petitions established pursuant to Article 9 of the Electronic Government Act;

5. The term "automatic machine for issuing civil petition documents" means electronic equipment that is installed in an administrative agency, public place, etc. by the head of an administrative agency and directly issues civil petition documents for civil petitioners.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 3 (Scope of Application) (1) Except as otherwise expressly provided in other Acts, this Act shall apply to civil petition affairs.

(2) For purposes of this Act, an administrative agency includes a corporation or organization that has been delegated or entrusted with the administrative authority pursuant to applicable Acts and subordinate statutes, or an agency or individual belonging thereto.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

CHAPTER II TREATMENT OF CIVIL PETITION AFFAIRS

Article 4 (Obligations of Public Officials Handling Civil Petition Affairs)

Each public official handling civil petition affairs shall treat civil petition affairs in his/her charge in an expeditious, fair and kind manner.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 5 (Principles of Handling Civil Petition Affairs) (1) Each administrative agency shall handle civil petition affairs in preference to other affairs, as prescribed by relevant Acts and subordinate statutes, etc.

(2) No administrative agency shall delay the handling of civil petition affairs on the ground that the period for handling civil petition affairs established in the relevant Acts and subordinate statutes, etc. has yet to expire or that the relevant civil petitioner fails to pay public charges that have nothing to do with the civil petition affairs.

(3) Except cases falling under provisions of Acts and subordinate statutes, etc. or by delegation, no administrative agency shall tighten procedures for handling civil petition affairs, etc.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 6 (Calculation of Period for Handling Civil Petition Affairs) (1) Where the period for handling civil petition affairs is fixed for no more than five days, said period shall be calculated on an hourly basis from the time of receipt of a civil petition, excluding holidays and Saturday. In this regard, one day shall be deemed eight working hours.

(2) Where the period for handling civil petition affairs is fixed for no less than six days, said period shall be calculated on a daily basis, including the first day, but excluding holidays.

(3) Where the period for handling civil petition affairs is fixed on a weekly, monthly, or yearly basis, the first day shall be included therein, and Articles 159 through 161 of the Civil Act shall apply mutatis mutandis thereto.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 7 (Keeping of Civil Petition Manual)

The head of each administrative agency shall post a notice of matters necessary to file a civil petition (including a notice through the Internet, etc.) or keep a civil petition manual for inspection by civil petitioners.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 8 (Filing of Civil Petitions)

A civil petition shall be filed in writing (including an electronic document set out in subparagraph 7 of Article 2 of the Electronic Government Act; hereinafter the same shall apply): Provided, That it may be filed orally or via telephone, telegraph, facsimile, or any other information and communications network (referring to the information and communications network set out in subparagraph 10 of Article 2 of the Electronic Government Act; hereinafter the same shall apply), in cases prescribed by Presidential Decree.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 9 (Receipt of Civil Petitions) (1) The head of an administrative agency in receipt of a civil petition, he/she shall not withhold or refuse the receipt thereof and

shall not unlawfully return the civil petition documents received, except as otherwise expressly provided in other Acts and subordinate statutes.

(2) Matters necessary for the receipt of civil petitions, etc. under paragraph (1) shall be prescribed by Presidential Decree.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 10 (Prohibition of Requests for Unnecessary Documents) (1) When the head of an administrative agency receives and handles a civil petition, he/she shall not request that the relevant civil petitioner submit additional documents other than the required documents.

(2) Where the head of an administrative agency receives the same civil petition documents or required documents in duplicates, he/she shall permit the relevant civil petitioner to submit a copy of such documents together with the original thereof, in the absence of special circumstances.

(3) Where the head of an administrative agency receives and handles a civil petition and the civil petition falls under any of the following, he/she shall not request the relevant civil petitioner to submit related evidentiary documents or required documents, and the public official handling such civil petition shall directly confirm and treat such civil petition:

1. Where it is possible to confirm matters necessary to handle such civil petition with a certificate of resident registration, passport, or driver's license carried by a civil petitioner, or any other certificate issued by an administrative agency;

2. Where it is possible to confirm matters necessary to handle such civil petition with the official book or administrative information of the relevant administrative agency;

3. Where it is possible to confirm matters necessary to handle such civil petition by sharing administrative information under Article 36 (1) of the Electronic Government Act.

(4) When the head of an administrative agency receives an application for change or renewal of matters in the original civil petition, he/she shall not request the relevant civil petitioner to re-submit related evidentiary documents or required documents already submitted, in the absence of special circumstances.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 11 (Receipt of Civil Petitions and Issuance of Civil Petition Documents through other Administrative Agencies, etc.) (1) For the convenience of civil petitioners, the head of an administrative agency may cause another administrative agency or a corporation prescribed by Presidential Decree, among corporations that have been incorporated pursuant to a special Act and have nationwide organizations, to receive civil petitions and issue civil petition documents instead of such administrative agency.

(2) Matters concerning procedures for the receipt of civil petitions and the issuance of civil petition documents under paragraph (1), methods of forwarding between administrative agencies, etc. shall be prescribed by Presidential Decree.

(3) An executive or employee who receives civil petitions and issues civil petition documents pursuant to paragraph (1) and who is not a public official shall be deemed a public official for purposes of the penal provisions of the Criminal Act or other Acts.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 12 (Delivery of Civil Petition Documents) (1) Where the head of an administrative agency receives any civil petition document under the jurisdiction of another administrative agency, he/she shall deliver such documents to the competent administrative agency without delay.

(2) Matters necessary for procedures and methods of delivering civil petition documents under paragraph (1) shall be prescribed by Presidential Decree.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 13 (Supplementation, Withdrawal, etc. of Civil Petition Documents) (1) Where the head of an administrative agency finds any defect in a civil petition document that he/she has received, he/she shall require the relevant civil petitioner to supplement such document within a designated period as necessary for the supplementation thereof without delay.

(2) A civil petitioner may, before handling of the relevant civil petition affairs is completed, supplement, change, or withdraw any detail of the civil petition filed: Provided, That this shall not apply where there exist special provisions to the contrary in other Acts or such supplementation, change, or withdrawal is impracticable due to the nature of such civil petition.

(3) Matters necessary for procedures for, and methods of, supplementing civil petition documents under paragraph (1) shall be prescribed by Presidential Decree.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 14 (Handling of Complex Civil Petitions) (1) The head of an administrative agency may designate a department to handle complex civil petitions and have such department handle such complex civil petitions at a time in cooperation with related administrative agencies or departments.

(2) Matters necessary for the methods of, and procedures for, handling complex civil petitions under paragraph (1) shall be prescribed by Presidential Decree.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 15 (Notification of Results of Handling Civil Petitions) (1) The head of an administrative agency shall give written notice to a civil petitioner of the result of handling a civil petition he/she has filed: Provided, That he/she may notify orally or

through the information and communications network, in cases prescribed by Presidential Decree. In this case, upon request of the civil petitioner, the head of the administrative agency shall provide documents on the result of the handling without delay.

(2) When the head of an administrative agency notifies the result of the handling of a civil petition pursuant to paragraph (1), where he/she rejects a civil petition filed by a civil petitioner, he/she shall notify the civil petitioner of the result thereof, along with the grounds for rejection and the remedial procedure therefor.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 16 (Issuance of Civil Petition Documents Using Automatic Machines for Issuing Civil Petition Documents) (1) The head of an administrative agency may issue the result of treatment of a civil petition (including civil petitions under the jurisdiction of other administrative agencies) by using automatic machines for issuing civil petition documents.

(2) Where the head of an administrative agency issues civil petition documents pursuant to paragraph (1), notwithstanding the provisions of other Acts, he/she may abate or exempt handling charges, but may collect money, other than handling charges, to cover expenses incurred in installing and managing automatic machines for issuing civil petition documents.

(3) The Minister of Security and Public Administration shall determine and publicly notify the kinds of civil petition documents to be issued by him/her pursuant to paragraph (1) in consultations with the heads of the relevant central administrative agencies.<Amended by Act No. 11690, Mar. 23, 2013>

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 17 (Receipt of Civil Petitions and Issuance of Civil Petition Documents under Jurisdiction of other Administrative Agencies via Information and

Communications Networks) (1) Where it is possible for the head of an administrative agency to receive civil petitions and issue civil petition documents under the jurisdiction of other administrative agencies via information and communications networks, he/she may directly receive civil petitions and issue civil petition documents.

(2) The Minister of Security and Public Administration shall determine and publicly notify the kinds of civil petitions that he/she may receive and civil petition documents that he/she may issue pursuant to paragraph (1) in consultations with the heads of the relevant central administrative agencies.<Amended by Act No. 11690, Mar. 23, 2013>

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 18 (Formal Objections against Refusal Dispositions) (1) A civil petitioner who is dissatisfied with a disposition for refusal taken by the head of an administration agency may file an objection in writing to the head of such administrative agency within 90 days of receipt of such refusal disposition.

(2) The head of an administrative agency shall render a decision on any objection filed, within ten days of receipt of the objection, and shall give written notice of the result thereof to the civil petitioner without delay: Provided, That when the head of the administrative agency is unable to render the decision within the designated period due to extenuating circumstances, he/she may extend such period for up to ten days from the day following the expiration date of such period, and notify the civil petitioner of the grounds for the extension thereof.

(3) A civil petitioner may file an administrative appeal under the Administrative Appeals Act and an administrative litigation under the Administrative Litigation Act, regardless of whether he/she has filed an objection under paragraph (1).

(4) Matters necessary for procedures for, and methods of, filing an objection under paragraph (1) shall be prescribed by Presidential Decree.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 19 (Requests for Preliminary Review) (1) In cases of a civil petition incurring huge financial costs, a civil petitioner may request a preliminary review with a summary document before he/she formally submits civil petition documents to the head of the relevant administrative agency.

(2) Where a civil petition for which a preliminary review has been requested pursuant to paragraph (1) is subject to consultations with the heads of other administrative agencies, the head of an administrative agency shall consult with the head of such other administrative agencies in advance.

(3) The head of an administrative agency shall notify a civil petitioner of the result of a preliminary review and shall not reject a civil petition with regard to which he/she has notified of a disposition, upon stating reasons that he/she has not specifically presented when he/she notified the results of the preliminary review, except where he/she is unable to implement such disposition for any reason imputable to the civil petitioner, force majeure, or any other special reason.

(4) The head of each administrative agency shall develop and implement legal and institutional systems to ensure the efficient operation of the preliminary review system under paragraph (1).

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 20 (Publication of Standards for Handling Civil Petition Affairs, etc.) (1) For the convenience of civil petitioners, the Minister of Security and Public Administration shall establish standards for handling civil petition affairs by integrating matters concerning agencies in charge, the time-periods for handling, required documents, handling procedures, the methods of filing civil petitions, etc. as provided in related Acts, subordinate statues, etc. and shall publish such standards in the Official Gazette and make them available on the Internet. <Amended by Act No. 11690, Mar. 23, 2013>

(2) If necessary to modify the standards for handling civil petition affairs published pursuant to paragraph (1) due to the establishment, amendment or repeal of related Acts, subordinate statutes, etc., the head of an administrative agency shall immediately notify the Minister of Security and Public Administration of the details thereof, and the Minister of Security and Public Administration shall reflect such details in the standards for handling civil petition affairs referred to in paragraph (1) after he/she publishes them in the Official Gazette and make them available on the Internet.<Amended by Act No. 11690, Mar. 23, 2013>

(3) Where the Minister of Security and Public Administration deems it necessary to simplify civil petition affairs, he/she may request the heads of the relevant administrative agencies to modify the time-periods for handling, required documents, handling procedures, and the methods of filing civil petitions, etc., as provided in related Acts, subordinate statutes, etc.<Amended by Act No. 11690, Mar. 23, 2013>

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 21 (Adjustment of Standards for Handling Civil Petition Affairs, etc.) (1) Where the Minister of Security and Public Administration deems it necessary to simplify civil petition affairs when he/she establishes and publishes the standards for handling civil petition affairs pursuant to Article 20, he/she may temporarily reduce the time-periods for handling and required documents, or change the handling procedures or methods of filing civil petitions, as provided in related Acts, subordinate statutes, etc. until such related Acts, subordinate statutes, etc. are amended in consultations with the heads of the relevant administrative agencies. <Amended by Act No. 11690, Mar. 23, 2013>

(2) Where the standards for handling civil petition affairs are adjusted and published pursuant to paragraph (1), the head of each administrative agency shall handle civil petition affairs according to such adjustment and publication, and the head of each central administrative agency shall amend and adjust related Acts, subordinate statutes, etc. without delay according to the adjusted or changed content of the standards for handling civil petition affairs.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 22 (Opening of Civil-Petition Offices)

Article 23 (Civil Petition Examiners) (1) The head of an administrative agency shall appoint a civil petition examiner from among public officials under his/her jurisdiction in order to confirm and check on the current status of the handling of civil petition affairs.

(2) Matters concerning the duties of civil petition examiners under paragraph (1) and other necessary matters shall be prescribed by Presidential Decree.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 24 (Implementation of One-time Visit Civil Petition Handling System) (1) When the head of an administrative agency handles civil petition affairs, he/she shall have a public official in charge of civil petitions directly confirm data that may be confirmable within such administrative agency and perform all procedures resulting from cooperation with related agencies and departments, thereby establishing the one-time visit civil petition handling system lest a civil petitioner should revisit the administrative agency for unnecessary reasons.

(2) The head of an administrative agency shall establish a counseling window for one-time visit civil petition handling in order to provide guidance and counseling convenience on the one-time visit civil petition handling system under paragraph (1).

(3) The one-time visit civil petition handling system referred to in paragraph (1) shall be implemented in accordance with the following procedures:

1. The operation of a counseling window for one-time visit civil petition handling;

2. The designation and operation of civil petition guardians;

3. The operation of a committee to deliberate on complex civil petitions;

4. Re-deliberation by a committee established for deliberation, adjustment, etc. of civil petitions;

5. Rendering final decisions by the head of an administrative agency.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 25 (Civil Petition Guardians)

The head of an administrative agency may designate public officials under his/her jurisdiction with abundant experience in handling civil petition affairs as civil petition guardians in order to provide guidance and counseling to civil petitioners for the effective operation of the one-time visit civil petition handling system.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 26 (Information Protection)

The head of an administrative agency shall endeavor not to infringe on the rights and interests of civil petitioners by divulging any detail relating to civil petitions and personal information of civil petitioners that he/she has learned in the course of handling civil petitions.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

CHAPTER III IMPROVEMENT OF CIVIL-PETITION ADMINISTRATIVE SYSTEM

Article 27 (Regular Inspection and Simplification of Civil Petition Affairs) (1) The head of each central administrative agency shall, every year, inspect the actual state of handling and operation of civil petition affairs under his/her jurisdiction.

(2) The head of each central administrative agency shall formulate a plan for simplifying required documents for civil petition affairs under his/her jurisdiction, handling procedures therefor, etc. in accordance with the results of inspection under paragraph (1).

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 28 (Confirmation, Check, Assessment, etc.) (1) When the Minister of Security and Public Administration deems it necessary for the improvement of efficiency of civil petition affairs, he/she may confirm, check, and assess each administrative agency's status of improvement of civil petition affairs and the actual conditions of the operation thereof. <Amended by Act No. 11690, Mar. 23, 2013>

(2) As a result of confirmation, check, and assessment under paragraph (1), where the Minister of Security and Public Administration deems that an administrative agency acts passively in improving civil petition affairs or its status of implementation is not satisfactory, he/she may recommend the Prime Minister to take measures necessary for the correction thereof.<Amended by Act No. 11690, Mar. 23, 2013>

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 29 (Gathering Public Opinion on Civil Petition Administration) (1) Where necessary for administrative agencies' handling of civil petitions, the Minister of Security and Public Administration may gather public opinion and reflect such public opinion in the improvement of the civil petition administrative system and the operation thereof. <Amended by Act No. 11690, Mar. 23, 2013>

(2) Matters necessary for gathering public opinion under paragraph (1) shall be prescribed by Presidential Decree.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 30 (Post Management of Civil Petitions Treated)

The head of an administrative agency may investigate the level of satisfaction of civil petitioners with civil petitions treated, matters requiring improvement, etc, and may reflect the results of such investigation in its business affairs.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

Article 31 (Handling of Public Proposals) (1) The head of each administrative agency shall receive and deal with public proposals on the improvement of government policies, administrative systems, and the operation thereof.

(2) Matters necessary for the operation of public proposals, procedures therefor, etc. under paragraph (1) shall be prescribed by Presidential Decree.

[This Article Wholly Amended by Act No. 11492, Oct. 22, 2012]

ADDENDA <No. 8171, 03. Jan, 2007>

Article 1 (Enforcement Date)

This Act shall enter into force six months after the date of its promulgation. (Proviso Omitted.)

Articles 2 through 6 Omitted.

ADDENDA <No. 8852, 29. Feb, 2008>

Article 1 (Enforcement Date)

This Act shall enter into force on the date of its promulgation. (Proviso Omitted.)

Articles 2 through 7 Omitted.

ADDENDA <No. 10012, 04. Feb, 2010>

Article 1 (Enforcement Date)

This Act shall enter into force three months after the date of its promulgation. (Proviso Omitted.)

Articles 2 through 6 Omitted.

ADDENDA <No. 11492, 22. Oct, 2012>

This Act shall enter into force on the date of its promulgation.

ADDENDA <No. 11690, 23. Mar, 2013>

Article 1 (Enforcement Date)

(1) This Act shall enter into force on the date of its promulgation.

(2) Omitted.

Articles 2 through 7 Omitted.