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Public Service Innovation Using Smart Governance

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Abstract

Purpose: This study determines the possibility of public service innovation to meet the rapid changes in information technology (IT) and the need for new governance by analyzing three cases in South Korea.

Methodology: The Smart Governance-Decision Support Systems (SG-DSS) in this study is a new form that guarantees the voluntary participation of citizens by applying IT to governance. SG-DSS supports the demand response that fulfills universal values and decisions about priorities by collecting citizens' needs. It also encourages citizens or stakeholders to participate in establishing implementation plans that are more specific and fit for reality, giving legitimacy to public service policies and developing them into a driving force.

Findings: The three case studies on Korean public policies show how public opinions reflect public service policies. Therefore, the findings of this study could lay the foundation for customized public services based on intelligent citizen participation by overcoming the current limitations.

Unique contribution to theory, practice and policy: SG-DSS supports the demand response that fulfills universal values and decisions about priorities by collecting citizens' needs. It also encourages citizens or stakeholders to participate in establishing implementation plans that are more specific and fit for reality, giving legitimacy to public service policies and developing them into a driving force. The core value of smart governance is to apply IT innovations such as big data and AI to public services. Furthermore, advanced technology enables the collection and application of actual public opinions, thereby improving public to be more objective and efficient.

Keywords: *Big Date, Text Mining, Smart Governance, Policies, Citizen Participation*

1.0 Introduction

Advanced technologies like those of the Fourth Industrial Revolution technologies significantly affect government operations or governance apart from changing the industrial structure. In particular, many countries are recently enhancing their national competitiveness by using information and communications technology (ICT) to provide convenience and promote the participation of citizens receiving public services (Bertot et al., 2010). While the focus in the past had been on building information and communication infrastructures and systems to provide public services, the form of services is changing off late. Thus, more citizens can enjoy the benefits by increasing the service utilization rates and making the services more accessible (Ameis, Lai, Mulsant, & Szatmari, 2020).

In this context, according to the trend, the Fourth Industrial Revolution will be used in the public sector too. With intensified environmental uncertainty and limited resources, Fourth Industrial Revolution technologies can be the tool to enhance administrative efficiency. Moreover, to provide quantitatively expanded and qualitatively intensified public services, these technologies can ensure that public decisions are taken rationally, thereby increasing democratic value. To efficiently provide public services, there must be a strategy to actively reflect public opinions on government policies using technical and systematic methods. Therefore, to fully establish service strategies to promote the efficiency of public services at the government level, it is necessary to improve the policy process from collection to the accurate evaluation of public opinions using technology (Hong et al., 2020).

However, despite this need, public services have not been effectively evaluated by citizens until recently. This raises the question of whether various public opinions are collected in evaluating public service policies and whether citizens can properly determine and evaluate the contents of government policies or administration (Holland, 2019; Kowalski et al., 2019).

Therefore, this study introduced the concept of “smart governance” that seeks cooperation with a broad range and great variety of stakeholders, breaking free from the conventional governance that limits participants and stakeholders from participating freely. This study also proposed the Smart Governance–Decision Support System Model (SG-DSSM) to effectively collect and analyze public opinions in an activated citizen participation environment based on ICT for future public services. The three case studies on Korean public policies show how public opinions reflect public service policies. Therefore, the findings of this study could lay the foundation for customized public services based on intelligent citizen participation by overcoming the current limitations.

2.0 Technological Advancement and Evolution of Governance

The latest ICTs referred to as the Fourth Industrial Revolution technologies such as big data, Internet of Things (IoT), and AI techniques, have made remarkable progress, rapidly transforming our society into an intelligent, automated information society. The rapid development of the most advanced technologies is improving the quality of individual life and accelerating change and innovation in society and government policies (Orben, 2020; Brem et al., 2021).

The development of ICT along with the Fourth Industrial Revolution technologies has raised people’s expectations that they can now overcome time and space constraints and experience direct democracy instead of indirect democracy (representative democracy) in the public sector (Kim, 2006). Direct democracy can be inefficient since it requires more time and cost in making decisions than indirect democracy. However, there is no doubt that it can more

accurately express public opinions (Kim, 2006; Bowler et al., 2020). In other words, indirect democracy has a disadvantage in that public opinions may be distorted just for efficient decision-making. However, direct democracy is receiving attention again with its potential for communication using ICT like the Internet.

2.1 Transformation into Participatory Governance

Due to the limitations of the new public management system, discussions on a new system began to induce the cooperation of citizens without leaving everything to market principles by strengthening government responsibilities (Rhodes, 1996; Lemos, & Agrawal, 2006; Kim, 2006; Smismans, 2008; Bell & Hindmoor, 2009; Gustafson, & Hertting, 2017). In this process, the concept of new governance or participatory governance has been adopted, wherein the government actively listens to and reflects on the opinions of civic groups, private enterprises, and residents regarding state affairs in collaboration with citizens, thereby inducing their participation in the policy process (Smismans, 2008; Gustafson, & Hertting, 2017). Those who best understand and most enthusiastically resolve the pending issues that require public interventions are the ones who actually face the issues. The governance system has utility because it allows stakeholders to solve the problems themselves while the government supports them.

Currently, the socioeconomic system is based on neoliberalism. However, in terms of guaranteeing the fundamental rights of citizens and government responsibilities, participatory governance is becoming a new policy paradigm. However, the concept of governance we are currently using is still in paradigm state, which cannot be scientifically proven or used as a deductive argument. It is merely a social concept created to solve the problems revealed in the policy process. Therefore, the definition of governance used in this study is based on the concept of participatory governance.

2.2 Policy Governance Implementing IT Innovation

One of the reasons why Korean society must maintain representative democracy is because individual opinions cannot be integrated into collective opinions (Urbinati, 2011; Tormey, 2014). This is because there was no realistic way to make a single decision that reflects all individual opinions based on individual communication. The development of IT is now infinitely expanding our communication space and speed. Subsequently, it raises the question: Can the development of communication skills among members of society in life be a way to overcome the limitations of representative democracy? This is where thoughts about smart governance, new state management, and policy formation system begin. The policy process is already changing toward a new direction with a close relation to the change in IT. The new governance that attaches importance to communication and cooperation among various stakeholders away from the government's one-way policy implementation has been producing certain outcomes in establishing and implementing policies based on the cooperation of the government, firms, and residents. However, the limitations in participants kept multiple stakeholders from freely participating without constraints. Now is the point where the existing governance system with limited stakeholders must evolve into smart governance using IT to promote communication and collect opinions from more extensive and diverse stakeholders.

2.3 Fourth Industrial Revolution Technologies and Smart Governance

When dealing with local issues regarding public services, policies are designed based on the best practices from other areas to save time and cost in policy planning and verification (Bovaird, 2007). Before the development of IT, it had been impossible to formulate a complete

policy by reviewing and integrating all opinions collected from many stakeholders. However, the development of IT that connects people has promoted communication among multiple stakeholders and brought justice.

The technological advancement today that we refer to as the era of the Fourth Industrial Revolution can be applied to social science in building an intelligent governance system. With this technological advancement, many citizens can offer their individual opinions about policies anytime and anywhere using the Internet and high-tech devices (de Jong et al., 2019). The development of technology and governance simplified or automated the process of complicated multilateral conversations and communication in the participation of multiple stakeholders. In addition, the evolution of communication tools and the advancement in text analysis technology made communication and cooperation possible between citizens and the government, which had previously been impossible before due to time and cost issues (de Jong et al., 2019; Kambil et al., 1999; Kang, 2014; Hong et al., 2015).

In conventional governance, policies are established and implemented by agents rather than encouraging the direct participation of stakeholders due to physical and time constraints. However, Smart Governance (SG) solves these problems and enables various stakeholders to directly participate and cooperate. SG is a new form of governance that guarantees voluntary participation (co-creation) of stakeholders by applying IT to governance (de Jong et al., 2019; Kambil et al., 1999; Hong et al., 2015). SG is practical and effective as it solves social problems and creates values with a focus on participants through active participation by members of the society based on IT such as the Internet, smart devices, and social networking service (SNS) (Sarker et al., 2018; Davies, 2015; Michael, & Miller, 2013; Siugzdiniene et al., 2019; Scholl, & Scholl, 2014). In particular, the social participation of the public on social media has brought a change in how social issues are selected and how new trends are set, in addition to increasing the number of smartphone and SNS users. Social media has an influence as new personal media that enables two-way communication instead of one-way communication by traditional mass media (Hong et al., 2015; Tang et al., 2015; Ross et al., 2015; Baptista, & Galliers, 2012; Wickramarachchi, 2014; Frederick et al., 2014). In addition, with the change in the policy environment due to the active use of social media, users are making more suggestions, and personal issues sometimes lead to policy agendas (Hong et al., 2015). Therefore, SG is a government form that is closer to representative democracy as a concept that is focused on policy users through active citizen participation, solving social problems, and creating values with a focus on citizens beyond government-led policy implementation strategies of the past.

3.0 Public Service Decision Support System Applying Smart Governance

The Smart Governance–Decision Support System (SG-DSS) in this study is a new form that guarantees the voluntary participation of citizens by applying IT to governance. SG-DSS supports the demand response that fulfills universal values and decisions about priorities by collecting citizens' needs.

3.1 Analysis of a Public Opinions using Big Data

The diffusion of social media such as SNS and Twitter has enabled the public sector to directly determine the actual public awareness of government policies, serving as a channel of communication where citizens can express their opinions (Ross et al., 2015; Baptista, & Galliers, 2012; Ju et al., 2018). Big data are used to analyze civic consciousness for the following reasons. First, it is efficient in fields that need quick large-scale decisions. Second, extensive and diverse data sources provide better insight into social problems. Big data can be used even when the data are limited or cannot be obtained to solve a problem. Third, big data

analysis in the public sector enables evidence-based policy development in establishing and implementing policies. The use and expected outcomes of policies are mostly focused on prediction based on information, and using big data for more accurate prediction. Moreover, it enhances the government's work efficiency, provides customized services for citizens, and enables preemptive measures for disasters and risks (Bright, & Margetts, 2016).

In public services, there are not enough opportunities and systems for the general public to have their individual opinions heard and applied to policies. Public opinions and needs are examined through surveys or experts, but there are limitations such as distortion of information due to limited samples or artificial survey methods. Text mining can be one-way to overcome these limitations as it directly analyzes the text, a typical form through which people express their views and exchange information online and offline (Bright, & Margetts, 2016). With the recent development and diffusion of the Internet and mobile devices, it has become easy and common for the public to actually express their views or information online. Resultantly, it led to a remarkable increase of text data generated from blogs, SNS, online news, online bulletin boards, and Internet communities (Baptista, & Galliers, 2012; Wickramarachchi, 2014). Thus, there are attempts to explain various social phenomena that had not been covered in structured data mining before by analyzing this unstructured text data.

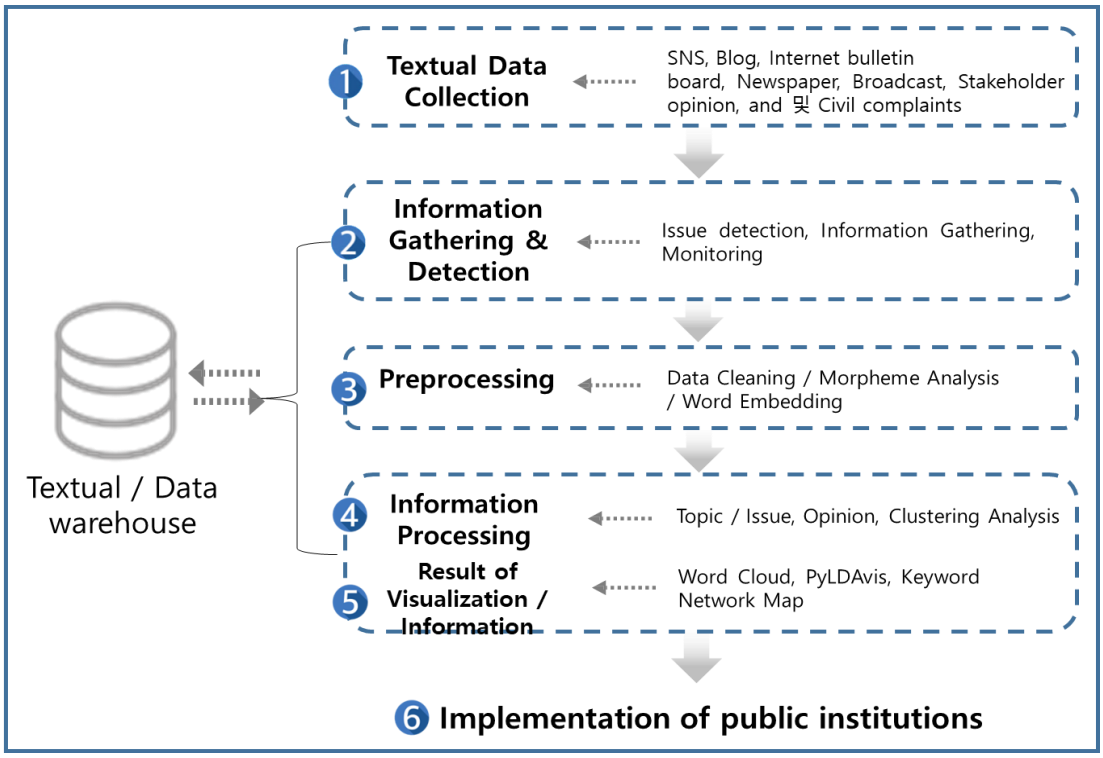

Figure 1: Analysis step of smart governance decision support system: written by Author

3.2 The Smart Governance Decision Support System for Public Service

The smart governance model in public service presented in this study is shown in <Fig. 1> below. Public opinions are collected through SNS, Twitter, bulletin boards, the press, or stakeholder views and civil complaints (Bright, & Margetts, 2016; Hong et al., 2019). This information is analyzed by applying various methodologies to analyze issues or user opinions.

The results are visualized so that users and public institutions can easily understand. Consequently, these results can be used by public institutions to reflect public opinions and provide higher-quality services.

3.2.1 Collection of Public Opinions Data

Collection of public opinions, which is the first step of the public service decision support system applying smart governance, is done by using an automated method that involves a computer to save time and cost. Web crawling, web scraping, and open API (application programming interface) are mostly used for data collection.

3.2.2 Text preprocessing

The preprocessing step requires morphological analysis, which is identifying the structure of various language attributes such as part of speech, root, suffix, and prefix (Ryu et al., 2018). Data preprocessing is performed as shown in <Fig. 2> below.

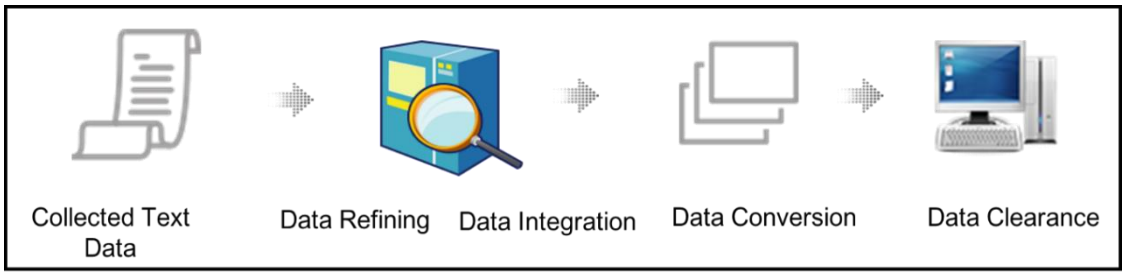

Figure 2: Text preprocessing step (Ryu et al., 2018)

①Data Cleaning: Increasing data reliability by filling up the missing values or eliminating outliers ②Data integration: Integrating and expressing multiple refined data ③Data conversion: Conversion and transformation to increase data mining efficiency ④Data reduction: Producing the same analysis results while reducing data size.

3.2.3 Information processing

For qualitative improvement of customized public services, it is necessary to collect public opinions scattered around multiple channels and develop key issues.

(1) Keyword frequency analysis

Keyword frequency analysis is a method that extracts keywords that are frequently mentioned in a specific group of documents and analyzes their importance based on frequency (Ryu et al., 2018). Term frequency (TF) represents how frequently a certain term appears in the document, and higher TF may imply that this term is important within the document. However, when the term itself is frequently used within the group of documents, this means that the term appears frequently. This is referred to as document frequency (DF), and the inverse number of this is inverse document frequency (IDF) (Lee et al., 2020). TF–IDF is TF multiplied by IDF.

(2) Association keyword analysis

Association keyword analysis is a development of keyword frequency analysis, which extracts associated words that are mentioned along with the main keyword within the document and analyzes which topics are associated with the keyword (Ryu et al., 2018). For example, pairs of terms that appeared simultaneously in one news article are extracted, and the pairwise

frequency and association of keywords in the entire set of documents are analyzed. It tracks the key issues on the media and the change in its connectivity. Relevance among key issues can be structurally identified by conducting an association keyword analysis after classifying the keywords by topic.

(3) Topic modeling

Topic modeling is an analytical technique that automatically extracts certain topics, issues, or topic groups that represent the text based on the pattern of simultaneous use of keywords in the text data (Hong et al., 2019). This method assumes that individual documents can cover multiple topics. In other words, the collected document data are regarded as a random mixture of these topics, and each topic can be represented by the extracted keywords. Topic modeling includes latent semantic analysis (LSA) and latent Dirichlet allocation (LDA) (Lee et al., 2020).

(4) Social network analysis

Social network analysis shows how certain issues are manifested and diffused by analyzing the correlation among documents or users that form the network on SNS (Ryu et al., 2018). This technique regards individuals as nodes and their social relations as links to obtain the social network and analyze its linkage and intensity. It is mostly used to find out which path certain messages are transmitted to or which influencers serve as the hub or center of word-of-mouth on the network.

(5) Classification analysis

Text classification is the process of building a classification model with learning data and text input to determine which class the text belongs to, mostly using machine learning. These techniques include Naive Bayes, support vector machine (SVM), random forest, and neural network (Kim, & Lee, 2018). Deep learning, a typical form of machine learning, is emerging as an effective solution for various text mining problems such as document classification and clustering, document summarization, web mining, and sentiment analysis (Hong et al., 2019). Thus, more and more studies are using a convolutional neural network (CNN) and recurrent neural network (RNN) based on deep learning. LSTM, an RNN, shows excellent performance in natural language processing (Hong et al., 2019; Ryu et al., 2018; Lee et al., 2020; Fang, & Zhan, 2015). It is mostly used in the language model that calculates the probability of the next word based on the previous word in a given sentence or in machine translation that determines which sentence is better as the output of automatic translation.

(6) Sentiment analysis

Social media has grown rapidly based on SNS, and various individual experiences, opinions, and information are produced and shared. Consequently, it results in the continuous development of text analysis techniques through which users can quickly find the data they need and extract meaningful information from a massive text produced on social media. Sentiment analysis is a typical technique applied to text analysis using opinion mining (Hong et al., 2019; Smiraglia et al., 2021). Sentiment analysis is used to determine whether certain topics are positive or negative using data such as people's attitudes, opinions, and dispositions. It identifies the emotions authors have toward the topics rather than finding what the topics are. Sentiment analysis is receiving attention as a tool that extracts and analyzes individual sentiments, emotions, or opinions in natural language processing (NLP) (Kim et al., 2018). In particular, it is useful in determining the positive and negative preference for structured or unstructured text collected online, such as social media. Studies on sentiment analysis have actively been conducted in Korea and overseas since the early 2000s using various techniques.

The main topics include movie reviews, product reviews, travel reviews, and stock-related issues applying social media, Twitter, and blogs.

(7) Facet analysis

Facet analysis is a technique mostly used to classify books in library and information science (Smiraglia et al., 2021). Facet is defined as a small plane surface. However, the concept of facet used in library and information science refers to "one of many aspects that make up the whole text." It indicates "conceptual categorization" in the broad sense and "group of concepts that organized elements that compose certain topics in general terms" in the narrow sense. Generation of ontology among texts using the concept of a facet can be useful in separating concepts that are not related nor similar and grouping the ones that are related or similar (Lee et al., 2020; Kim, & Lee, 2018). In particular, it provides a system to organize the concepts included in the text into a hierarchical structure in individual units. A faceted framework can be constructed to disassemble certain aspects out of many to be identified from the text. Furthermore, machine learning (deep learning) can be used to analyze the aspects of new documents by learning multiple aspects of the document.

3.2.4 Visualization and digitization of information for results

The results of analyzing various public opinions must be visualized so public service policy practitioners can easily interpret the results.

(1) Word cloud

Word cloud is named after the cloud shape used to present data. It can be expressed in the form of a graph or in a big size to emphasize extensive data and even include the size of data inside the cloud. It is commonly used to visualize the word frequency data. It is difficult to obtain greater information since it is more meaningful to arrange data in terms of correlation or similarity rather than expressing the frequency.

(2) PyLDAvis

PyLDAvis is a Python library that visualizes the results of LDA models used in topic modeling. In LDA, documents are a mix of topics, and topics create words based on probability distribution. When data are given, LDA back-tracks the process of document creation. <Fig. 3> below is an example of the LDA visualization result of Amazon product reviews.

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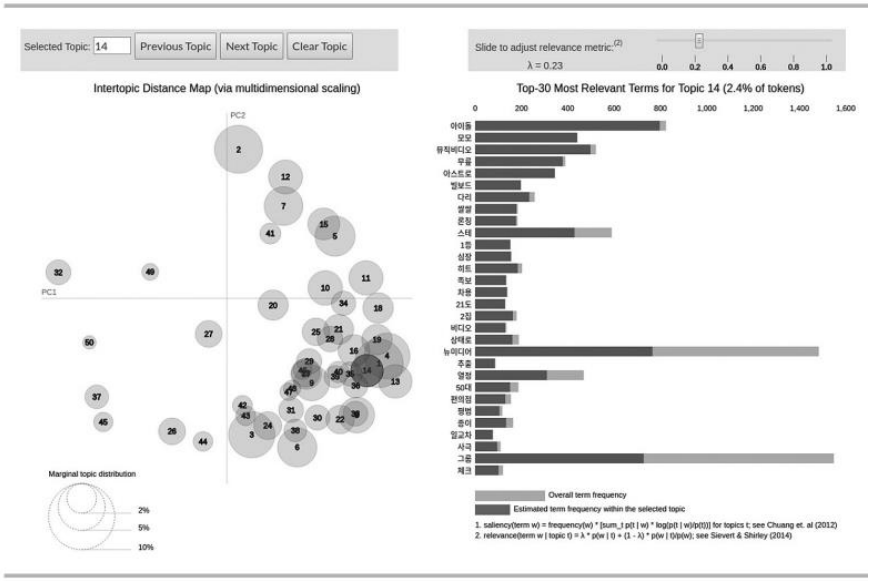

Figure 3: Visualization of the LDA model using PyDAvis (Nikita, 2016)

(3) Visualization of social network analysis

Social network analysis shows how certain issues are manifested and spread. By visualizing the results of analysis, it is possible to capture at a glance the relations among keywords in addition to frequency, thereby obtaining more information than word clouds.

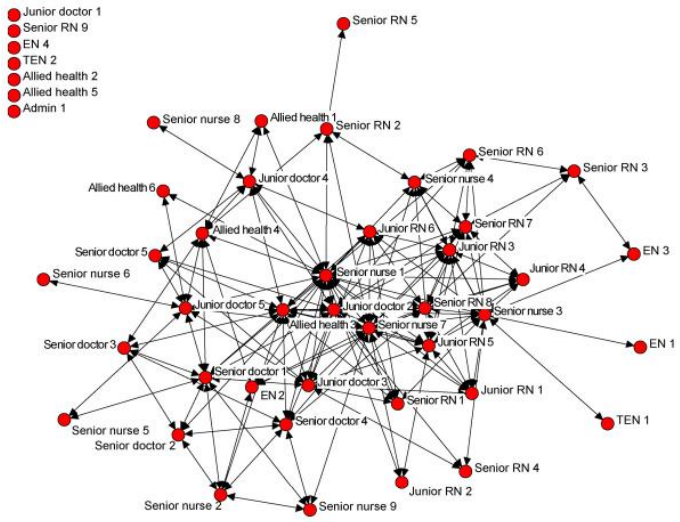

Figure 4: Visualization of social network analysis (Ryu, 2018)

4.0 Exploring the Applicability of Smart Governance to Public Services

The applicability of smart governance to public services is described based on research cases in which some methodologies among text mining technologies are applied.

Case Study 1: Civil complaints about buses in Busan (Ryu et al., 2018)

In this case, issues related to buses, one of the chronic civil complaints raised by citizens living in the outskirts of Busan, were resolved using smart governance. According to Ryu et al., (2018), customized public service was provided by applying text mining techniques to the decision-making model process presented by smart governance.

Civil complaints about buses were raised by residents with poor access to public transportation for three years from 2015 to 2017 on the Busan Metropolitan City's public service board. To resolve the complaints, Busan analyzed the difficulties and opinions of the residents and applied the procedures of the public service decision support system to come up with a solution.

Step 1: Information gathering & detection

Out of 10,421 civil complaints on the Busan Metropolitan City website in the last three years from 2015 to 2017, around 6,300 (60%) complaints were about the inconvenience of using the buses, raised by residents living in areas with poor access to public transportation. The contents of the civil complaints were collected using web crawling to identify the issues from various public opinions.

Step 2: Text preprocessing

To analyze the contents of civil complaints, it is necessary to perform data preprocessing using text mining. This study converted the XLS (Excel) file to TXT (text) file. From text files, words that form the document data were extracted using morphological analysis. This process required tokenization that separates words from character strings using a Python library, stop-word elimination that eliminates unnecessary words, and stemming that extracts the basic form of words.

Step 3: Information processing

Frequency analysis and social network analysis of text mining were conducted to analyze the text after preprocessing. Frequency analysis is conducted to select keywords with high relevance to the research topic. Words with top frequency and words with at least a certain frequency were extracted. Keywords with high-frequency included "bus route," "commuting," "bus station," and "stop violation" as shown in <Fig. 5>. With local issues regarding public services, policies are designed based on the best practices from other areas to save time and cost in policy planning and verification

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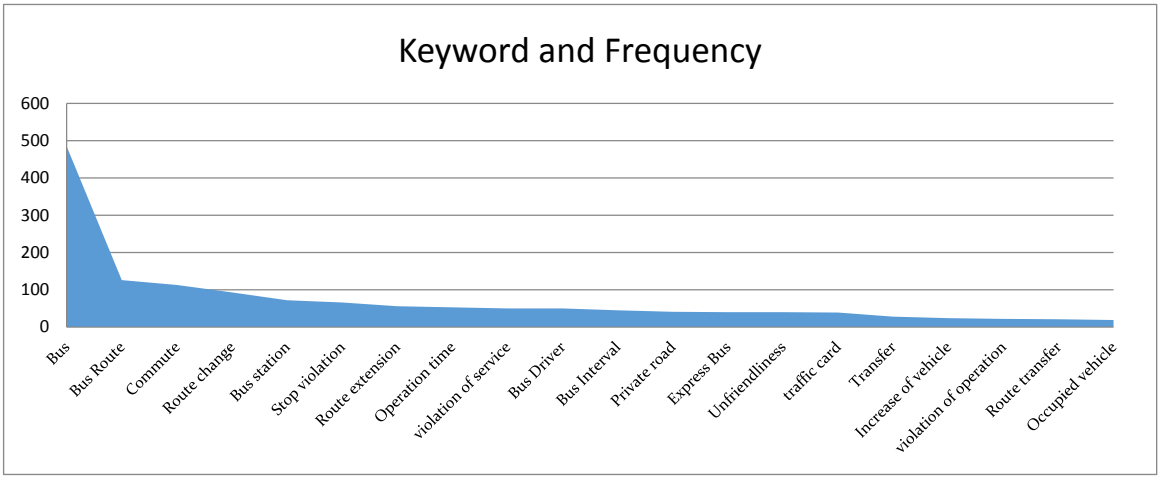

Figure 5: Keywords occurring multiple times and frequency

The network of main keywords were analyzed to determine the importance and relational structure of each keyword based on high-frequency words in civil complaints, which is visualized as shown in <Fig. 6>.

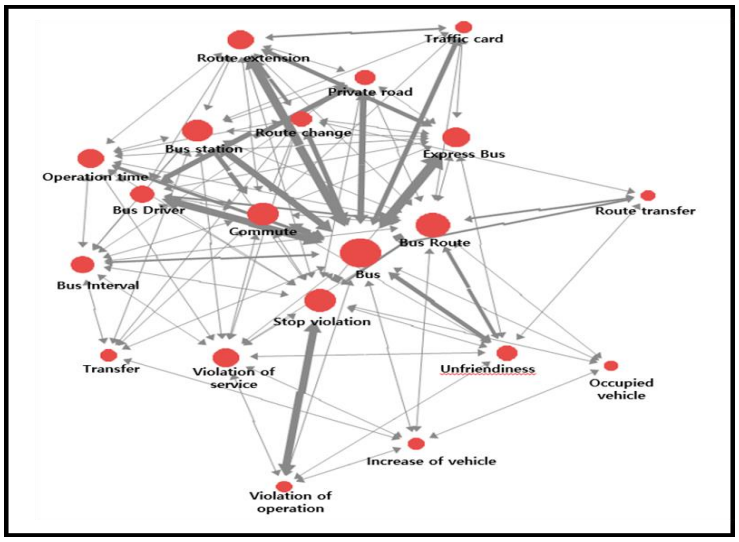

Figure 6: Network visualization network

This network analysis shows how certain issues are manifested and spread. Keywords with high connectivity are shown in big circles and those with low connectivity in small circles. Keywords with low connectivity are serving as the hubs of those with high connectivity in the entire network. For example, circles of “bus,” “route,” “interval,” and “transfer” are relatively bigger than others. The links between “bus” and “route” and between “bus” and “route extension” are the thickest, indicating that the nodes are most actively interacting. As a result, the issues that are related to buses are bus route complaints, bus interval, commute, route extension, and violation of service.

Step 4: Supporting decision & implementation

Busan Metropolitan City provided customized public service measures to increase bus routes that connect the outskirts of Busan to downtown and also increase nonstop buses to solve problems related to buses that cause complaints and inconvenience to citizens with poor access to public transportation. For citizens living in certain areas, the bus intervals during rush hour were also reduced from 20 to 10 minutes, and the bus operating hours were extended by 30 minutes each. Regarding rudeness and traffic violation of bus drivers, a smartphone application was developed for users to report to public institutions on a real-time basis. Busan Metropolitan City also made it mandatory for bus drivers to receive training on the basic mindset and service attitude required by bus drivers. This case provided customized public service for citizens living in areas with poor access to public transportation. To meet the rapidly changing demands in time, the government as the public service provider must detect various changes and meet the changing needs of active consumers. Moreover, it is necessary to provide not only services that benefit all users of public services but also customized services that can meet the needs of specific individuals or groups.

Case Study 2: Analysis of public parking lot service (Kim et al., 2018)

Step 1: Issue

Complaints were constantly raised about parking issues on the civil complaint bulletin board of the city's website that caused chronic inconveniences for residents and tourists.

Step 2: Data collection

This study collected data from the public service board on the official Busan Metropolitan City website. There were approximately 10,000 civil complaints on the public service board entitled "Parking Problems."

Step 3: Data preprocessing

To analyze the contents of civil complaints, it is necessary to perform data preprocessing using text mining. This study converted the XLS (Excel) file to TXT (text) file. From text files, words that form the document data were extracted using morphological analysis. This process required tokenization that separates words from character strings using a Python library, stop-word elimination that eliminates unnecessary words, and stemming that extracts the basic form of words.

Step 4: Data analysis

Frequency analysis and social network analysis were conducted to analyze the text after preprocessing. Frequency analysis shows the most frequently occurring words in the civil complaints, as shown in <Table 1>. Social network analysis shows how certain issues are manifested and spread, as shown in <Fig. 7>.

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Table 1: Keywords frequency

No.	Keywords	Frequency	No.	Keywords	Frequency
1	Illegal parking	245	9	Traffic lights	65
2	Public Parking lot	198	10	Station	54
3	Parking information	110	11	Danger	50
4	Parking penalty	98	12	Road	48
5	Parking fee	88	13	Driving	47
6	Towing	82	14	Illegal	35
7	Traffic congestion	71	15	Traffic accident	18
8	Crackdown	68	16	Refusal of passengers	10

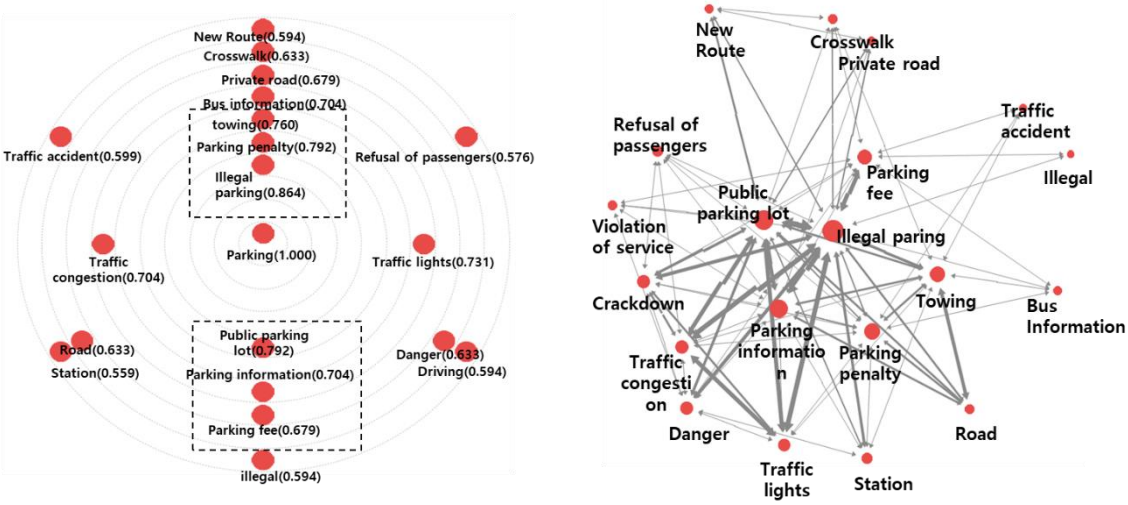

Figure 7: Social network analysis

As a result, many issues were raised about illegal parking and public parking lots. Issues about illegal parking included a fine for negligence, complaints about towing, traffic jams, and danger. Issues about public parking lots included lack of parking space and parking information as well as fee issues.

The fundamental problem of parking in the city could be solved by efficiently managing parking lots to ensure enough parking space. However, Busan Metropolitan City analyzed public opinions once again to improve the quality of public service.

Step 5: Implementation of measures by public institutions

Busan Metropolitan City chose to improve the operating service of public parking lots to solve the problem of parking space. To determine the adequacy and effectiveness of the chosen plan, Busan Metropolitan City collected public opinions for service improvement in public parking lots. Specific issues and solutions were determined by analyzing the semantic network on the collected opinions. The results showed serious parking issues near BEXCO (Busan Exhibition

and Convention Center), and it was necessary to provide the location and information of the parking lot so that users could use the service conveniently.

Accordingly, Busan Metropolitan City provided a "parking information service" on a smartphone application to resolve the parking issues. The information provided includes the location of the parking lot, available parking space, and parking rates. An application was developed to provide parking information service of public parking lots, after which user opinions were collected to determine service satisfaction and matters that need improvement. Data was collected from user reviews and SNS, using sentiment analysis that analyzes the sentiment toward specific topics, topic analysis that extracts certain topics, issues, and topic groups, and social network analysis that analyzes the connection and diffusion of various issues. The result of sentiment analysis showed an 80% positive data in service satisfaction. The results of topic analysis and social network analysis showed inconveniences due to concentration in lower-priced parking lots, service expansion to private parking lots, and the information update cycle. Thus, it established that services can be improved by attracting users to private parking lots nearby to prevent concentration of users, providing real-time information, and reducing inconveniences due to time differences.

Case Study 3: Analysis of the government's five-day rotation face mask distribution system in the COVID-19 pandemic (Lee et al., 2020)

In response to the COVID-19 global pandemic, governments of each country are taking hardline measures to prevent and spread the virus. Korea has been able to control COVID-19 because of the government's quick and effective measures since January 20, 2020, when the first confirmed case was determined. This is considered as one of the best practices of controlling COVID-19 by many other countries. The Korean government strongly recommends citizens maintain social distancing, wash their hands, and wear face masks. Face masks have been hard to get in not only Korea, but also many countries since the virus is known to spread by droplet infection. When not all citizens could freely buy face masks due to limited supply compared to the rapid increase in demand, the government announced the "five-day rotation face mask distribution system" to stabilize the supply and demand. This system confused many citizens at first.

Step 1: Issue

This study derived citizens' needs by applying the smart governance decision-making process based on the experiences and opinions of citizens that are actual users regarding policy issues in the government's five-day rotation mask distribution system.

Step 2: Data collection

Online news articles and posts on online cafés about the system were analyzed to identify the mass media and social media agendas that contain the media and public responses as well as the differences. For analysis, 5,096 full-text Naver news articles and 7,840 café posts were collected.

Step 3: Data preprocessing

The collected data was preprocessed through morphological analysis, tokenization, normalization, and stop-word removal.

Preprocessing refers to refining text data so that it is suitable for analysis, and this requires the

most time among other text mining methods. Nouns were extracted through morphological analysis of the collected data, after which preprocessing was performed repeatedly to refine the data for analysis. Data that is not preprocessed may affect data analysis results due to problems in word spacing and synonyms. First, User Dictionary on NetMiner was used to process words like "app" and "application" or "COVID-19," "coronavirus" and "Wuhan virus" as the same word. In addition, the same words with different spacing were also refined as one word. Second, words unnecessary for analysis, such as the name of the press or journalist were excluded. Finally, certain words such as "COVID-19" and "public mask" were included in all documents, which do not provide differentiated information in extracting topics and thus were excluded.

Step 4: Data analysis

First, term frequency analysis was conducted on nouns related to the five-day rotation face mask distribution system. The results were visualized in a word cloud after frequency analysis, and LDA topic modeling analysis was conducted based on word frequency. The results showed that mass media like the press mostly delivered information such as the current status of the COVID-19 pandemic, social movements, government policies, and frauds in mask distribution, with keywords such as "infection," "hospital," "preventive measures," "price," and "police investigation." Conversely, social media that represents the voices of citizens reflected individual characteristics, showing topics related to real-life such as "proxy purchase," "delayed school opening," "how to wear a mask," and "where to buy a mask," which indicates that social media serves as a venue for individuals to exchange opinions, emotions, and information.

To decide on the number of topics in news articles, this study set the number of topics to 9 after testing with any number between 5 and 15 and conducted topic modeling with iteration=1000, α=0.1, β=0.01 based on the studies by Zhao et al. (2015) and Lu et al. (2011). Topics of news articles and café posts are as follows table2 & 3.

Table 2: Topics of news articles

Number of Topic	1	2	3	4	5	6	7	8	9
Number of Document	209	207	416	155	376	168	229	131	205
lable of Topic	Infection	mask supply	mask support	mask fraud	5-day Rotation Mask Distribution	social movement	mask stock information	government	emergency disaster measures
keyword 1	definite diagnosis	company	support	sale	pharmacy	people	information	citizen	aid
keyword 2	Infection	government	region	police	purchase	usage	service	government	school
keyword 3	hospital	supply	distribution	Seoul	5-day rotation	requirement	provide	the Democratic Party	start of a new semester
keyword 4	patient	production	center	report	sale	hand	App	broadcast report	countermeasure
keyword 5	Dae-gu	distribution	citizen	fraud	execution	situation	inventory	representative	government
keyword 6	Prevention	quantity	vulnerable social group	distribution	resident	online	date	economy	supplementary budget
keyword 7	group	filter	cotton	investigation	birth	degree	present condition	policy	prevention
keyword 8	Center	policy	manufacture	being related	time	social movement	pharmacy	politics	minister
keyword 9	area	price	delivery	company	pharmacist	virus	development	integration	supply
keyword 10	church	imitation	citizen	purchase	deliver	exercise	sale	candidate	present condition

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Table 3: Topics of café posts

Number of Topic	1	2	3	4	5	6	7	8	9
Number of Document	162	86	95	70	319	193	612	198	105
lable of Topic	usage of mask	mask support	cluster infection	postponement of starting school	mask purchase	mask stock information	substitute purchase	5-day Rotation Mask Distribution	mask supply
keyword 1	usage	supply	people	postponement	pharmacy	App	home	purchase	government
keyword 2	filter	region	church	school	time	information	child	5-day rotation	price
keyword 3	cotton	social	country	law	line	inventory	check	birth	sale
keyword 4	virus	hospital	Korea	students	people	pharmacy	mother	pharmacy	supply
keyword 5	disinfection	medical treatment	worship	solution	pharmacist	sale	purchase	possibility	company
keyword 6	hand	need	think	public official	the front	check	husband	resident	citizen
keyword 7	wear	center	definite diagnosis	study	sale	service	specified day	sale	distribution
keyword 8	degree	welfare	Infection	no charge	think	oline web-site	bridegroom	substitute	quantity
keyword 9	oneself	economy	situation	counseling	work	present condition	small size	ID card	production
keyword 10	product	donation	world	children	degree	Naver	family	end of the phone number	insufficiency

Step 5: Expected support for implementation of measures by public institutions

This study examined how the press and public responded to the five-day rotation face mask distribution system in the COVID-19 pandemic. It analyzed news articles that represent traditional mass media and café posts that represent social media and compares mass media and social media to determine the differences. This study can be used as a reference for the process of policy agenda setting in which social issues turn into public agendas and then into government agendas based on media analysis. Once sufficient data are obtained, time-series topic analysis can be conducted to analyze the topics divided into events at each time point. Moreover, various implications can be derived by analyzing the characteristics and changes in each section.

5.0 Conclusion

The provision of public services is a government activity to solve problems and offer a desirable environment that meets the needs of members of society. Citizens must be able to participate more enthusiastically in public services offered by the government. In addition, it is necessary to accurately analyze their opinions about public services based on participation and use the results as information to improve and develop services.

The quality of public services has thus far been evaluated by experts, surveys, or evaluation models. These methods may have limitations in that the researchers set the direction they want instead of collecting various public opinions. To overcome these limitations, this study aimed to apply the concept of smart governance to provide public services based on citizens' needs and assessment of government policies with the participation of citizens and policy stakeholders online. In addition, it aimed to implement administrative services or policies that are consistent

with citizens' needs based on adequate information like anticipated responses toward potential services.

The following outcomes can be anticipated from developing and improving public services with the application of smart governance.

First, there will be a change in how citizens participate in public service policies. The Internet allows the government to implement open policies with transmission capacity, flexibility, interactivity, and low costs (Hong et al., 2015). It also increases public access to government policies, promotes trust in the government, and provides the opportunity for more citizens to freely participate in the policy process. This overcomes the limitations of the conventional citizen participation method and opens up new possibilities for citizens' responses to policies. Citizen participation has significance as a new participation system that overcomes the limitations of responsiveness in conventional democracy and transcends time and space. It is a good method of participation as citizens can express various opinions in an open space.

Second, various policy demands can be verified and fulfilled through public opinions. Citizen demands online are developing constantly for the fulfillment of diverse policy demands and effective and efficient administration in public services such as environment, healthcare, energy, and welfare (Kim, 2006). For example, Kang (2014) presents the case in which the Internet promoted the citizen policy network on social issues and brought a change in public policies.

However, IT development does not necessarily guarantee public service innovation. The development of public services in the information age must be supported by the efforts of IT users as well as social systems. It is impossible to develop public services without the government's transparent information disclosure, sincere response to national or stakeholder demands, and the active and serious participation of citizens.

6.0 Limitations

There are the following limitations in analyzing the opinions of citizens using public services with big data.

First, too much time and costs are required for government agencies to collect citizens' opinions about public services. Second, the contents of civil complaints cannot be easily used because it is difficult for administrative agencies to obtain qualitative data necessary for analysis, such as complaints or opinions. The public opinion platform built by the government is also not really activated in many cases, and the quantity of posts by citizens on public websites also makes it difficult to analyze with significance. Third, there are technical and environmental issues. The relationship between the government and citizen participation is affected by not only the technical factors but also organizational, institutional, and environmental conditions. For example, the qualitative level of the e-government system that can provide various communication channels for citizen participation as well as the difference in information leadership that can provide institutional and managerial support for citizen participation may lead to a gap in participation effectiveness (Kim, 2006). Moreover, the political and social attributes of local communities related to each policy sector may also provide different motives or conditions for citizens to access the policy process in cyberspace.

Public services are created to satisfy the citizens that are service users. Since the citizen demands for public services are being more diversified, the government as the service provider is facing difficulties in meeting these diverse needs and providing services that can satisfy them. From the perspective of implementing citizen-centered public policies and customer-

oriented public services, efficient collection and analysis of public opinions are critical elements in providing user-centered services. The results of collecting and analyzing public opinions regarding public services can be used to improve public service quality, which will ultimately improve performance. Public services must further be developed toward the direction aimed by smart governance, as suggested in this study.

Reference

Ameis, S. H., Lai, M. C., Mulsant, B. H., & Szatmari, P. (2020). Coping, fostering resilience, and driving care innovation for autistic people and their families during the COVID-19 pandemic and beyond. *Molecular Autism*, *11*(1), 1-9.

Baptista, J., & Galliers, R. D. (2012, January). Social media as a driver for new rhetorical practices in organisations, In 2012 45th Hawaii International Conference on System Sciences (pp. 3540-3549). IEEE.

Bell, S., & Hindmoor, A. (2009). Rethinking governance: The centrality of the state in modern society. Cambridge University Press.

Bertot, J. C., Jaeger, P. T., & Grimes, J. M. (2010). Using ICTs to create a culture of transparency: E-government and social media as openness and anti-corruption tools for societies. *Government information quarterly*, *27*(3), 264-271.

Bowler, S., Dobbs, R., & Nicholson, S. (2020). Direct Democracy and Political Decision Making. In Oxford Research Encyclopedia of Politics.

Bovaird, T. (2007). Beyond engagement and participation: User and community coproduction of public services. Public administration review, 67(5), 846-860.

Brem, A., Viardot, E., & Nylund, P. A. (2021). Implications of the coronavirus (COVID-19) outbreak for innovation: Which technologies will improve our lives?. Technological forecasting and social change, 163, 120451.

Bright, J., & Margetts, H. (2016). Big Data and Public Policy: Can It Succeed Where E-Participation Has Failed?.

Davies, R. (2015). e-Government: Using technology to improve public services and democratic participation. *European Parliamentary Research Service*.

de Jong, M. D., Neulen, S., & Jansma, S. R. (2019). Citizens' intentions to participate in governmental co-creation initiatives: Comparing three co-creation configurations. Government information quarterly, 36(3), 490-500.

Fang, X. & Zhan, J. (2015), "Sentiment analysis using product review data," Journal of Big Data, 2–5.

Frederick, E., Lim, C. H., Clavio, G., Pedersen, P. M., & Burch, L. M. (2014). Choosing between the one-way or two-way street: An exploration of relationship promotion by professional athletes on Twitter. Communication & Sport, 2(1), 80-99.

Gustafson, P., & Hertting, N. (2017). Understanding participatory governance: An analysis of participants' motives for participation. The American Review of Public Administration, 47(5), 538-549.

Holland, B. (2019). Factors and strategies that influence faculty involvement in public service.

Building the Field of Higher Education Engagement: Foundational Ideas and Future Directions.

Hong, S. G., Ryu, S. E., Kim, N. R., Lee, T. H., Lee, S. M., & Ahn, S. J.(2020) Smart Governance Policy Process Innovation, Youwon Books, 2020

Hong, S. G., Lee, H. M., Han, S. E., & Kim, J. W. (2015). A Study on the Youth Job Creation Problem Solving with a Co-creation Approach: Focusing on the Busan City. *Journal of the Korea Industrial Information Systems Research*, *20*(1), 91-102.

Hong, S. G., Ryu, S., E., & Ahn, S., J. (2019), Sentimatal analysis on urban regeneration policy: Focused on reviews of Gamcheon culture village, Journal of the Korean Data And Information Science Society, 30(6), 1233-1244.

Horvitz, E. (2016). One hundred year study on artificial intelligence.

Ju, J., Liu, L., & Feng, Y. (2018). Citizen-centered big data analysis-driven governance intelligence framework for smart cities. Telecommunications Policy, 42(10), 881-896.

Kambil, A., Friesen, G. B., & Sundaram, A. (1999). Co-creation: A new source of value. Outlook Magazine, 3(2), 23-29.

Kang, S. N. (2014). A Diffusion of Social Media and the Change of Policy Governance, Seoul Association For Public Administration, 24(4), 261-287.

Kim, H. S. (2006). A Critic of the Relationship between On-line Citizen Participation and Electronic Democracy: Comparison of Responsiveness and Collaboration. Social Science Research, 22(1), 91-119.

Kim, H. J., Lee, T. H., Ryu, S. E., Kim, N. R. (2018), Study on Text Mining Methods to Analyze Civil Complaints: Structured Association Analysis, 23(3), 13-24.

Kim I. (2006), Influence of Governance Structure on Performance in Public Service Delivery of Local Governments Comparative Analysis by Service Type, The Korean Association for Local Government Studies, 5-39.

Kim. Y. & Lee, S. (2018). "Combinations of Text Preprocessing and Word Embedding Suitable for Neural Network Models for Document Classification," Journal of KIISE, 45(7), pp. 690–700.

Kowalski, R., Esteve, M., & Mikhaylov, S. J. (2019). Improving Public Services by Mining Citizen Feedback: An Application of Natural Language Processing. EasyChair preprint, 1103.

Lee, N. M., & VanDyke, M. S. (2015). Set it and forget it: The one-way use of social media by government agencies communicating science. Science Communication, 37(4), 533-541.

Lee, S. M., Ryu, S. E., & Ahn, S. J. (2020), Mass Media and Social Media Agenda Analysis Using Text Mining: focused on '5-day Rotation Mask Distribution System', Journal of The Korea contents association, 20(6), 460-469.

Lemos, M. C., & Agrawal, A. (2006). Environmental governance. Annu. Rev. Environ. Resour., 31, 297-325.

Michael, K., & Miller, K. W. (2013). Big data: New opportunities and new challenges [guest editors' introduction]. *Computer*, *46*(6), 22-24.

Lu, Y., Mei, Q., & Zhai, C. (2011). Investigating task performance of probabilistic topic models: an empirical study of PLSA and LDA. *Information Retrieval*, *14*(2), 178-203.

Nikita, M. (2016). Select number of topics for LDA model. *Retrieved from*.

Orben, A. (2020). The Sisyphean cycle of technology panics. Perspectives on Psychological Science, 15(5), 1143-1157.

Rhodes, R. A. W. (1996). The new governance: governing without government. Political studies, 44(4), 652-667.

Ross, K., Fountaine, S., & Comrie, M. (2015). Facing up to Facebook: politicians, publics and the social media (ted) turn in New Zealand. Media, culture & society, 37(2), 251-269.

Ryu, S. E., Hong, S. G., Lee, T. H., & Kim, N. R. (2018), A Pattern Analysis of Bus Civil Complaint in Busan City Using the Text Network Analysis, Korean Computers and Accounting Review, 16(2), 19-43.

Sarker, M. N. I., Wu, M., & Hossin, M. A. (2018, May). Smart governance through bigdata: Digital transformation of public agencies. In 2018 international conference on artificial intelligence and big data (ICAIBD) (pp. 62-70). IEEE.

Scholl, H. J., & Scholl, M. C. (2014). Smart governance: A roadmap for research and practice. *IConference 2014 Proceedings*.

Šiugždinienė, J., Gaulė, E., & Rauleckas, R. (2019). In search of smart public governance: The case of Lithuania. *International Review of Administrative Sciences*, *85*(3), 587-606.

Smiraglia, R. P., Henry, J., Milonas, E., Marchese, C., & Zherebchevsky, S. (2021). A Formal Taxonomy of Knowledge Organization: Meta-Analysis and Facet Analysis. KO KNOWLEDGE ORGANIZATION, 47(7), 558-573.

Smismans, S. (2008). New modes of governance and the participatory myth. West European Politics, 31(5), 874-895.

Tang, Z., Zhang, L., Xu, F., & Vo, H. (2015). Examining the role of social media in California's drought risk management in 2014. Natural Hazards, 79(1), 171-193.

Tormey, S. (2014). The contemporary crisis of representative democracy. Democratic Theory, 1(2), 104-112.

Urbinati, N. (2011). Representative democracy and its critics. The future of representative democracy, 23-49.

Wickramarachchi, P. M. (2014). Perceived impact of two-way communication in social media on contemporary SRI LANKAN TELECOMMUNICATION brands.

Zhao, W., Chen, J., & Zen, W. (2015). Best practices in building topic models with LDA for mining regulatory textual documents. *Cder 9th November*..