Study of nuclear public acceptance based on the BIG data analysis

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1. Introduction

Korea is a nation with an energy dependence of over 97%, where nuclear power is indispensable to secure energy security(Roh and Kim, 2014). Nuclear power has also enabled Korean industries and products to acquire cost competitiveness, and as a result, has contributed to a rapid economic growth over the past 40 years(Valentine and Sovacool, 2010; Yoo and Yoo, 2009). Despite such benefits, however, nuclear power has also come with some fundamental drawbacks such as the disposal of spent fuel(Fthenakis and Kim, 2007; Jenkins Smith et al., 2011; Stohl et al., 2012). As a consequence, the Korean government has been endeavoring to resolve such drawbacks by tackling political (e.g., Korea-U.S. nuclear-energy cooperation agreement), legal, and financial difficulties(Roh and Kim, 2014).

Although the Korean government's endeavor has made progress, Korean citizens are uneasy about nuclear power owing to the Fukushima accident that occurred in 2011 in Japan, a nation in proximity of Korea(Kim et al., 2013). A recent shutdown of Kori nuclear power plant unit no. 1 illustrates uneasiness(Khalaquzzaman et al., 2010). The unit successfully passed the safety standards in a recent official inspection for an operation extension conducted by nuclear experts, but was compelled to shut down owing to strong opposition from the public. Since Korean citizens are actively expressing and spreading their opinions, the most important task for the Korean government and nuclear power plant operator has now become persuasion of the relevant stakeholders, i.e., residents of the candidate area, Korean citizens overall, and anti-nuclear NGOs, when establishing nuclear-related facilities(Choi et al., 1998).

2. Methods and Results

There has been extensive research on the public acceptance of national/regional residents on retaining/building nuclear power plants, radioactive waste disposal, spent fuel storage, and hosting radioactivity related industry clusters(Flynn et al., 1992; Jenkins Smith et al., 2011; Kemp, 1990; Rowe and Frewer, 2000; Slovic et al., 2000).

[Futures, Harry J. Otway, Dagmar Maurer, Kerry Thomas] Otway et al. (1978) pointed out the reason behind the strong public opposition to nuclear power in the view of persuasive technical arguments at the time of this research(Otway et al., 1978). They identify "affect" as a key factor of public acceptance of nuclear power. Although this research lays a foundation for public acceptance framework, it is not suitable for our purpose as we are aiming to find reasons behind affect displayed by local residents.

2.Semantic network analysis

Semantic Network Analysis has been applied in many fields in practice. Examples include a comparison of different stakeholders' perceptions on IT industry policy, customers' perceptions on brand image, and perceptions of CEO and staff members in a franchise firm's headquarters(Lee et al., 2010; Sevin, 2014; Su and Liu, 2012). In the academic literature, Semantic Network Analysis was used for a diversity of disciplines such as education, marketing, rural planning and statistics.

Kim (2013) analyzed pre-service elementary school teachers' perception on different scientific concepts such as "scientific," "being scientific," "scientific events," and "scientific questions". Since perception is subjective, any pre-defined framework may alter or lead respondents to a specific opinion, but Kim successfully overcame this caveat by using Semantic Network Analysis. As a result, Kim was able to identify that the respondents considered science as a static concept and did not consider it as a part of their life/experience, which means that science was mostly considered the "memorization of simple facts."

Lee and Lee (2010) used Semantic Network Analysis to understand the online and offline shopping behaviors of males and females in Korea. They conducted in-depth interviews which were transcribed for analysis using the Semantic Network Analysis. Because the methodology did not confine them to pre-defined standardized frame, they were able to identify the specific features of each group(Lee et al., 2010). For example, they identified that females tend to purchase products whose design/color is an important buying factor offline while males tend to purchase shoes or limited edition clothing online.

[Journal of the Korean Society of Rural Planning] Lee et al. (2015) interviewed different families and the disabled to deduce universal design principles for National Forest Park. Because the universal design principle is something that should welcome every person and not discriminate anyone even unintentionally, it was important to gain as much in-depth insight as possible. They identified that different features such as accommodation and safe stairs are essential for a park to be accessible.

Jang and Choi (2012) used semantic network analysis on the "statistics act" to evaluate the significance and power of the head of the national bureau of statistics. They deduced that the head was an important figure and any system involving national statistics should collaborate with the head with him/her being central figure.

There are many theories that provide the basis for semantic network analysis. One of them is the spreading activation theory, which states that the attributes in human memory are like nodes and the edges between nodes (i.e., a node reminds a person of another node) form an information network(Anderson, 1983). Suppose that the nodes are defined as keywords, when a keyword on a particular subject is stimulated, the keyword and associated keywords are then activated. Therefore, a keyword embedded in one's memory is associated with other keywords, which forms a network, as shown in Figure 1.
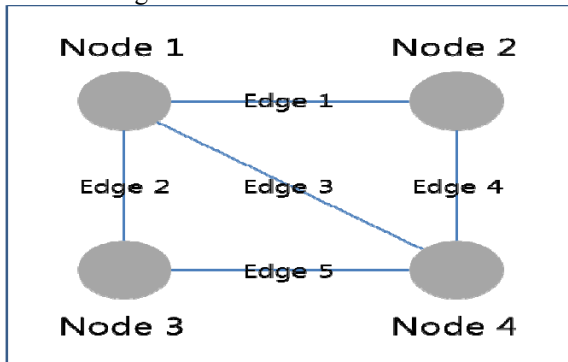
[Figure 1. Nodes and Edges]
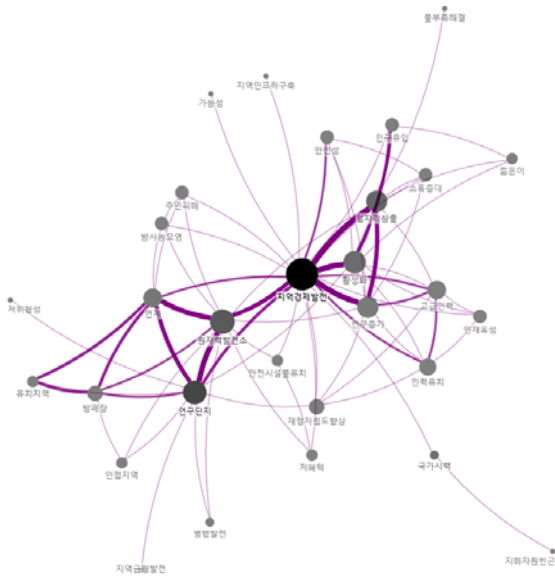
[Figure 2. The reasons for hosting approval as analyzed by Semantic Network Analysis]

3. Conclusions

While there have been many researches on the public acceptance of nuclear-related facilities, the existing literature has only utilized a variable-centric approach targeting the national public overall. Such approaches, however, are not appropriate for an in-depth investigation of a group of people in a specific region. This research overcomes the limitations by using Semantic Network Analysis and was able to deduce meaningful implications from opinions that approve/oppose the hosting of nuclear research institutes in candidate areas (especially areas in proximity of a nuclear power plant). Since nuclear power plants are already in their proximity, the residents shared rational opinions (whether it is approval or opposition). The networks of the two types of opinions showed little difference in network density and average geodesic distance, but the network of opposing opinions consisted of more nodes with a higher centrality. Approving opinions indicated the significance of the research institutes, population growth, and an invigoration of the regional economy as the rationale, while opposing opinions indicated the anxiety of radioactivity leakage and researchers not moving into the candidate areas. This means that both approval and opposition are not unconditional but are based on sound rationale. This is fortunate for governments and the institutes in concern as expected difficulties may be resolved through appropriate policies. This research, based on the results and analysis presented in the previous sections, suggest the following four policy measures.

Firstly, the most appropriate place for a nuclear research institute would be in the proximity of existing nuclear power plants as the residents are more approving, and synergy between the research institute and the power plants is expected. In addition, owing to the mere exposure effect (psychology), there is likely to be less opposition on nuclear-related facilities. Furthermore, one can justify the placement, as the solution to spent fuel from a region will be developed in that particular region and the residents will be more than happy to join the cause. Since the residents have long been experiencing the economic benefit of nuclear power plants, they are more likely to perceive the additional benefits from a hosting nuclear research institute.

Secondly, governments should consider the placement of a nuclear research institute along with nuclear-related educational facilities and hospitals based on nuclear technologies (e.g., cancer treatment). This is because the two facilities are perceived as being more positive than research institutes, and the two facilities may have a positive economic impact on the region. The government should also treat the region with regard to the placement of PIMFY (Please In My Front Yard) institutions there.

Thirdly, there must be sufficient communication among the government, researchers, local government,

and residents in the process of hosting nuclear research institutes. First of all, the government must plan and develop educational and cultural infrastructure for researchers such that they may bring their family with them to live and for residents to access and use. Without such measure, hosting of the research institutes may lead to "successful hosting, but failed settlement"

Lastly, compensation is necessary as the hosting of a nuclear research institute may damage the image of the region and will lead to economic damage such as drops in the following: the property price of the region, demand for fishery/agricultural goods produced in the region, and a reduced number of tourists visiting the region. However, legislation on compensating regions in the proximity of nuclear power plants, enacted in 1989, does not include nuclear research institutes, and therefore may incite opposition from residents who would definitely want economic benefits. Therefore, the government must also drive the amendment of the legislation along with the placement of a nuclear research institute.

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