Consensus based Nuclear Public-Hearing system Model

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1. Introduction

For public participation, Korea has a system of Public-Hearing in accordance with the law. Because of the absence of the detailed way for public opinion aggregation and for the reflection of the aggregated opinion, Korean Public-Hearing system is only a concept model.

In this study, to share the right of decision making, which is an ultimate concept for public participation, components of decision making and the characteristics of each phase are analyzed. It could be said that the relative weight of attributes for assessment and comparison with alternatives are founded as a valuation factor of the decision making, which should be based on the social consensus.

2. CPDM(Consensus based Participatory Decision Making) Model

As a vision of participatory policy making, the final object of participatory model is the form of stakeholders as decisionmaker. In other words, stakeholders may share some authority in decision making process. Therefore, this study may propose shared participatory decision making model named "CPDM"(Consensus based Participatory Decision Making).

Public policy is to be social goodness. Therefore, public policy making should be based on the social consensus. However, because specific policy has specific stakeholder, in this study, just interesting stakeholder could be social components for specific issued policy. Ideal policy review and decision making model is that technical analyzing on alternatives and availability is performed by experts in each area and reviewing is performed by stakeholders. In this point, review could be pertinent only about value assessment.

3. Mathematical Quantifying & Feedback Mechanism

To develop the CPDM(Consensus based Participatory Decision Making) model, definition of concepts for consensus degree measure was summarized as follows. Because of the limited space summary form, mathematical expression for each concept can not be seen in this summary.

3.1 Definitions and Indices

"Social Consensus" : The "Social" is within the society composed of persons who have interest in related issue. And "Consensus" means a concept of "soft" consensus dgree. [Herrera, 2002]

"Policy Making Factor" : Major attributes affect decision making related policy issue.

"Personal Opinion" : Preference or utility value for each alternatives or factors obtained by means of personal responds.

"Collective Solution" : Preference or utility valuer for each alternatives or factors obtained by means of aggregation of all individual opinions.

"Personal Consensus Degree" : Degree of consensus of each respondent to the collective solution obtained by means of dissimilarity aggregation.

"Consensus Degree of Collective Solution" : Degree of consensus of whole respondents obtained by means of aggregation of degree of consensus of each respondent to the collective solution.

"Personal Contribution to Consensus" : Difference between the consensus degree for with and without each respondent.

"Factor Contribution to Consensus" : Difference between the consensus degree for with and without each factor.

3.2 Aggregation of Stakeholder's Opinions

At first, for problem setting, L of policy making factors, M of alternatives and N of respondents are assumed. It was assumed that the policy making factor were agreed by participating respondents. Also, it was assumed that the alternatives were assured by experts and available.

Ideas, attitudes, motivations, and personality is presented by various way. For example, there is major expression such as preference ordering, fuzzy preference relation, multiplicative preference relation, utility function. All these expression can be transformed to fuzzy preference relation.[F. Chiclana, 1998] And then, N of fuzzy preference relation can be extracted.

Aggregation operator is divided into three categories that were arithmetic averaging, and-like, and or-like aggregation one. In the phase of aggregation, for the purpose of aggregation that opinion aggregation is a scoring by human act, OWA(Odered Weighted Averaging) aggregation operator was adopted. That is to say, OWA operator can eliminate the tail effect of response.

In this study, the fuzzy linguistic quantifier of "most" was recommended, for the reason of that is reasonable in the opinion aggregation cases. And then, collective fuzzy preference relation is computed that was named

collective preference relation. Also, this could be transformed to priority vector(for the policy making factors) or preference vector(for the alternatives) by eigenvector theory.

3.3 Consensus Measure

As previously stated, collective fuzzy preference relation and eigenvector could be exploited from the individual fuzzy preference relations by OWA aggregation operator and fuzzy linguistic quantifier of "most". Also, individual preference eigenvector could be computed by eigenvector theory. And then, using dissimilarity function, individual and collective eigenvector for alternatives or policy making factor could be compared.

As a variation of fuzzy distance, dissimilarity function could be expressed as $D\left(\left|p_i^c - p_i^n\right|\right) = \left(a \cdot \left|p_i^c - p_i^n\right|\right)^b$, generally. In this study, the simple case of Euclidean distance was adoptable as a dissimilarity function(a=1, b=1).[lee, 1991]

It can be said that aggregation of dissimilarity is some more important phase of consensus measure. Individual differences from collective for each alternative or policy making factor should be aggregated collective difference, which are component of collective difference vector. And then, the component of collective difference vector should be aggregated to single value representing consensus degree of collective solution. On opposite direction of opinion aggregation, aggregating for dissimilarity between individual and collective preference should include tailed effects, as an important directivity factor for consensus degree improving. Therefore, in this study, parameterized or-like-OWA(conjunctive) operator was adopted.[Yager, 1994]

3.4 Feedback & Consensus Building Directivity

On the contrary to the case of expert group decision making, multi stakeholder has various senses of value on the issue. So, specific consensus level must be hard to achieve in stakeholder involved policy making system. However, by feedback and directivity using previously defined two indices as follow could make CPDM be effective in time and efforts for consensus improving. When dissimilarity value of the personal/alternative/factor contribution to consensus degree is higher than specific level(case specific value), the respondents or factor could be named tail positioned.

Personal contribution to consensus represents the degree of tailed responds effect from each respondent. Respondent, who contribution to tail effects, should be informed his position and degree of consensus for each alternative/factor. Also, his foundation reasoning about the preference position should be prepared, and then, should be notified to the others participation, the others

replying to the foundation reasoning, successively. Opinion exchange within the participants should be continued until pertinent mood for consensus prepared. And alternative/factor contribution represents the degree of tailed factor effect from each respondent and alternative/factor. Factors, who contribution to tail effects, should be informed its position and degree of consensus for each respondent. Also, opinion exchange within the participants should be continued until pertinent mood for consensus prepared.

And then changed opinion may be surveyed and analyzed, repeatedly. If degree of consensus had reached specific level, the feedback system would be ceased.

4. Discussion and Further Study

In this study, CPDM model that stakeholders share the authority that can make policy making was proposed for the improvement of public acceptance. Also, mathematic model applicable to this CPDM system was conceptualized. The methodology to determine case specific consensus level should be established and application of this mathematic model should be performed near time to come. By now, lifetime management for operating nuclear power plants could be a sample problem.

REFERENCES

[1] K. Y. Shon et al., "Assimilation of Public Opinion in Nuclear Decision-Making using Risk Perception," Annals of Nuclear Engineering 28, 2001.

[2] J. H. Moon et al., "Application of Fuzzy Decision Making Method to the Evaluation of Spent Fuel Storage Options" Annals of Nuclear Engineering, 1999.

[3] R. R. Yager and D. P. Filev, "Parameterized and-like and or-like OWA operators," *Int. J. Gen. Syst.*, vol. 22, 1994.

[4] E. Herrera et al., "A Consensus Model for Multiperson Decision Making With Different Preference Structures" IEEE Transaction on Systems, Man and Cybernetics, 2002.

[5] J. Kacprzyk et al,. "On the use of fuzzy majority for supporting consensus reaching under fuzziness" IEEE Transaction, 1997.