Agent Based Simulation Model of Consensus Building on Locating a Nuisance Facility

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Introduction

The garbage treatment plant is a facility which is essential to our urbanized daily lives. However, it is perceived as unpleasant or hazardous in our own backyards. Accordingly the location problem of the facility is very important to most urban communities throughout the world. (Wen 1997)

In Japan, local public bodies, namely cities, towns and villages, are directly responsible for garbage disposal within their jurisdictions. Recently, because of the difficulty of finding sites for new plants and the financial restrictions caused by increased cost of elderly care services, a few neighboring local public bodies collaborate to treat their communities' garbage. Moreover, Japanese people have the strong negative image to the garbage treatment plant because garbage incineration plants emitted dioxin and other toxic gas before, and many dirty garbage trucks gather together around these plants. Their unpleasant impressions may be derived from "Dread risk" and "Unknown risk" which are the components of "Perceived risk" presented by Slovic (1978). Therefore, the key to solve the location problem is how to achieve a consensus in the community as a whole.

Although there are many researches about the process of formulating a consensus in the community, many are the case based studies and accordingly the findings may be affected by factors peculiar to the case area and characteristic of the period.

In order to find key factors for reaching a consensus under the more generic condition, an agent-based model is constructed. In particular, inhabitant's reliance on their municipal government, learning by mutual interaction between inhabitants and change in their attitudes toward their municipal government are included in the model as the key factors.

Outline of a proposed model

Settings

In a local municipality, the local government has a plan of locating a new garbage treatment facility. Although the plan is almost fixed, citizens living there haven't built consensus about the plan yet. The problem is how the municipal government achieves the consensus among the citizens. In the proposed model, many citizens are living in an actual 2 dimensional space and also staying in a virtual 2 dimensional communication space as shown in Figure 1. A citizen has her or his address in both actual and virtual spaces, the volume and topics of information which she or he wants to get, the value of reliance on the municipal government and a type of basic attitude toward the government as her or his attributes. Except the living address, the attributes are changed in a simulation.

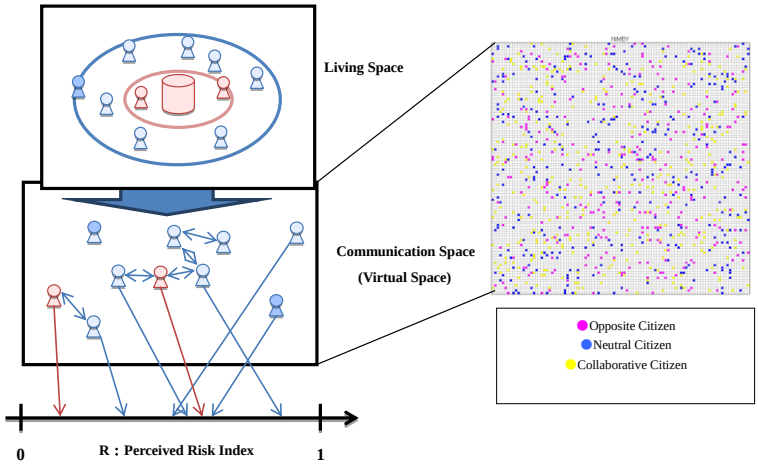

***Figure 1**:* Citizens in Actual and Virtual Spaces

Simulation Process

A simulation is composed of many time steps and in each time step the following processes are carried out:
(0) the municipal government announces the information about the plan, then it can choose the volume and the topics. (1) a citizen evaluates whether the given information fulfills the requirements. (2) in the communication space, a citizen communicates with other citizens staying in the surrounding cells and is affected by the attitudes of them. (3) the results of the step (1) and (2) cause the change in the value of reliance on the municipal government and a type of basic attitude toward the government of the citizen. (4) a citizen calculates the perceived cost of the plan which is determined by the distance from the facility and the value of reliance on the municipal government, and decides her or his approval or disapproval. Behaviors of 1000 citizens on 100x100 cells are simulated.

Results of simulations

The model is coded by using Artisoc, developed by a Japanese company. An illustration of the many results is the comparison of three cases about the distribution of citizens in the virtual space. (Figure 2 to 4)

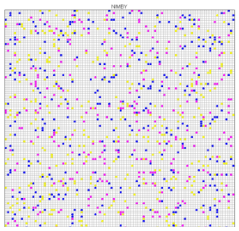

Fig 2: (a) Random location

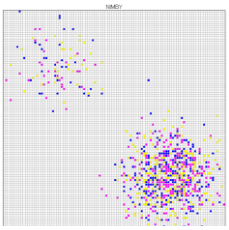

Fig 3: (b) Related to address

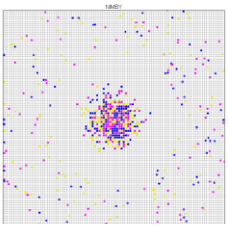

Fig 4: (c) Concentrated

Figure 5 shows that the locations on the virtual space which are closely related to the actual addresses causes shorter range of the consensus ratios at 30 steps in 1000 simulations. However, cases of uniformly random location and concentrated location are almost the same.

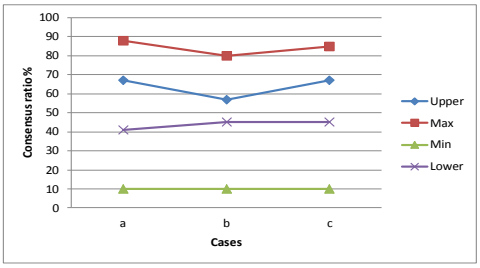

Fig 5: Upper & lower 25%, Max and Min

Discussion

An agent based model of the process of consensus building in a municipality is constructed and carried out simulations. The validation has not been enough yet, so the comparison of the results of simulation with actual cases is the most urgent problem.

References

Wen H., Yu Y. H., 1997 Social and Economic Factor in the Spread of the NIMBY Syndrome against Waste Disposal Sites in Taiwan, Journal of Environmental Planning and Management 40 (2), 273-282.

Slovic P., 1978 Perception of Risk, Science, 236, 280-285.