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An Evaluation Model for Community-Networking Projects

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INTRODUCTION

Sound social relations between people and organizations or other people are established through communication among people with different values. Modern society's ability to solve the difficulties it has with social relations would contribute to the mitigation of social problems such as crime, discrimination, environmental problems, bias in public decision-making, and so on. The same difficulties seriously affect community organizations in Japan, which could function as the primary institution to offer opportunities for communication but actually fail to do so.

Recent community-networking projects are a response to this failure. It is generally agreed that social networks are the invisible infrastructures which support our daily lives both physically and mentally. Therefore we propose a method which aids project management for community-networking by applying a social engineering methodology in infrastructure planning.

MODEL DEVELOPMENT

What we propose here is an evaluation model for community-networking projects such as organizational strategies and urban policies; this model is subdivided into a forecasting model and an evaluation model. The forecasting model simulates over time the formation of social networks with independent variables such as the social attributes of its residents and the organizational characteristics of the community. It is calibrated so that the indicators for representing structural characteristics of the simulated social networks match that of the observed. This concept makes possible the estimation of the model without network data, an absolute necessity in actual situations. In the evaluation model, the indicators are represented as network outcomes of community activities concerned with education, welfare, environment, culture, *etc*. They are calculated based on the forecasting model with political variables which show the changes of organizational strategies or urban policies.

Forecasting Model

We assume that, at time $t+1$, a symmetrical binary relation between person i and either person j or organization k, denoted by binary variables $x_{ij}(t+1)$ and $y_{ik}(t+1)$ respectively, is formed on the basis of the differences in their attributes[1] and the existing network structures[2]. By developing Weesie's model[3], each can be modeled as follows:

$$x_{ij}(t+1) = \left(1-x_{ij}(t)\right) U_{pc} + x_{ij}(t)\, U_{pr} \quad (1)$$

$$y_{ik}(t+1) = \left(1-y_{ik}(t)\right) U_{cc} + y_{ik}(t)\, U_{cr} \quad (2)$$

$$U_{pc} = 1-\left(1-\hat{U}_c^{(ij)}\right)\prod_k \left(1-U_{7(k)}\right) \quad (3)$$

$$U_{pr} = 1-\left\{1-\left(1-\hat{U}_d^{(ij)}\right)\left(1-U_5\right)^{n_5(i,j,t)}\right\}\left(1-U_6\right)^{n_6(i,j,t)} \quad (4)$$

$$U_{cc} = 1-\left(1-\tilde{U}_c^{(ik)}\right)\left(1-U_1\right)^{n_1(i,k,t)} \quad (5)$$

$$U_{cr} = 1-\left\{1-\left(1-\tilde{U}_d^{(ik)}\right)\left(1-U_2\right)^{n_2}\left(1-U_4\right)^{n_4}\right\}\left(1-U_3\right)^{n_3} \quad (6)$$

where U_l ($l = 1, \ldots, 7$) is denoted as an independent Bernoulli variable which is equal to 1, *iff* a structurally biased net with the l th configuration (see Fig.1) is generated. Similarly, $n_l(i, j/k, t)$ ($l = 1, \ldots, 7$) is the number of the l th configuration between i and j/k at time t. Since U_7 Denotes the likelihood of two members in the organization k having some tie, only U_7 is dependent on k ($U_{7(k)}$). Furthermore, $\hat{U}_c^{(ij)}$, $\hat{U}_d^{(ij)}$, $\tilde{U}_c^{(ik)}$ and $\tilde{U}_d^{(ik)}$ are independent Bernoulli

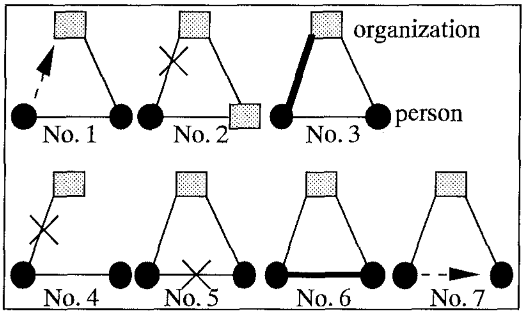

Fig.1 Transitive configurations

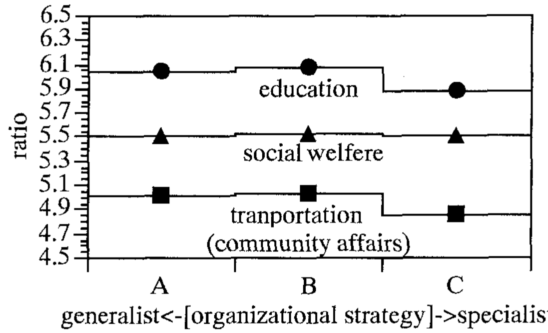

Fig.2 Evaluation of organizational strategies

variables whose constants correspond to the initial probabilities that i and j/k are connected(c)/ disconnected(d), which decrease as their social distances increase.

In a large network with a stable process, the distribution of the number of contacts of each person s_i reaches a state of equilibrium, which is defined as $f^*(s)$. This is obtained numerically, with a parameter set $\boldsymbol{\theta}$, specific forms of the functions and the observed data about the attributes of residents in a community and niches of the community organizations. Using s_i which is observed, $\boldsymbol{\theta}$ is determined so as to maximize the likelihood function:

$$L(\boldsymbol{\theta}) = \prod_i f^*(s_i ; \boldsymbol{\theta}) \qquad (7)$$

subject to the equality constraints of the organizational activities investigated.

Evaluation Model

We define I_m as a group of members who engage in community affair m ($m = 1, \ldots, M$). Referring to Gould[4], we assume that the contribution of $c_{mi}(t_0)$ to issue m of i at time t_0 is modeled as follows:

$$c_{mi}(t_0) = \begin{cases} 1 & \text{for } i \in I_m \\ 0 & \text{for } i \notin I_m \end{cases} . \qquad (8)$$

Based on those initial contribution, each successive contribution influenced by the forecasted network with the former model is described as

$$c_{mi}(t+1) = \left(\lambda \sum_j x_{ij}(t) c_{mj}(t)\right) \Big/ \left(\sum_j x_{ij}(t)\right) \qquad (9)$$

where λ is a discounting parameter ranging between 0 and 1. Under this condition, the total contribution will converge to a point of equilibrium $c_m^* = \sum_{t=t_0}^{\infty} \sum_i c_{mi}(t)$ (10). We take the ratio of the initial total contribution to c_m^* as an indicator of the degree to which social networks influence residents to join the community activities. Changing an organizational strategy or an urban policy and comparing the indicators in each case make possible the "with-and-without-project" analysis.

CONCLUSION

A model was developed which evaluates the sociological influence of community-networking projects. Although the evaluation indicator still needs to be improved because of lack of consideration of the public welfare, our numerical tests with various alternative organizational strategies confirmed that this model can describe complicated processes and give decision-makers valuable information that cannot always be predicted intuitively (See Fig.2).

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