A VERIFICATION STUDY ON METHODOLOGY OF PROJECT PLANNING FOR URBAN DEVELOPMENT CONSIDERING FINANCIAL MANAGEMENT

By Mamoru HARUNA**, Tomohiko WATANABE*** and Xuepeng QIAN****

1. Background

In recent years, it is coming close the requirement of local cities for self-supporting and sustainable development in the flow of the decentralization which progresses increasingly. However, there are some negative problems, such as the reduction in tax revenues and the curtailment of subside, and the tight financial situation. Not only the functional plans shall be implemented effectively, but also the financial plans at the same time. How to make the local financial plan effective and efficient is aim of this research.

Kusatsu city was selected in the study as the subject city in fiscal 20 years, from 1981 to 2000, which is divided three periods because of the time-related dynamic analysis: first is from the 1st year to the 5th year, second from the 6th year to the 10th year, and third is from 11th year to the 20th year. The verification is made by the comparison of the output optimal distribution and the practical distribution pattern.

2. The Introduction of Kusatsu City

Kusatsu City lies in the central part of Japan, in Shiga prefecture, near the largest lake – Lake Biwa. Here the city is briefly introduced from the following five aspects, which are also defined as seven objective categories in the study.

a) Population: representation of the vitality of the city; Kusatsu City is one of the few cities in Japan which has the increasing population.
b) Employee persons: representation of the city employment power; there is a trend of increase of the employee persons in Kusatsu City.
c) Average income: representation of the civic economical content; the average income of the city keeps waving under limited control.
d) The production sum of 1st, 2nd, 3rd industry: representation of the activity of the industry; the agriculture of the city decays slowly; and the main industry is the 2nd industry. While the 3rd industry is developing in a high speed.
e) Tax: representation of the strength of the independence of city finance; there is no obvious change about tax of the city in recent years.

And the city structure is changing toward the urban type. To realize the sustainable and self-supporting concepts, three pieces of objectives have been set for the urban development in Kusatsu City:

a) To keep the population scale and develop the 2nd and 3rd industry;
b) To increase the tax for self-supporting;
c) To keep the level of the 1st industry though no rapid expansion is expected.

So, we arranged priority positions of the seven objective categories according the development objectives mentioned above. They are listed in order of importance: population, the production sum of 2nd industry, the production sum of 3rd industry, the tax, the employee persons, the average income and the production sum of 1st industry.

*Keywords:recycle: urban development, financial simulation system, hybrid model

** Member of JSCE, Dr. Eng., Dept of Environmental Sys. Eng., Ritsumeikan University (Noji Higashi 1-chomei, 1-1 Kusatsu, 525-8577 shiga-ken, Japan TEL: 077-561-2736, Fax: 077-561-2667)
***Engineer in Tokyu Estate Co. Ltd.
****Student Member of JSCE, Master student of Ritsumeikan University (Noji Higashi 1-chomei, 1-1 Kusatsu, 525-8577 shiga-ken, Japan TEL: 077-561-2736, Fax: 077-561-2667)

3. Study Procedure

(1) Simulation of Local Activities

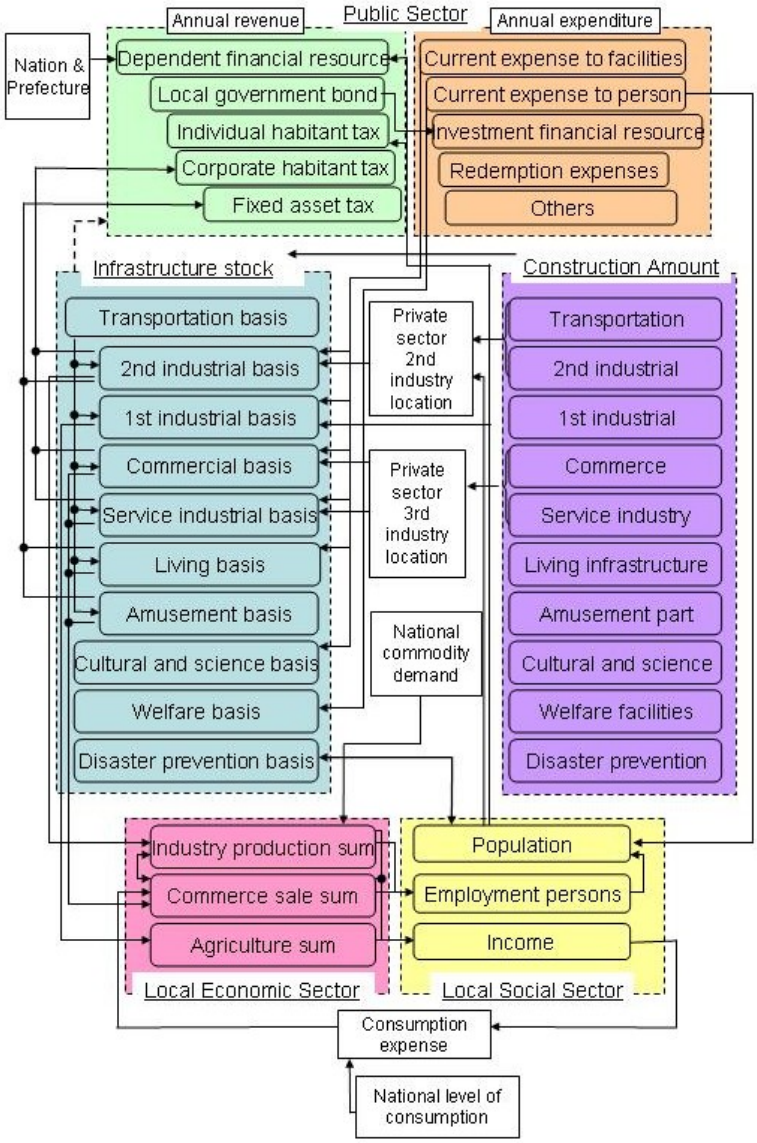


Fig 1. The Structure of Local Activities Simulation

The study starts from construction of the simulation model aiming at measuring the influence effect from infrastructure construction. This part contains two steps, the first is to analyze the complex relationship of local activities, which is the theory basis of mathematical formulation, and the second is to formulate the simulation system year by year.

The local activities are supported by the six sectors from urban function classification: disaster prevention basis, transportation basis, living basis, industrial basis, the culture, science and amusement basis and the welfare basis. The input and output are both abstracted from these media. Also the structure (Fig. 1) shows the relationship of local activities simulation of Kusatsu City.

To evaluate the results of simulation, we compare them with the real data. The following table of average tolerance (Table 1) shows that all the average tolerance are less than 5%, from which it can be concluded that the simulation system works fairly well in the comparison of the individual habitant tax, the corporate habitant tax, the fixed asset tax, the total population and the total income of Kusatsu City from Year 1982 to Year 2000.

(2) Simulation Experiments

As we can see from the simulation system, the investment to the six kinds of infrastructure will influence the output such as population, average income, the production sum of the three industries and the tax, which are all considered as evaluation criterions. Then totally we considered four kinds of investments, which are the investment to living basis, the investment to transportation basis, the investment to culture and science basis and the investment to welfare basis, as the four control variables, because they cost large parts of investment from government. Then among them, which one influences the objective categories the most and the order of them according to the influence effect are desirable for correct planning model. The experiments have been done for this aim.

There are different levels set to the content of satisfaction. Three levels and the four kinds of investments

Table 1 The Average Tolerances

Item	Average Tolerance (%)
The individual habitant tax	3.65
The corporate habitant tax	4.05
The fixed asset tax	4.46
The total income	2.88
The number of the family	4.40
The employee person	0.70
The agriculture production sum	1.13
The industry production sum	4.32
The annual commerce sale sum	4.39

are chosen to construct 27 (3^4) patterns as input to the simulation system. The software added in Microsoft Excel helped us to get the results quickly, which were then analyzed by dispersing method for the order of relationship.

Table 2 shows that the investment to the living basis influences the seven categories the most, and then followed by the investment to transportation basis, the investment to culture science and amusement basis and the investment to welfare basis in order.

Table 2 The Order of Relationship

		The investment to			
		Living basis	Transportation basis	Culture & science	Welfare basis
Population		○○○○	○○○	○○	○
Production sum	The 1st industry	○○○○	○○○	○○	○
	The 2nd industry	○○	○		
	The 3rd industry	○○○	○○	○	
The number of employees		○○○	○○	○	
The average income		○○○	○○	○	
Tax		○○○	○○	○	

(3) Multi-objective Function

The multi-objective problem in this research is made up of linear functions. We consider the optimization from the satisfaction extent, which was developed by economist Mr. Simon. The objective functions are the seven distances to preset objective values of the seven items. And the four control variables mentioned above get parameters from the simulation stage regarding the order of influence effects.

The functions are listed below:

Objective Function:

$$\min\ y_p^-,\ \min\ y_1^-,\ \min\ y_2^-,\ \min\ y_3^-,\ \min\ y_w^-,\ \min\ y_{in}^-,\ \min\ y_{pi}^-$$

Subject to:

$$\alpha_{p1}I_l + \alpha_{p2}I_r + \alpha_{p3}I_c + \alpha_{p4}I_w + d_p - y_p^+ + y_p^- = A_p$$
$$\alpha_{11}I_l + \alpha_{12}I_r + \alpha_{13}I_c + \alpha_{14}I_w + d_1 - y_1^+ + y_1^- = A_1$$
$$\alpha_{21}I_l + \alpha_{22}I_r + d_2 - y_2^+ + y_2^- = A_2$$
$$\alpha_{31}I_l + \alpha_{32}I_r + \alpha_{33}I_c + d_3 - y_3^+ + y_3^- = A_3$$
$$\alpha_{w1}I_l + \alpha_{w2}I_r + \alpha_{w3}I_c + d_w - y_w^+ + y_w^- = A_w$$
$$\alpha_{in1}I_l + \alpha_{in2}I_r + \alpha_{in3}I_c + d_{in} - y_{in}^+ + y_{in}^- = A_{in}$$
$$\alpha_{pi1}I_l + \alpha_{pi2}I_r + \alpha_{pi3}I_{pi} + d_{pi} - y_{pi}^+ + y_{pi}^- = A_{pi}$$
$$I_l + I_r + I_c + I_w = I$$
$$I_l \geq I_l^*, I_r \geq I_r^*, I_c \geq I_c^*, I_w \geq I_w^*$$

$$y_p^+ * y_p^- = 0, y_1^+ * y_1^- = 0, y_2^+ * y_2^- = 0, y_3^+ * y_3^- = 0$$
$$y_w^+ * y_w^- = 0, y_{in}^+ * y_{in}^- = 0, y_{pi}^+ * y_{pi}^- = 0$$
$$y_p^+, y_p^-, y_1^+, y_1^-, y_2^+, y_2^-, y_3^+, y_3^- \geq 0$$
$$y_w^+, y_w^-, y_{in}^+, y_{in}^-, y_{pi}^+, y_{pi}^- \geq 0$$

I_l: The living basis service investment

I_r: The traffic basis service investment

I_c: The culture, science basis service investment

I_w: The welfare basis service investment

	Meaning	***p***	**1**	**2**	**3**	***w***	***in***	***pi***
y^+, y^-	Distance to target	Population	1st industry	2nd industry	3rd industry	Employee persons	Average income	Tax
A	Target value							

4. Dynamic Search Process

In the study, we combine simulation model and the plan model and carried out the dynamic search process.

From initial conditions, the simulation model provides the basic system information for the plan model which means the parameters of the multi-objective functions. Then by solving the optimization problem, the decision 1 is concluded, which will cause a serial of change to the initial conditions. So it is necessary to perform the simulation again to update the system information. And the result 1 is the target value of the second phase, which implicates the sustainable

development. This is one cycle. Then as mentioned before, we have three terms in the study. After the first term (cycle), the analysis is continued to the second term (Year 6th to Year 10th). And the updated parameters in optimization functions come together with the new plan, which is decision 2. Following the same process, we performed the three cycles divided by three terms, shown in Fig 2.

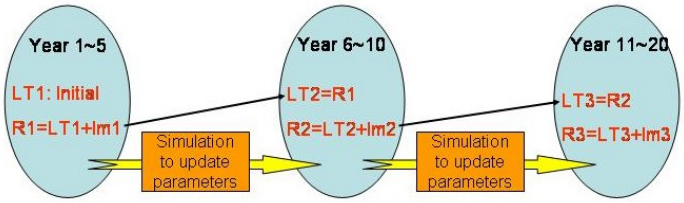


Fig 2. Dynamic search process

5. Conclusion

In the study, the related data from Kusatsu city were collected a lot. Table 3 lists the distribution patterns concluded from the three terms. And Fig. 3 shows the comparison with the distribution patterns performed now by the local government.

The two distribution patterns were calculated from the same initial conditions and in the same financial simulation systems. And there is a average about 6% improvement of the influence effect after applying the optimal distribution plan we got from the hybrid model, from the least 1.5% to the largest 14%. It can be said that the planning methodology developed in this study is rational and effective.

For optimal principle, the research aimed to the current problems and development policies and decided the importance order of the multiple objectives, which were not all independent. This was from one viewpoint of optimization and could be not sufficient. In the further study, we could discuss the optimal proposal from other viewpoints.

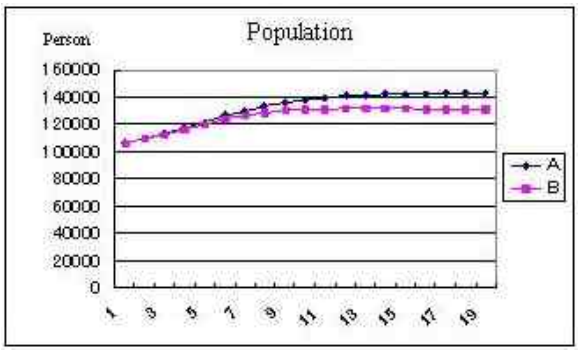
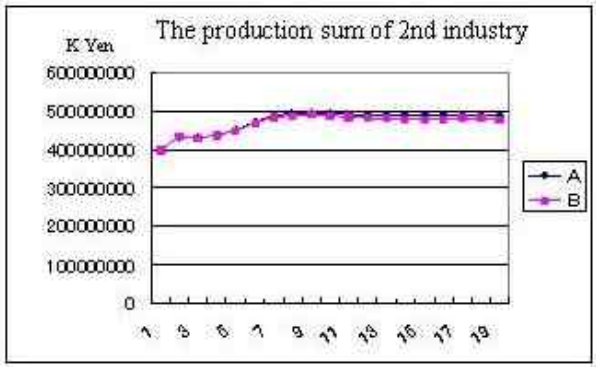


Table 3. The Distribution for Each Term

Investment field	Proportion of distribution (%)		
	1st	2nd	3rd
Living infrastructure	46.2479	43.3379	45.2354
Road infrastructure	28.9092	36.6621	28.6621
Cultural art and science	12.4221	10	16.1025
Welfare infrastructure	12.1208	10	10



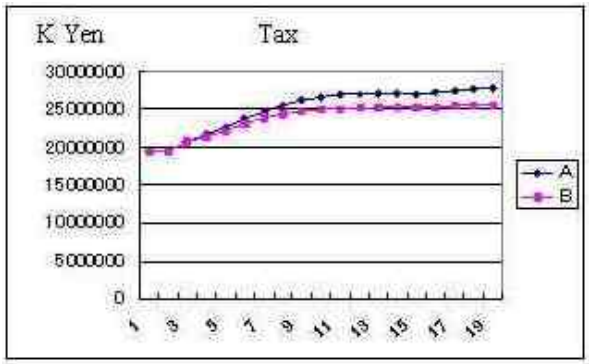


Fig. 3 Final Result of Seven Objective Categories

A: the result after applying the optimal distribution from plan model

B: the result of the distribution performed now by local government

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