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Changes in the Residents' Consciousness due to Environmental Improvements After Consolidation of Municipalities

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ABSTRACT: The purpose of this paper is to clarify the changes in the consciousness of residents due to environmental improvements after consolidation of municipalities. The focus of this research is to quantify both "increases in residents' satisfaction" and the "increased sense of unity in residents' consciousness" due to environmental improvements during the four years after consolidation. The city analyzed is Isesaki City, Gunma Prefecture, Japan, which has already carried out consolidation. In analyzing residents' consciousness, we performed factor analysis and covariance structural analysis using the results of surveys of residents' consciousness. The results of the analysis showed that (1) residents' satisfaction has increased, but (2) the sense of unity in residents' consciousness has not increased. This paper is intended to suggest that (1) residents' satisfaction can be increased by improving the environment for four years after consolidation, and (2) increasing the sense of unity in residents' consciousness by improving the environment for four years after consolidation is extremely difficult.

Keywords: Consolidation of municipalities, Environmental improvement, Residents' consciousness, Factor analysis, Covariance structural analysis

1. INTRODUCTION

In Japan, the consolidation of municipalities through mergers of cities, towns, and villages is progressing. The main goal of this consolidation is for the government to effectively address the broad array of residents' demands. A newly merged municipality can govern more broadly and efficiently as a result of the choices and support of a greater number of residents. In addition, the residents living in the merged municipality can participate in community design from a broader perspective.

Against this backdrop, the number of municipalities in Japan has drastically reduced, from 3,232 in March 1999 to 1,727 in March 2011. Many merged municipalities demonstrate an increase in resident satisfaction and in unity of residents' consciousness. Several papers regarding these issues have already been published.

Okusawa *et al* [1] argues the importance of continual study of city planning among merged municipalities that were enlarged through the consolidation of several municipalities. Hashimoto and Yuzawa [2] makes clear that regional differences in residents' consciousness are arising due to discontinuous city planning among merged municipalities. Endo *et al* [3] makes clear the deep connection between a municipality's name and its residents' sense of belonging, and the barrier that sense of belonging can pose to forming a sense of unity. Hashimoto and Yuzawa [4] argues the importance of city planning that responds to regional differences that arise in merged municipalities not only in residents' consciousness, but in the consciousness of the municipalities as well.

In the midst of these developments, the Ministry of Internal Affairs and Communications [5] has published the changes in residents' consciousness following the consolidation of municipalities, based on the results of a national survey of residents. This literature shows that simply consolidating, without environmental improvements that residents can feel, will not result in an increase in resident satisfaction or unity of residents' consciousness. Furthermore, this literature shows that to increase the unity of residents' consciousness following consolidation takes years, even decades.

However, the undertaking of environmental improvements throughout the merged municipality also appears to affect resident satisfaction and unity of residents' consciousness. Feeling improvements in the environment, especially improvements in green spaces and parks that are closely connected to everyday life, appears to change residents' consciousness. Research using covariance structure analysis from the perspective of the environment and resident consciousness has already been published [6]-[8]. Among these publications, Tsukada and Yuzawa [6], [7] makes clear that park amenities greatly influence residents' consciousness. Tsukada *et al* [9] also explains that, when evaluating parks, it is important to focus on residents' use of the park after improvement.

From the above research, it can be hypothesized that environmental improvements throughout a merged municipality can increase residents' satisfaction and unity of residents' consciousness. Therefore, research that quantifies the changes in residents' consciousness due to environmental improvements throughout a merged municipality is required. However, research that continually surveys residents' consciousness following consolidation and quantifies the changes is not being conducted.

Therefore, the goal of this research is to quantify the changes in residents' consciousness due to environmental improvements following consolidation. For the subject of this research, we chose Isesaki City in Gunma Prefecture, which satisfies the conditions necessary for a subject of this research because (1) it is a merged municipality, (2) it has actively promoted environmental improvements following the consolidation, and (3) over four years have passed since the consolidation, making it possible to analyze the long-term changes in residents' consciousness due to environmental improvements after consolidation of municipalities. Isesaki City consolidated one city, two towns, and one village on January 1, 2005.

2. RESEARCH METHOD

2.1 Research Flow

Fig. 1 shows the research flow of this paper.

First, in order to make clear the changes in residents' consciousness that is the goal of this research, two surveys were conducted, one at the time of consolidation (in 2005), and another four years later (in 2009).

In the first analysis, we conduct a factor analysis and covariance structural analysis using the data gained from responses to the surveys (980 responses), and determine the factors of residents' subconscious and a structural model of residents' consciousness.

In the second analysis, we analyze changes in residents' consciousness using path coefficients gained from the results of the covariance structural analysis. This analysis method uses path coefficients to calculate an evaluation score based on the data from each survey (494 responses in 2005; 486 responses in 2009), and analyzes the mean value and variation coefficient of the evaluation score of each factor. Increase of the mean value of the evaluation score can be evaluated as increase in residents' satisfaction. Decrease of the variation coefficient of the evaluation score means a reduction in variability and can be evaluated as increase in the sense of unity in residents' consciousness. From the results of these analyses, we then consider the changes in residents' consciousness post-consolidation.

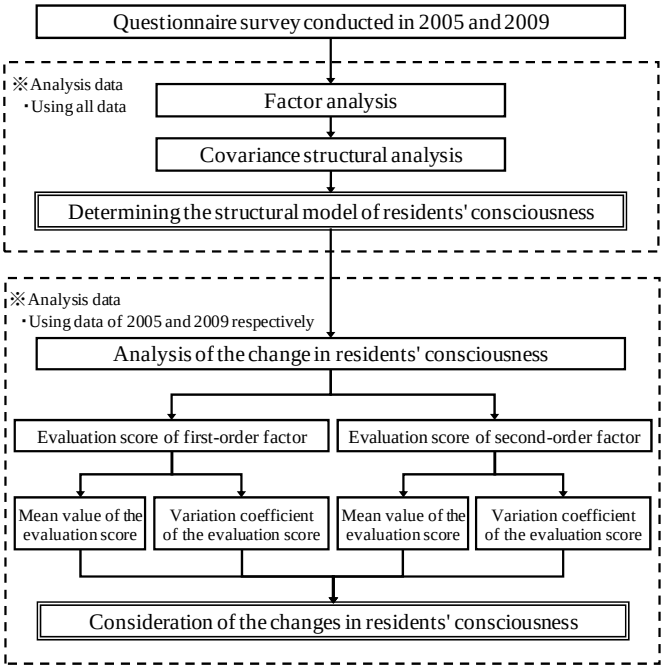

Fig. 1 Research Flow

Table 1 Overall Overview of the Survey

	2005 Survey	2009 Survey	Total
Survey Distribution Period	1/15/2005 to 1/20/2005	1/10/2009 to 1/15/2009	–
Number of Surveys Distributed	4,000	4,000	8,000
Number of Responses	494	486	980
Response Rate (%)	12.4	12.2	12.3
Subjects of Survey	residents of households within a 1.0km radius of the research area		
Survey Method	surveys distributed in research area, and collected by postal mail		
Survey Contents	individual attributes, with five levels of resident satisfaction		

2.2 Surveys

The overall overview of the survey and the overview of the survey area are displayed in Tables 1 and 2, respectively. The response rate of the surveys is displayed in Table 1, with the response rate for both the 2005 and 2009 surveys at approximately 12 percent. So that no biases among survey respondents would occur, the survey area covered the 10 areas listed in Table 2. These 10 areas can be sorted by former municipality into former Isesaki City (areas 1 through 5), former Sakai Town (areas 6 and 7), former Azuma Village (areas 8 and 9), and former Akabori Town (area 10). Four hundred households were chosen at random from survey areas 1 through 10 as targets of the surveys. Survey responses were collected by postal mail.

The evaluation items of the survey consisted of 25 items that have a deep connection to the overall evaluation of a city, and are listed in Table 3. Survey respondents evaluated each item on a scale of 1 to 5 (1=dissatisfied; 2=slightly dissatisfied; 3=normal; 4=slightly satisfied; 5=satisfied).

Table 2 Overview of the Survey Area

Former Municipalities	Research Area	2005 Survey			2009 Survey		
		Distribution Number	Number of Responses	Response Rate (%)	Distribution Number	Number of Responses	Response Rate (%)
Former Isesaki City	1	400	62	15.5	400	40	10.0
	2	400	48	12.0	400	40	10.0
	3	400	45	11.3	400	43	10.8
	4	400	41	10.3	400	55	13.8
	5	400	62	15.5	400	68	17.0
Former Sakai Town	6	400	54	13.5	400	40	10.0
	7	400	48	12.0	400	55	13.8
Former Azuma Village	8	400	39	9.8	400	47	11.8
	9	400	38	9.5	400	44	11.0
Former Akabori Town	10	400	57	14.3	400	54	13.5

Table 3 Evaluation Items of the Surveys

Evaluation Item	Contents of the Evaluation Item
A1	provide administrative services that meet the demands of residents
A2	ease of use of city hall and city branch offices
A3	health of public finances
A4	ease of obtaining government information
A5	opportunities to participate in community design
A6	enhancement of the content of primary education
A7	enhancement of kindergartens and preschools
A8	improvement of school facilities
A9	enhancement of universities, junior colleges, vocational schools
A10	places and opportunities for lifelong learning
A11	vibrant commercial districts and shopping centers
A12	securing places of employment by attracting industry
A13	ease of use of leisure and entertainment facilities
A14	convenience of daily shopping
A15	support for revitalizing agriculture
A16	protection of green space and nature
A17	connection to water through improvement of rivers and ponds
A18	improvement and ease of use of parks
A19	improvement of city landscape
A20	environmental measures to reduce noise, vibration, and air pollution
A21	improvement of local roads
A22	improvement of arterial roads
A23	safe passage of pedestrians and cyclists
A24	ease of use of railways
A25	ease of use of buses

3. ENVIRONMENTAL IMPROVEMENT POLICY

Isesaki City is located in central Japan in southern Gunma Prefecture, as shown in Fig. 2. As can be seen from Fig. 2, the city has abundant rivers and parks.

Before consolidation, Isesaki City was former Isesaki City, former Sakai Town, former Azuma Village, and former Akabori Town. At the time of consolidation, the city's area was 13,933 hectares, and the population was 207,000, as shown in Table 4. In order to increase resident satisfaction and unity of residents' consciousness following the consolidation, Isesaki City pursued a policy of environmental improvement. This policy consisted mainly of the following five items (A) through (E):

(A) Increased Park Space (Table 4)

During the four years from 2005 to 2009, Isesaki City increased its park space from 96 hectares to 127 hectares. This increase was largely the result of the completion of the Consolidation Memorial Park, discussed next.

(B) Creation of Consolidation Memorial Park (Fig. 3)

Isesaki City created Consolidation Memorial Park from 20 hectares of former ponds and green space. The park was located near a highway and parking area for visitor convenience.

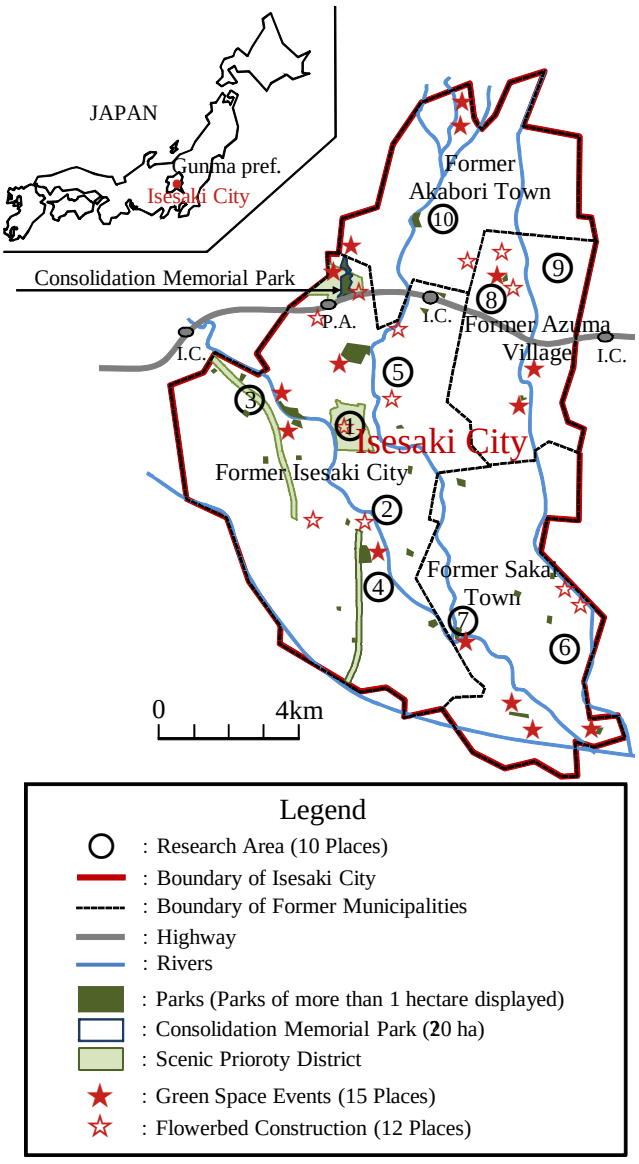

Fig. 2 Research Area (10 Places)

(C) Creation of a Scenic Priority District (Fig. 4)

Isesaki City designated Consolidation Memorial Park and surrounding areas a scenic priority district, and carried out scenic improvement projects. The main goal of these projects was to increase hospitality towards visitors through improvements such as benches at scenic spots.

(D) Green Space Events (Fig. 5)

Isesaki City and its residents carried out greening events throughout the consolidated city. These events took place from March to November 2008. Their locations are marked in Fig. 2 as ★ (15 in all), and they promoted interaction among different regions throughout the city. The events consisted not only of interacting with the natural environment, but also of presentations by children and introductions of traditional crafts by the elderly, thus promoting interaction between generations.

(E) Flowerbed Construction (Fig. 6)

Isesaki City and its residents constructed flowerbeds at parks and open spaces throughout the city. Their locations are marked in Fig. 2 as ☆ (12 in all), and described in Fig. 6. Through such resident volunteer activities, the city promoted environmental improvement through greening in areas other than parks such as open spaces.

In these ways, post-consolidation Isesaki City and its residents actively promoted environmental improvement throughout the merged municipality.

Table 4 Increase in Park Space Area (A)

Scale of Municipalities at the time of the Merger			At Year 2005	At Year 2009
Former Municipalities	Area (ha)	Population (Thousands)	Park Space Area (ha)	Park Space Area (ha)
Former Isesaki City	6,517	134	82	106
Former Sakai Town	3,126	31	10	13
Former Azuma Village	2,438	23	0	4
Former Akabori Town	1,852	19	4	4
Total	13,933	207	96	127

Fig. 3 Creation of Consolidation Memorial Park (B)

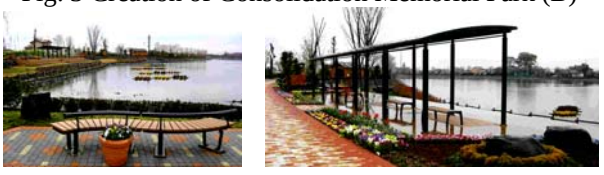

Fig. 4 Creation of a Scenic Priority District (C)

Fig. 5 Green Space Events (D)

Fig. 6 Flowerbed Construction (E)

4. CONSTRUCTING A STRUCTURAL MODEL OF RESIDENTS' CONSCIOUSNESS

4.1 Results and Consideration of the Factor Analysis

In the factor analysis, we extracted factors from the response data in order to understand the residents' subconscious.

Table 5 displays the results of the factor loadings, eigenvalue, cumulative contribution rate, and factor definitions gained through the factor analysis. The first factor is defined as "Government" due to the large weight given to the needs of residents, city hall, public finance, government information, and resident participation. Similarly, the second factor is defined as "Education," the third as "Industry," the fourth as "Environment," and the fifth as "Transportation."

4.2 Determining the Structural Model of Residents' Consciousness

The results of the factor analysis make clear the five factors of the residents' subconscious. In the following analysis, we determine the structural model of the residents' consciousness in the merged municipality, and conduct a covariance structural analysis using the survey response data to quantify the importance of each factor.

Fig. 7 shows the path diagram of the covariance structural analysis model used in this analysis. The first-order factor of Fig. 7 consists of the five factors extracted using the factor analysis, and establishes a second-order factor model that makes a "Comprehensive Evaluation" from the second-order factor.

Table 6 represents the results of the covariance structural analysis conducted using the path diagram of Fig. 7. The t-value of path coefficients *Pk* and *Pkn* all satisfy a 1% significance level, and the GFI (Goodness of Fit Index) was a satisfactory 0.873.

From these results, we judged the path diagram of Fig. 7 to be a highly reliable model of residents' consciousness.

In addition, the *Pk* values from Table 6 were, from largest to smallest, 2.262 for Transportation, 2.190 for Environment, 2.110 for Education, 1.590 for Government, and 1.000 for Industry. From these results, it is clear that the Comprehensive Evaluation of residents' consciousness is largely influenced by Transportation, followed by Environment.

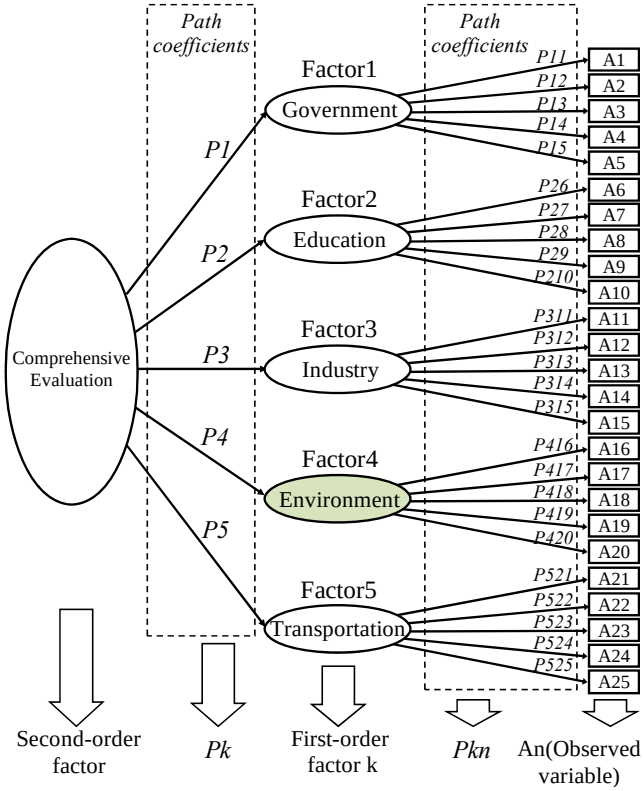

Fig. 7 Covariance Structural Analysis Model (Path Diagram)

Table 5 Results of Factor Analysis (after Varimax Rotation)

Evaluation Item		Factor1	Factor2	Factor3	Factor4	Factor5
Factor Loadings	A1	0.780	0.223	0.055	0.135	0.260
	A2	0.722	0.152	0.076	0.122	0.286
	A3	0.674	0.184	0.083	0.190	0.265
	A4	0.653	0.242	0.217	0.214	-0.031
	A5	0.589	0.201	0.315	0.145	-0.132
	A6	0.194	0.761	0.066	0.190	0.147
	A7	0.096	0.746	0.041	0.131	0.191
	A8	0.229	0.708	0.117	0.111	0.205
	A9	0.141	0.663	0.210	0.044	0.083
	A10	0.337	0.489	0.251	0.263	-0.007
	A11	0.136	0.101	0.706	0.102	0.157
	A12	0.142	0.142	0.695	0.157	0.128
	A13	0.158	0.234	0.678	0.222	0.135
	A14	0.000	0.049	0.635	0.154	0.288
	A15	0.334	-0.039	0.375	0.195	0.028
	A16	0.234	0.105	0.198	0.787	0.097
	A17	0.220	0.159	0.138	0.786	0.081
	A18	0.105	0.160	0.243	0.717	0.202
	A19	0.147	0.168	0.409	0.446	0.325
	A20	0.291	0.218	0.060	0.438	0.301
	A21	0.087	0.135	0.189	0.345	0.709
	A22	0.052	0.083	0.154	0.302	0.709
	A23	0.217	0.279	0.261	0.114	0.572
	A24	0.248	0.230	0.323	-0.166	0.527
	A25	0.206	0.279	0.433	-0.012	0.434
Eigenvalue		3.146	2.984	2.981	2.811	2.539
Cumulative Contribution Rate		12.58	24.52	36.44	47.69	57.84
Definition of Factors		Government	Education	Industry	Environment	Transportation

Table 6 Results of Covariance Structural Analysis

Second-order factor	*Pk*	First-order factor k	*Pkn*	Observed variable	*Pk*×*Pkn*	α_j	$\Sigma\alpha_j$	β_j	$\Sigma\beta_j$
Comprehensive Evaluation	1.590	Government	1.542	A1	2.452	23.7	100	4.7	100
			1.506	A2	2.395	23.2		4.6	
			1.279	A3	2.034	19.7		3.9	
			1.175	A4	1.868	18.1		3.6	
			1.000	A5	1.590	15.4		3.1	
	2.110	Education	0.986	A6	2.080	20.9		4.0	
			1.000	A7	2.110	21.2		4.1	
			0.993	A8	2.095	21.0		4.0	
			0.878	A9	1.853	18.6		3.6	
			0.861	A10	1.817	18.2		3.5	
	1.000	Industry	2.138	A11	2.138	22.4		4.1	
			1.954	A12	1.954	20.4		3.8	
			2.236	A13	2.236	23.4		4.3	
			2.231	A14	2.231	23.3		4.3	
			1.000	A15	1.000	10.5		1.9	
	2.190	Environment	1.102	A16	2.413	23.5		4.6	
			1.000	A17	2.190	21.3		4.2	
			1.073	A18	2.350	22.8		4.5	
			0.834	A19	1.826	17.7		3.5	
			0.690	A20	1.511	14.7		2.9	
	2.262	Transportation	1.172	A21	2.651	22.5		5.1	
			1.000	A22	2.262	19.2		4.4	
			1.015	A23	2.296	19.5		4.4	
			0.959	A24	2.169	18.4		4.2	
			1.063	A25	2.405	20.4		4.6	

Number of Samples=980, GFI=0.873, AGFI=0.847, (*Pk, Pkn* : 1% significance level)

In addition, the *Pkn* values from Table 6 were, from largest to smallest, 1.102 for protection of green space and nature, 1.073 for improvement and ease of use of parks, 1.000 for connection to water through improvement of rivers and ponds, 0.834 for improvement of city landscape, and 0.690 for environmental measures to reduce noise, vibration, and air pollution. From these results, it is clear that the residents' consciousness of the Environment is largely influenced by protection of green space and nature, followed by improvement and ease of use of parks.

Furthermore, Table 6 uses path coefficients *Pk* and *Pkn*, derived from the results of the covariance structural analysis, to calculate parameter α_j, the first-order factor of each observed variable, and parameter β_j, the second-order factor of each observed variable. The equations for calculating α_j and β_j are as shown in items (1) and (2) below.

$$\alpha_j = \frac{Pkn}{\sum Pkn} \times 100(\%) \quad (1)$$

$$\beta_j = \frac{Pk \times Pkn}{\sum (Pk \times Pkn)} \times 100(\%) \quad (2)$$

Parameters α_j and β_j express, as a percentage, the influence that each observed variable has on the first-order factor and second-order factor. This research attempts to analyze the evaluation score of the residents' consciousness using parameters α_j and β_j and the observed variables.

5. ANALYSIS OF THE CHANGE IN RESIDENTS' CONSCIOUSNESS

5.1 Analysis of the Evaluation Score of the First-Order Factor and Second-Order Factor

The evaluation score analysis takes the five-step evaluation of parameters α_j and β_j and the observed variables, divides it by 5 to arrive at X_j, then calculates the evaluation score of each survey respondent for the first-order factor ($\alpha_j \times X_j$) and second-order factor ($\beta_j \times X_j$).

The reason for converting the observed variables into X_j is to make the evaluation score of the first-order and second-order factors a full 100 for responses with a "5" rating given for each item.

Thus, the equations for calculating the evaluation score Y_i of the first-order factor k for each survey respondent, and for calculating the evaluation score Z of the second-order factor, are (3) and (4), respectively.

$$Y_i = \sum_{j=1}^{m} (\alpha_j \times X_j) \quad (3)$$

$$Z = \sum_{j=1}^{n} (\beta_j \times X_j) \quad (4)$$

Y_i : Evaluation Score of the First-Order Factor (max 100)

Z: Evaluation Score of the Comprehensive Evaluation (max 100)

X_j : 5-Step Evaluation of the Observed Variables ÷ 5

m : Number of Evaluation Items of the First-Order Factor k

n : Number of All Evaluation Items

Next, we quantify the mean value and variation coefficient of the evaluation score of the data from each survey (the first-order factor being $\alpha_j \times X_j$, and second-order factor being $\beta_j \times X_j$).

Figures 8 and 9 display the mean value and variation coefficient of each evaluation score. Both figures display the analysis results of the 2005 data on the horizontal axis, and the analysis results of the 2009 data on the vertical axis, with a 1:1 line drawn for reference.

In Fig. 8, only plots where the results of the independent t-test satisfied a 5% significance level were labeled "Changes." In Fig. 9, only plots where the results of the test of variance homogeneity satisfied a 5% significance level were labeled "Changes." The plots labeled "Changes" in both figures represent not only qualitative changes of being above or below the 1:1 line, but also statistical changes.

5.2 Consideration of the Changes in Residents' Consciousness

The following considers the changes in residents' consciousness using the results of Figures 8 and 9.

(A) Mean Value of the Evaluation Score (Fig. 8)

The mean value of the evaluation score of the first-order factor "Environment" and the second-order factor "Comprehensive Evaluation" increased. Consequently, during the 4 years following the consolidation of Isesaki City, residents' satisfaction in "Environment" and "Comprehensive Evaluation" increased.

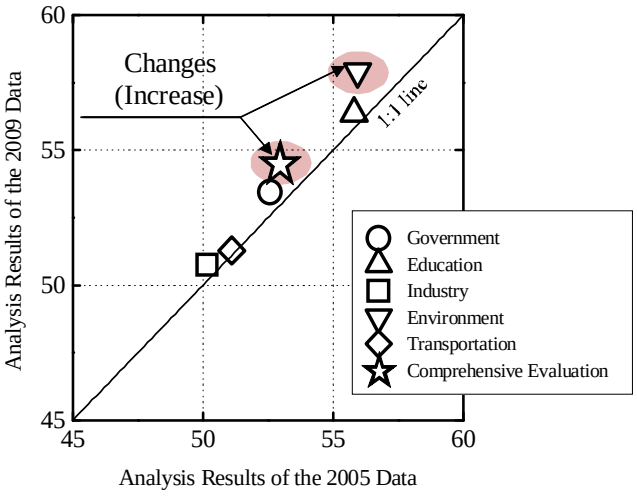

Fig. 8 Mean Value of the Evaluation Score

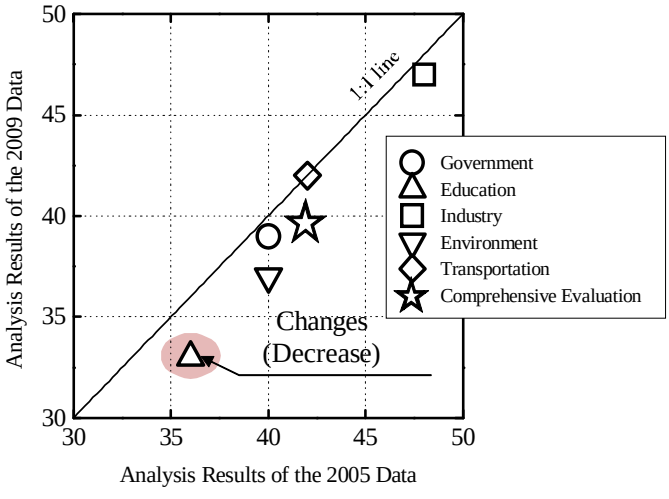

Fig. 9 Variation Coefficient of the Evaluation Score

(B) Variation Coefficient of the Evaluation Score (Fig. 9)
The variation coefficient of the evaluation score of the first-order factor "Education" decreased. The evaluation score of the variation coefficient of the first-order factor "Environment" and the second-order factor "Comprehensive Evaluation" did not display a statistical change. Consequently, during the 4 years following the consolidation of Isesaki City, the unity of residents' consciousness towards "Education" increased, but the unity of residents' consciousness towards "Environment" and "Comprehensive Evaluation" did not increase.

6. CONCLUSION

This research has sought to quantify changes in the consciousness of Isesaki City residents due to environmental improvements throughout Isesaki City using data from surveys conducted at the time of consolidation (in 2005) and four years after consolidation (in 2009). The conclusions from the results of this research is as follows.

(A) Isesaki City and its residents were able to increase residents' satisfaction in "Environment" by promoting environmental improvements throughout the merged municipality. Therefore, it is possible to increase residents' satisfaction in the environment by carrying out environmental improvements throughout a merged municipality with the cooperation of city residents.

(B) Isesaki City and its residents were able to increase residents' satisfaction in "Comprehensive Evaluation" through increases in residents' satisfaction in "Environment" by promoting environmental improvements throughout the merged municipality. We reached this conclusion because the mean value of the evaluation score of only "Environment" and "Comprehensive Evaluation" increased during the 4 years after consolidation. Furthermore, because the value of first-order factor *Pk* for "Environment" was second only to "Transportation," residents' satisfaction in "Environment" has a large influence on "Comprehensive Evaluation."

(C) Although Isesaki City and its residents promoted environmental improvements throughout the merged municipality, we did not observe an increase in unity of residents' consciousness towards "Environment." We reached this conclusion because the variation coefficient of the evaluation score of "Environment" did not decrease during the 4 years after consolidation. Therefore, a longer period of time is required to increase the unity of residents' consciousness through environmental improvements. This coincides with the findings of prior literature [5], and it appears the 4-year period of this research is too short to reveal any increase in the unity of residents' consciousness.

(D) Based on the results of this research, a merged municipality and its residents can contribute to an increase in residents' satisfaction in their new city by improving the environment throughout the merged municipality. However, in order for a merged municipality and its residents to increase the unity of residents' consciousness by improving the environment throughout the merged municipality, an extremely long period of time is required. Therefore, the future task of this research is to continue conducting surveys and analyses, and make clear any changes in residents' consciousness over a longer period. Furthermore, the future task of this research is to analyze the differences in residents' consciousness between the former municipalities.

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