2007 Dec. 12-14 Hong Kong
International Conference on Siting of Locally Unwanted Facilities: Challenges and Issues

# STRUCTURAL MODEL OF RISK PERCEPTION ON LANDFILL SITE FOR MUNISIPAL SOLID WASTE

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# Background of Study

In Japan, municipal solid waste was generated more than 50 million tons per year.(2006)
- up most 80% of that were incinerated.
-7.3 million tons of ash and non-combustible wastes were disposed in landfill site with leachate control.

Landfill site is an essential facility for our social activity, however, associated with uncertain risks and public protests described as NIMBY.


**Problems**

- Shortage of the Landfill site
- The Rising of disposal cost

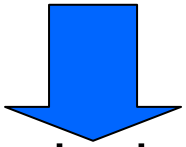
**It call for the study about the public acceptance and risk perception of landfill site, and those relevant factors.**

# Objectives of This Study

Major Focus:

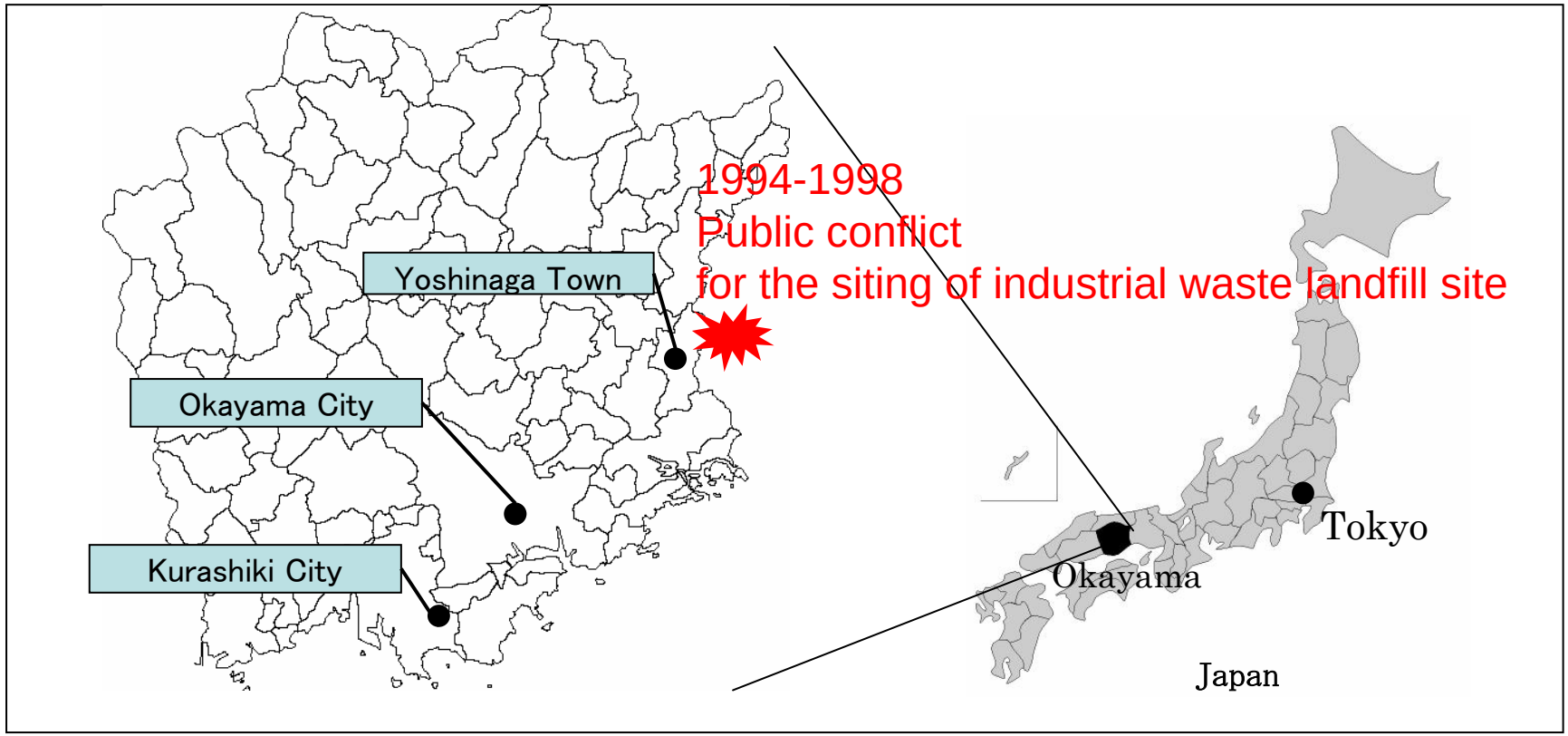
- Analyze the factors relevant to the acceptance and risk perception of landfill site for municipal solid waste
- Construct the structural model to understand the relationship of these factors

Major Goals:



- Get suggestions about designs of countermeasure to improve the public acceptance of landfill site

# Location of research area




| Research Area | Area type | Population | Number of households | Size of household |
|---|---|---|---|---|
| Okayama City | commercial area | 626,534 | 244,010 | 2.57 |
| Kurashiki City | industrial area | 430,239 | 152,510 | 2.82 |
| Yoshinaga Town | Rural area | 5,288 | 1,690 | 3.13 |

# Questionnaire Method : Samples

## Subjects

1000 citizens living in 3cities were selected by systematic random sampling from the telephone directory

## Mailing method

## Response rate : 42.3%

## Description of the Samples

| | |
|---|---|
| Sex | |
| Male | 70.4% |
| Female | 26.7% |
| No answer | 2.9% |
| Age | |
| 0-29 | 1.4% |
| 30-39 | 3.3% |
| 40-49 | 13.0% |
| 50-59 | 25.5% |
| 60-69 | 30.0% |
| 70- | 23.6% |

Sex and age distribution showed no significant differences among 3 cities.

# Questionnaire Method : Items of Questionnaire

| | | |
|---|---|---|
| Acceptance | Q302 | Can you accept the siting of municipal waste landfill site near your residence? |
| | Q305 | Can you accept the waste generated in other area? |
| Risk Perception | Q601 | Do you think a possibility of leak accident in landfill site is high? |
| | Q602 | Do you think it seem more likely that the serious pollution of soil and ground water caused by the breakage of the liner of landfill? |
| Necessity | Q210 | Do you think the land fill site is essential facility? |
| Benefit | Q708 | Do you want to use welfare provisions (ex. pool ) attached waste treatment facility? |
| Trust in technology and standard | Q603 | Do you think that landfill needs only to meet national standard under the construction? |
| | Q604 | Do you think that landfill can be controlled safely if the current technology is applied to the landfill? |
| Trust in local government | Q701R | Do you fear whether you get compensation, if the environmental pollution is occurred by the waste treatment facility? |
| | Q702R | Do you fear whether city conceal information intentionally if the accident in waste treatment? |
| | Q703 | Do you think city make an effort to disclose information properly? |
| | Q705 | Do you think city reflect on views (opinions) of residents in management of waste treatment facility? |
| | Q706 | Do you leave the waste treatment facility without fearing if city management it? |
| Knowledge of chemical substances | Q901 | Do you think chemical substances can be divided in two categories: hazardous one and safe one? |
| | Q902 | Do you think the chemical substance's risk can be reduced to zero? |
| | Q903 | Do you think hazard of chemical substance is well understood scientifically? |
| | Q904 | Do you think you are safe if you take carcinogen below the regulated dose? |
| Perception of Necessity and Safety | | Comparison with another risk factor: Nuclear power plant, automobile factory, tobacco, ※ pesticide, electromagnetic wave of cell-phone, exhaust gas from diesel automobile, food additive, genetically-modified food |
| Individual attrib | | |

These Questions were answered by 7 point Likert scale.

# Steps for Modelling Analysis

1. Data selection

To remove biased sample, we compared the means of 3 city data and selected data for modelling analysis.

2. Factor analysis

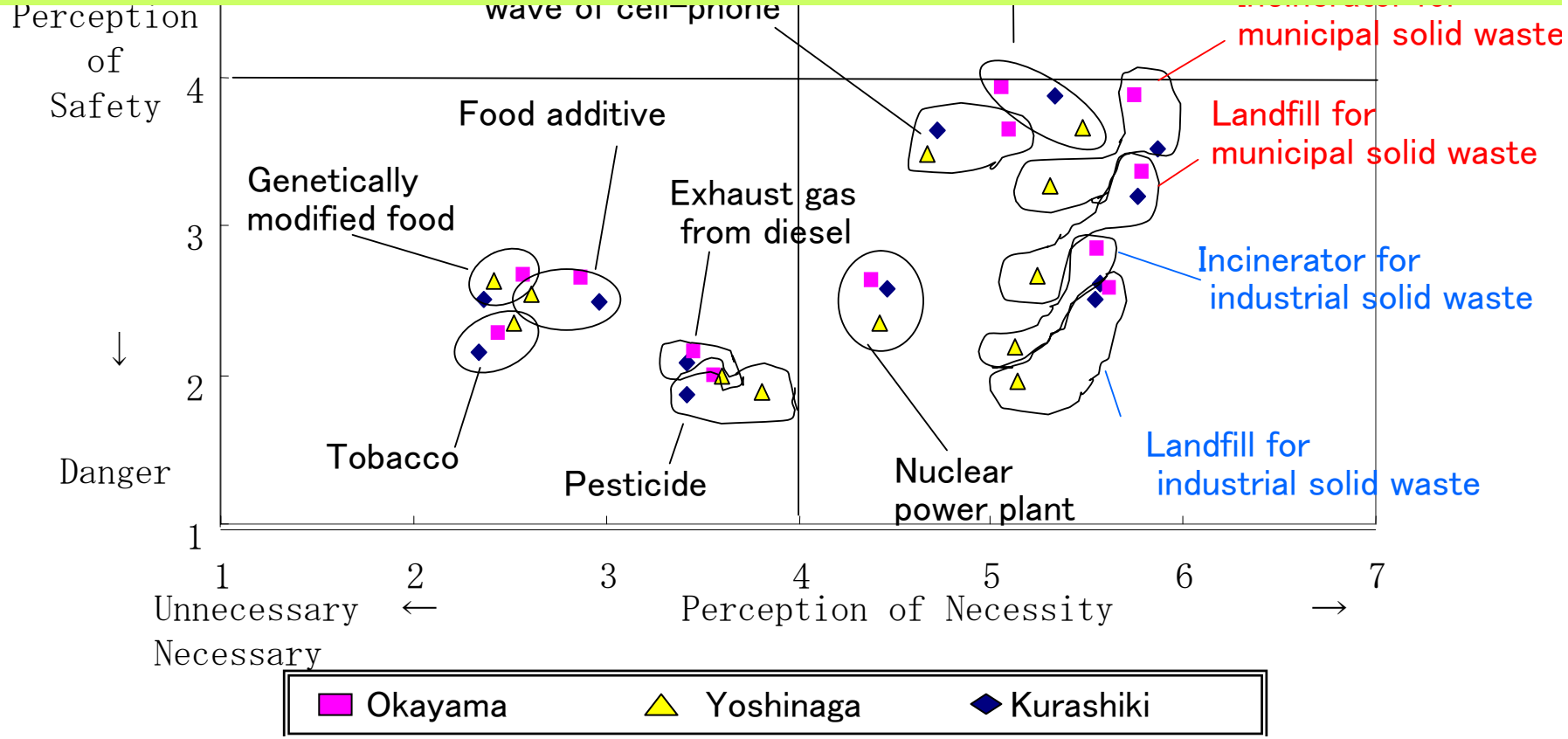
To fix the latent variables, we undertook explanatory factor analysis.

3. Model construction

To understand relationship of variables, we construct the model by the structural equation modelling.

# 1.1 Data selection : Comparison of 3 City's Data

- We examine the statistical differences of 3 cities data by one-way analysis of variance and nonparametric multiple comparison ($p<.05$).
- As a result, Yoshinaga city data shows significant difference on almost questions. (Q302, Q305, Q601, Q602, Q603, Q604, Q904, Q701, Q702, Q703, Q705, Q706) , and these data shows Yoshinaga citizens have a negative image to waste management.
- This study aims to develop a general model, thus, we remove Yoshinaga city data from modelling analysis



# 1.2 Data selection : Significance of correlation with acceptance and risk perception

| | | |
|---|---|---|
| Acceptance | Q302 | Can you accept the siting of municipal waste landfill site near your residence? |
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| | Q904 | Do you think you are safe if you take carcinogen below the regulated dose? |

×:no significant correlation with acceptance and risk perception (peason, $p<0.05$)

We left out these questions from factor analysis.

# 2. Factor analysis to fix the latent variables

Rotated component matris

| | Component | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |
| | **.840** | 7.550E-02 | -5.856E-02 | .106 | -1.986E-02 |
| | **.920** | -5.744E-02 | 5.873E-02 | -9.133E-02 | 1.888E-02 |
| | | **.910** | -6.029E-03 | -3.031E-02 | -1.669E-02 |
| | | **.942** | -1.714E-02 | 3.096E-02 | -1.077E-03 |
| Q603 | | | **.856** | -2.161E-02 | .109 |
| Q604 | | | **.896** | -2.814E-02 | 8.211E-03 |
| Q904 | | | **.628** | 8.413E-02 | -.144 |
| Q701 | -1.396E-03 | | | **.982** | -.102 |
| Q702 | 2.594E-03 | | | **.841** | .157 |
| Q703 | 2.971E-02 | -3.576E-02 | | | **.846** |
| Q705 | 4.245E-02 | -3.203E-02 | | | **.963** |
| Q706 | -8.214E-02 | 5.778E-02 | | | **.778** |

Acceptance

Risk Perception

Trust in technology and Standard

Trust in response to accident

Trust in sincerity to citizens

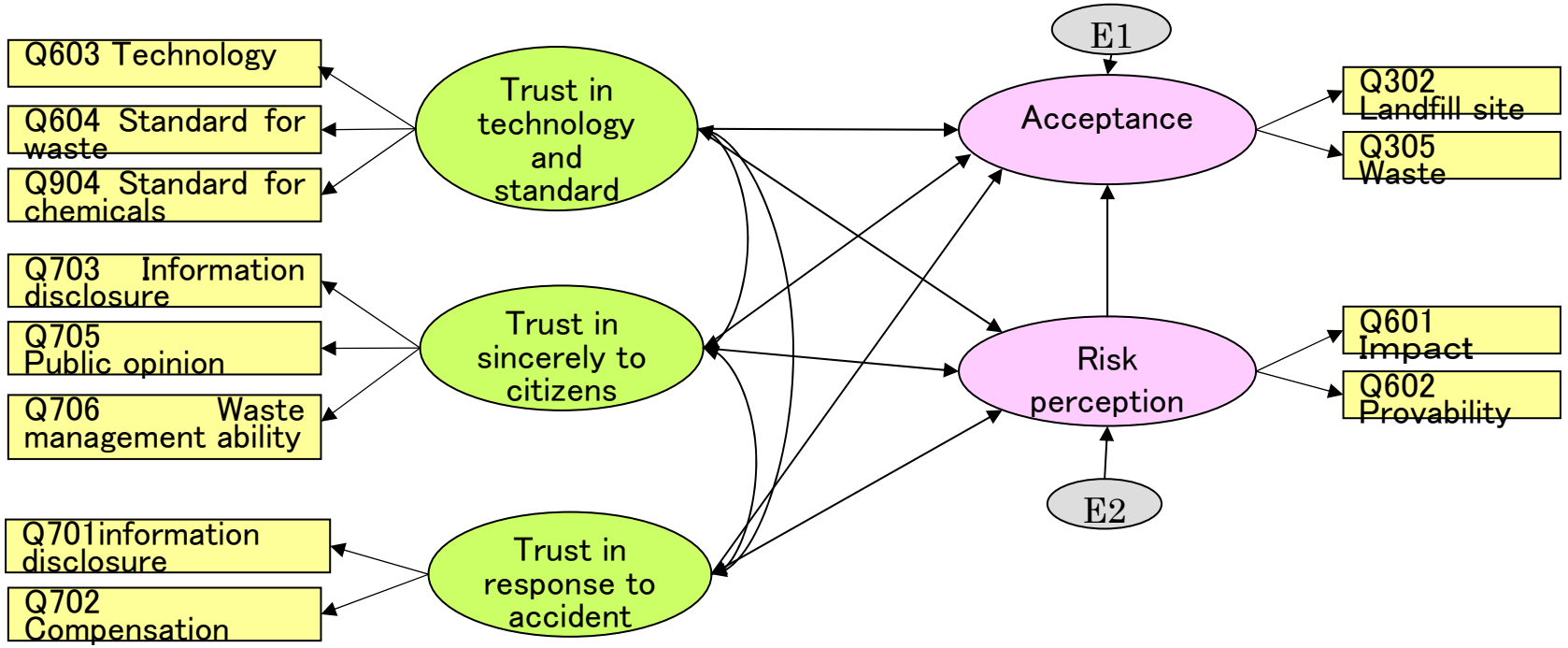
Extraction Method: Principal factor method

Rotation Method: Promax rotation

Boldface values indicate items loading most heavily on each factor.

# 3.1 : Structural Equation Modeling :Hypothesis

1. ‘Acceptance’ depended on ‘Risk perception’, ‘Trust in technology and standard’, ‘Trust in response to accident’, and ‘Trust in sincerity to citizens’
2. ‘Risk perception’ depended on ‘Trust in technology and standard’ , ‘Trust in response to accident’ and ‘Trust in sincerity to citizens’
3. ‘Trust in technology and standard’, ‘Trust in response to accident’ and ‘Trust in sincerity to citizens’ were in covariant relationship.



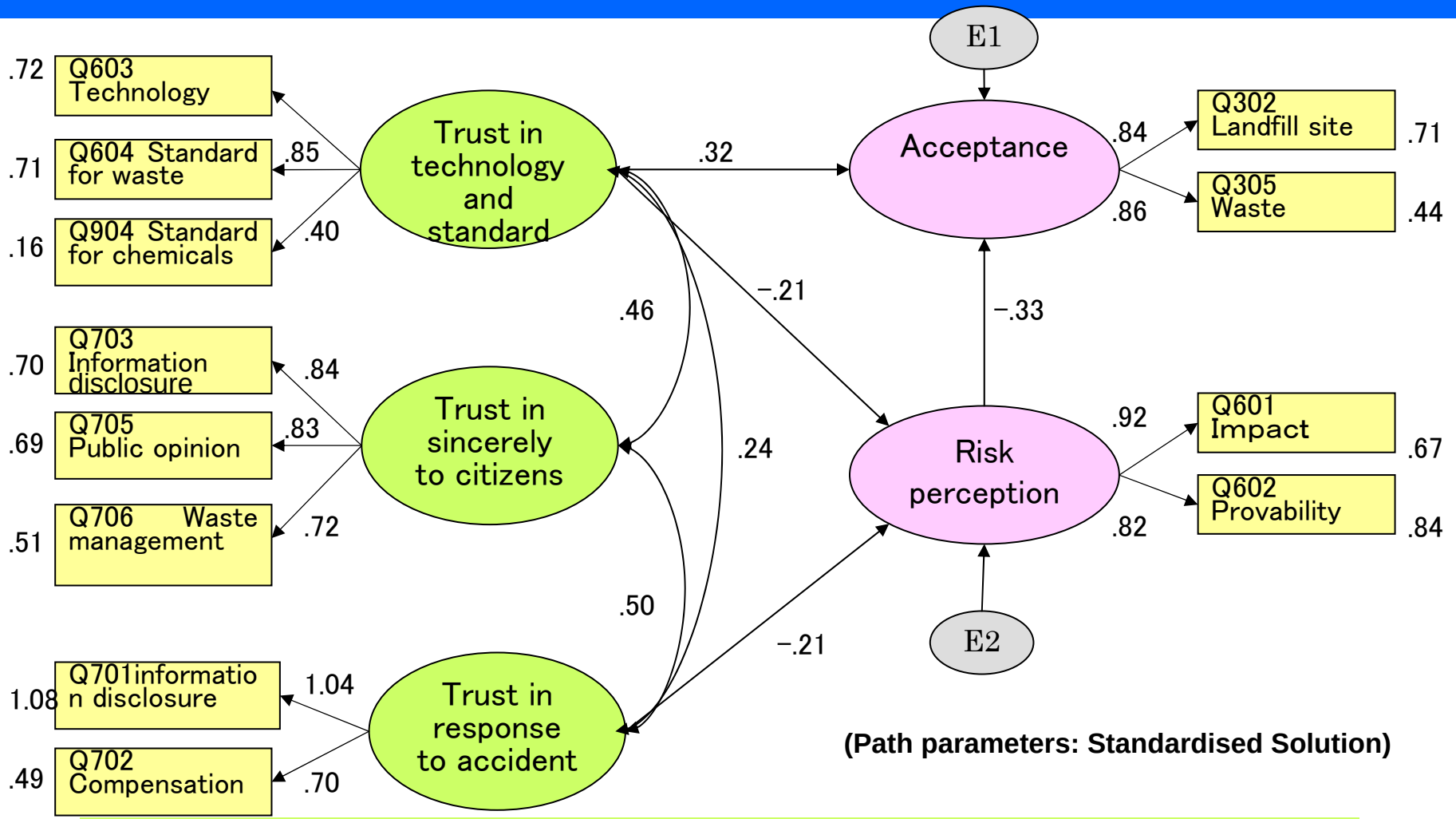

Model 4

# 3.2 : Comparison of Goodness-of-fit measures for the 4 models

| Goodness-of-fit measures | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| $X^2$ | 59.617 | 59.639 | 59.683 | 59.847 |
| Degrees of freedom | 44 | 45 | 46 | 47 |
| Probability level | .058 | .071 | .085 | .099 |
| RMSEA: Root Mean Square error of Approximation | 0.034 | 0.032 | 0.031 | 0.029 |
| GFI : Goodness of Fit Index | .971 | .970 | .970 | .970 |
| AGFI: Adjusted Goodness of Fit Index | .948 | .949 | .950 | .951 |
| RMR: Root Mean square Residual | .064 | .064 | .064 | .064 |
| AIC: Akaike's Information Criterion | 127.617 | 125.639 | 123.683 | 121.847 |

We adopt model 4 as the final model.

# Result :The Structural model with estimated parameter




**(Path parameters: Standardised Solution)**

1. ‘Risk perception’ and ‘Trust in technology and standard’ influence to ‘Acceptance’ in comparable level.
2. ‘Trust in technology and standard’ and ‘Trust in response to accident’ influence to ‘Risk perception’ in comparable level.
3. ‘Trust in sincerity to citizens’ is in covariant relationship with ‘Trust in technology and standard’, ‘Trust in response to accident’ , and it’s relationship is relatively strong.

# Discussion and Conclusions

## Structural Equation Modelling

- We construct the structural model using 5 latent variables ( ‘Acceptance’ and ‘Risk perception’and 3 relevant factor).
- The estimated model has an acceptable fit to data.

## Suggestions for countermeasure to improve public acceptance

1. Model parameter shows ‘Trust in technology and standard’ have a positive impact on acceptance of landfill site. It affirms a importance and effectiveness of public information on risk management technology and standard.
2. ‘Trust in response to accident’ have a negative impact on risk perception. This result suggests a importance to make contingency plans (ex: information disclosure system at the time of accident , compensation plan for residents)
3. ‘Trust in sincerity to citizens’ have a strong relationship with ‘Trust in technology and standard’ and ‘Trust in response to accident’ . Based on this result, It is expected that a daily communication between citizens and the local municipality has an indirect effect to improve the public acceptance.

# Subject for a Further Study

- In this study, we designed questionnaire items focusing public trust.
- Though, in our earlier survey conducted on actual conflict case, the fairness of siting process was a main a point of issue acceptance of landfill site.
- Because fairness of siting process is expected to have a direct effect to trust in local government, we are planning to analyse this aspect in next survey.