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QOL method for appraisal of transport facilities: theory, case studies, and implications to Indian HSR

ADBI HSR Seminar

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Scope of Research

Motivation

1. In conventional CBA the use of transport systems by retired people and children makes no merit?

2. Quality of Life indicators, a non-monetary (not GDP motivated) yet scientific approach to identify *happiness* in urban & regional development

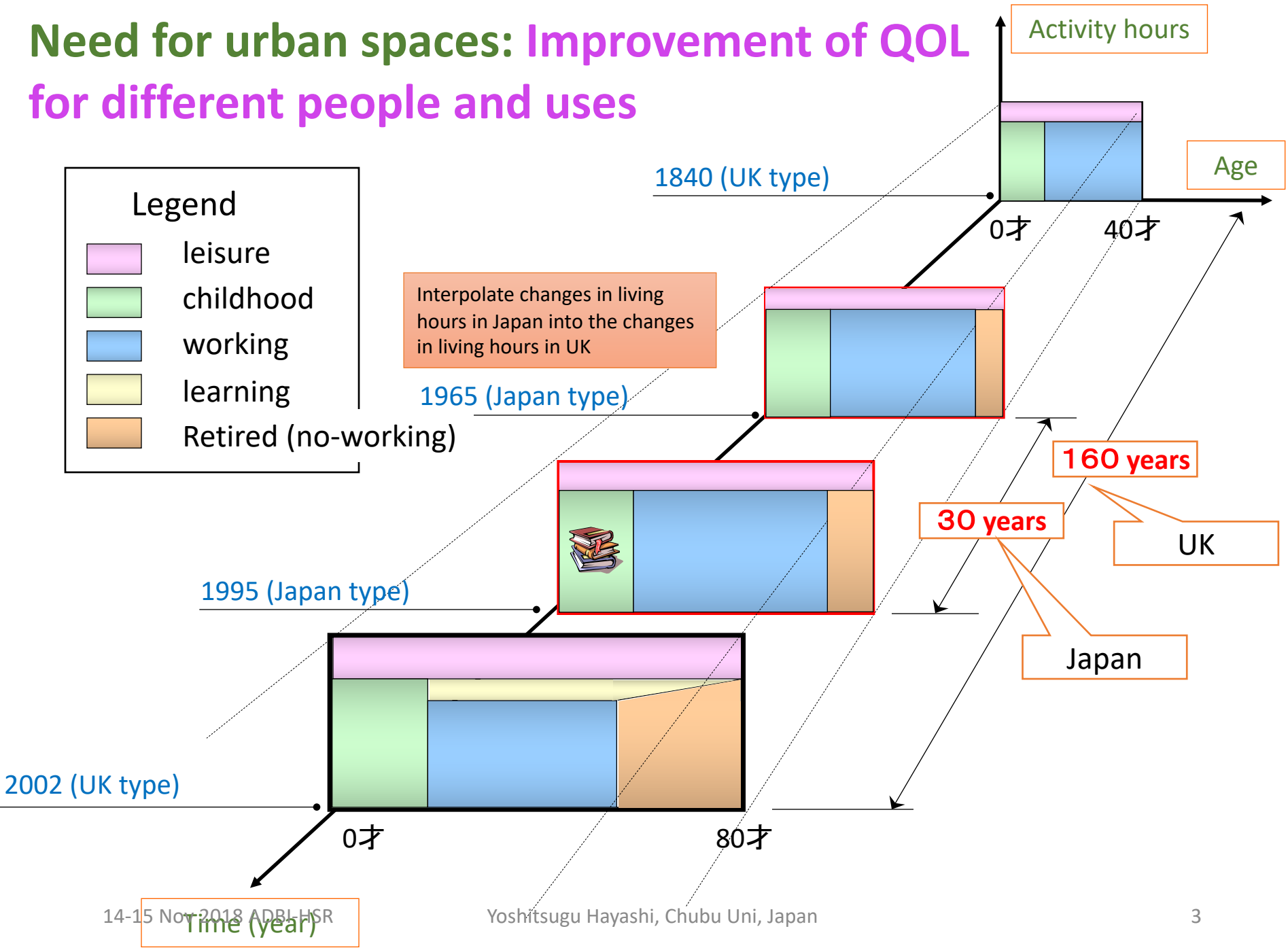
Questions

1. Can QOL provide an alternative indicator to GDP ?
2. How can we choose L-T policies better for everyone, meeting SDG11(sustainable living),16(inclusiveness)?

Objectives

1. Investigate the changes in QOL according to economic development
2. Effectiveness of integrated L-T policies to increase QOL
   - Construction of railways x Local Urban Development ➔ GRP ➔QOL

Need for urban spaces: Improvement of QOL for different people and uses



【Goal】 **Higher QOL**

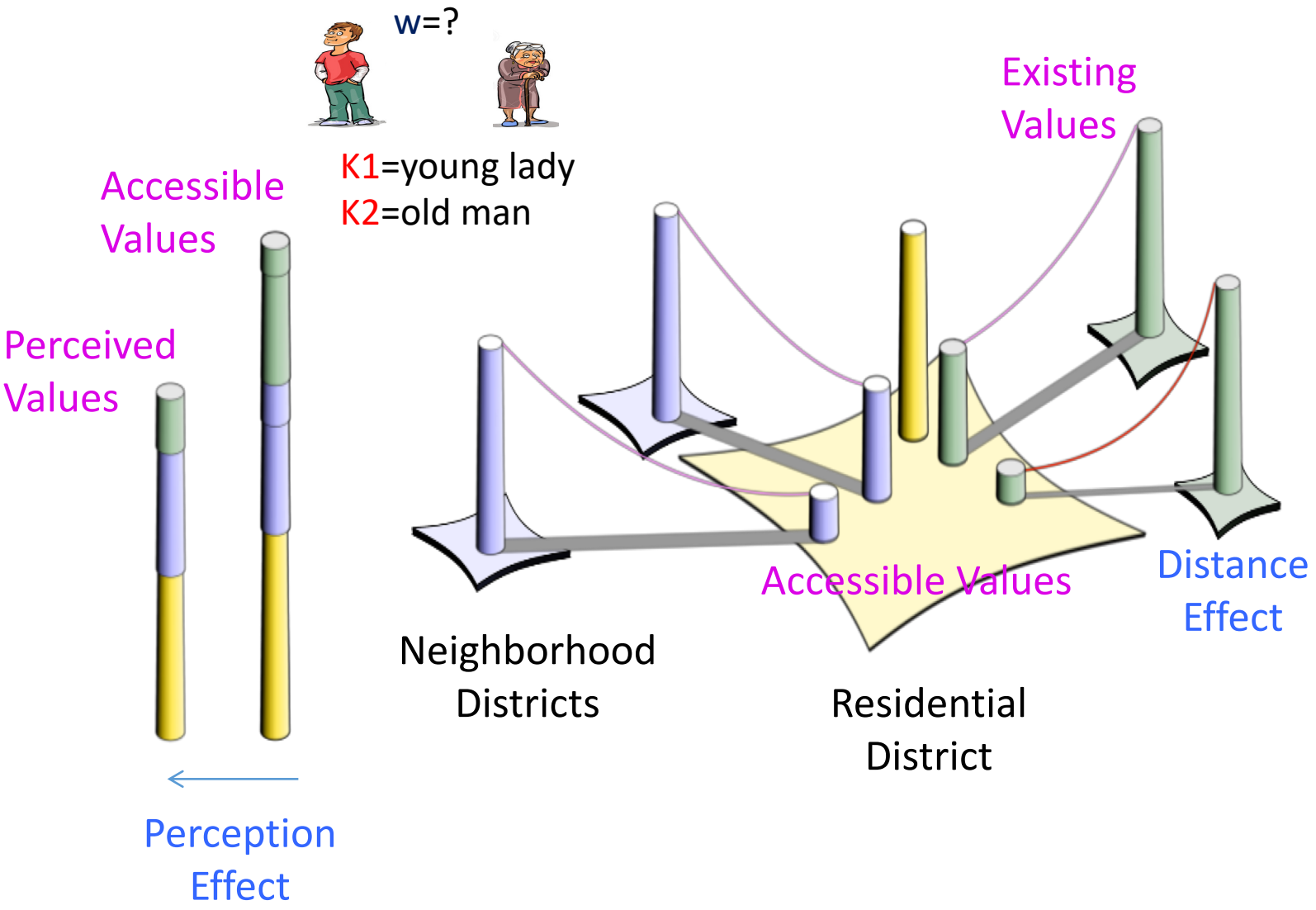
【Endogenous Conditions】

＜Domestic＞	＜Int'l＞
Low birth rate	Growth of Asia
Aging	Globalization
IT	IT

Economy ⟷ Ecology

A. Economic Opportunity	B. Living & Cultural Opportunity	C. Amenity	D. Safety & Security・	E. Burden on Environment
●Opportunity for Income ●Accessibility to Agglomeration of Industries/Population	●Service ●Education/Culture ●Health/Medical Care ●Shopping/Service ●Amusement/Travel	●Housing ●District Landscape ●Nature of Region ●Identity of Region ●Comfortability / Punctuality of travel ●Time for leisure/cultural life	●Risk of Natural disaster ●Risk of Building / Facility disaster ●Risk of Chemical Pollution ●Risk of Traffic Accident ●Resource Preservation ●Criminal Rate	●Burden from Industry ●Burden from Domestic ●Burden from Transport ●Heat Island ●Noise

Value Accessibility Theory of QOL



Measuring QOL: Concept and model

Accessible Value

$$A_{ij}^{m} = V_{j}^{m} \cdot e^{-\alpha c_{ij}}$$

- ***m***: QOL factor
- ***i***: Mesh block with residents living in
- ***j***: Mesh block with objective value of QOL factor ***m***
- α^{m}: Impedance parameter for traveling from mesh block ***i*** to mesh block ***j***
- c_{ij}: Travel cost between mesh block ***i*** and mesh block ***j***
- ***Vjm***: Existing value of QOL factor ***m*** exists in mesh block ***j***
- ***Aijm***: Accessible Value of ***Vjm*** for residents living in mesh block ***i***.

Perceived Value

=QOL for individual

$$QOL_{i}^{k} = \sum W^{mk} A_{ij}^{m}$$

- ***k***: Population group ***k*** with certain social-economic attributes
- ***Wmk***: Weight of QOL factor ***m*** for person ***k*** among all factors
- ***QOLik***: Perceived Value=Quality of life for person ***k*** living in mesh block ***i***

Gross Regional Happiness

$$GRH^{k} = \sum_{i} P_{i}^{k} \cdot QOL_{i}^{k}$$

$$GRH = \sum_{k} GRH^{k}$$

QOL in Nanging,China

Distance Effect

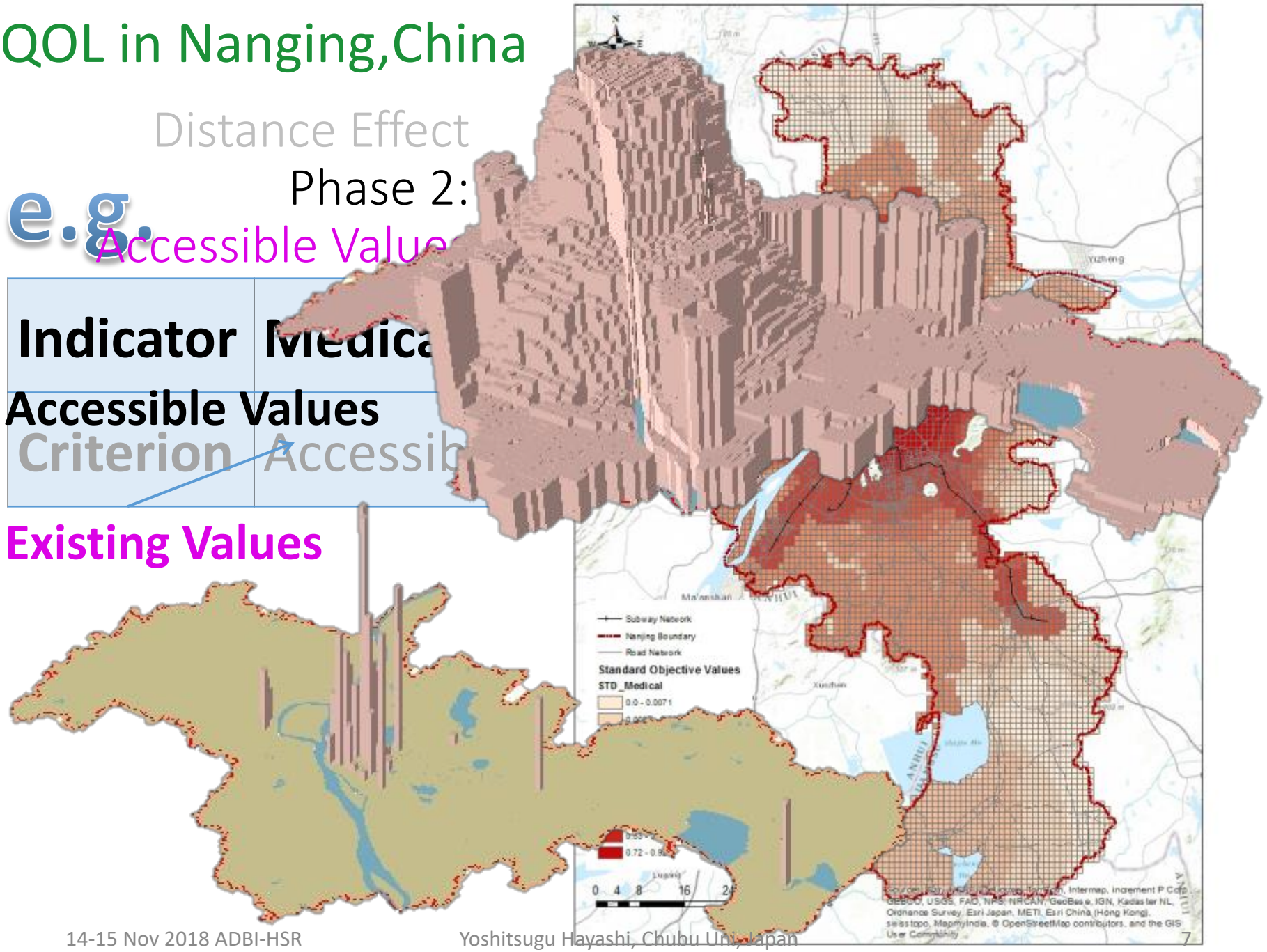
Phase 2:

e.g. Accessible Value

Indicator	Medica
Criterion	Accessib

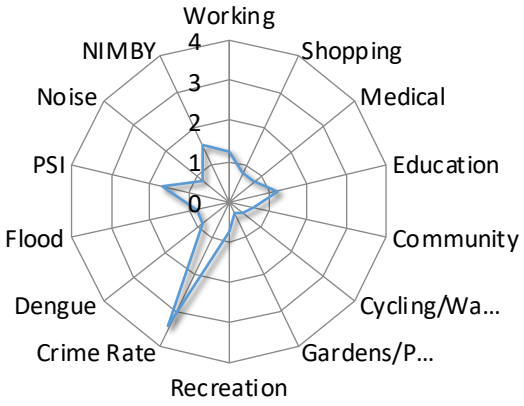
Accessible Values

Existing Values

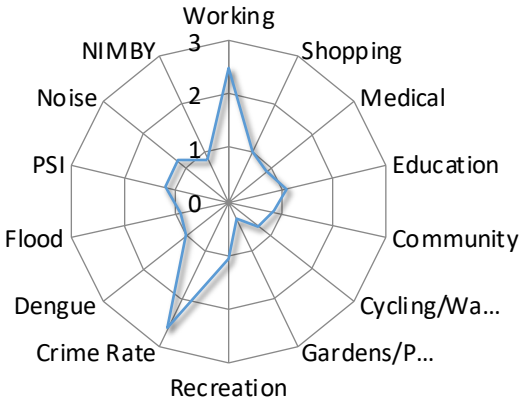


Weights between QoL Factors (Singapore)

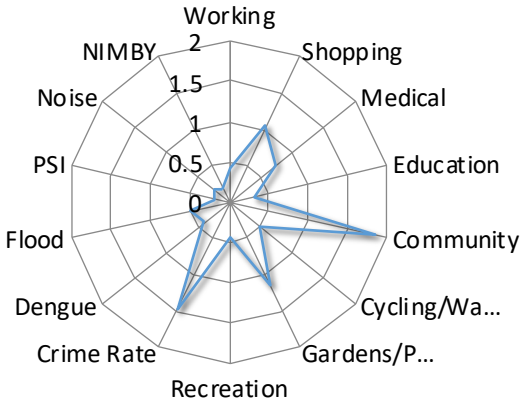
Young / Female



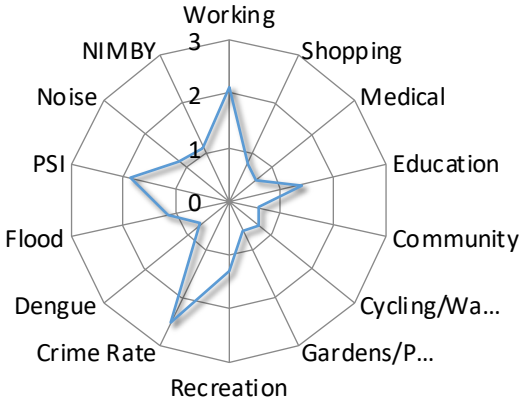
Middle-aged / Female



Aged / Female



Young / Male



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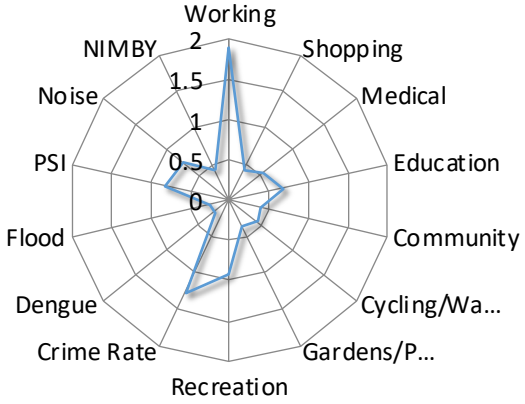

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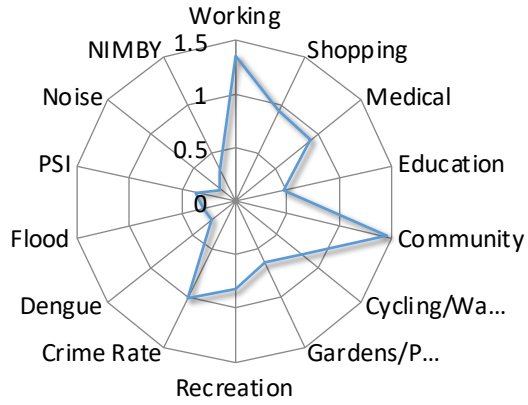
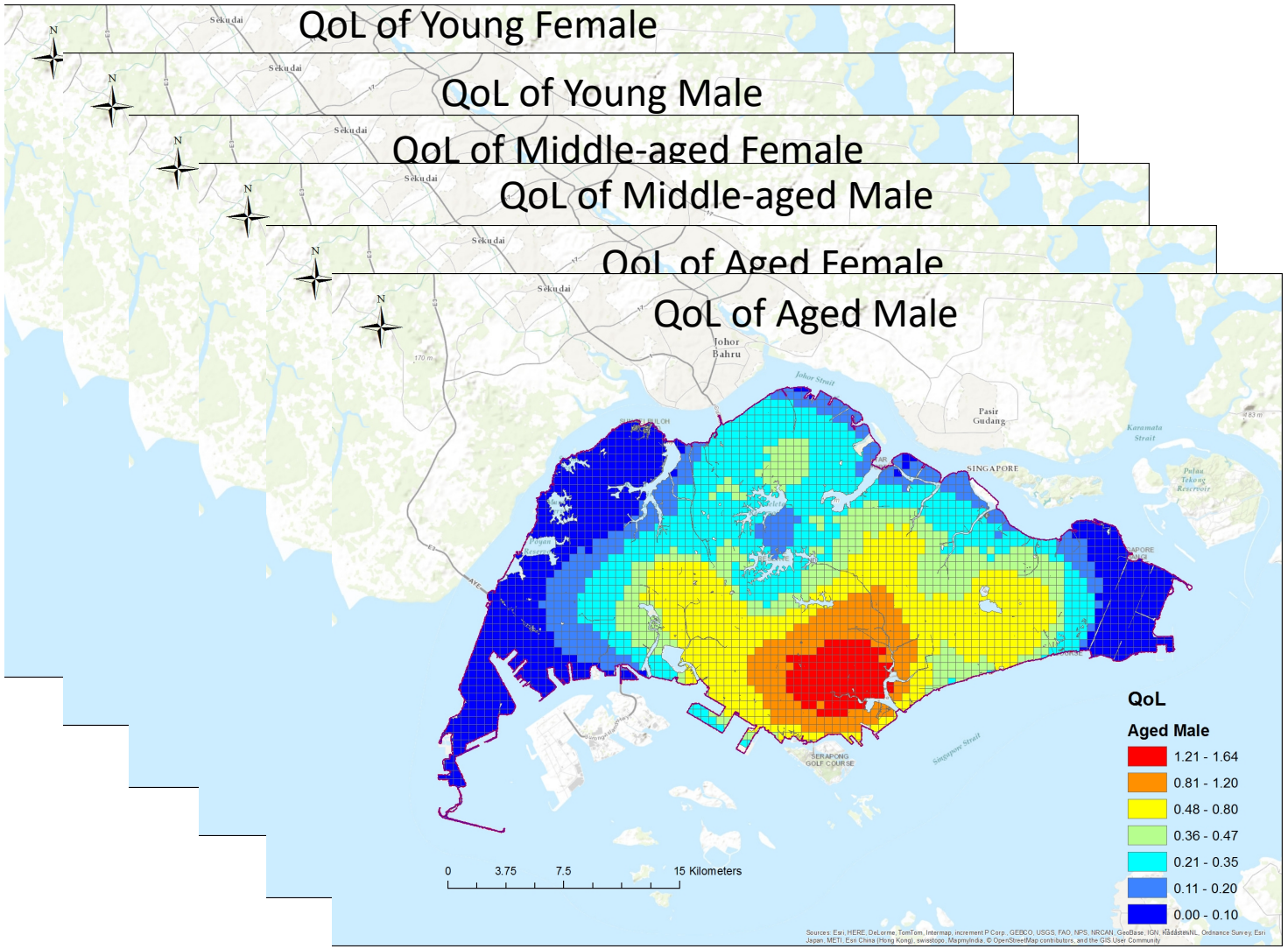
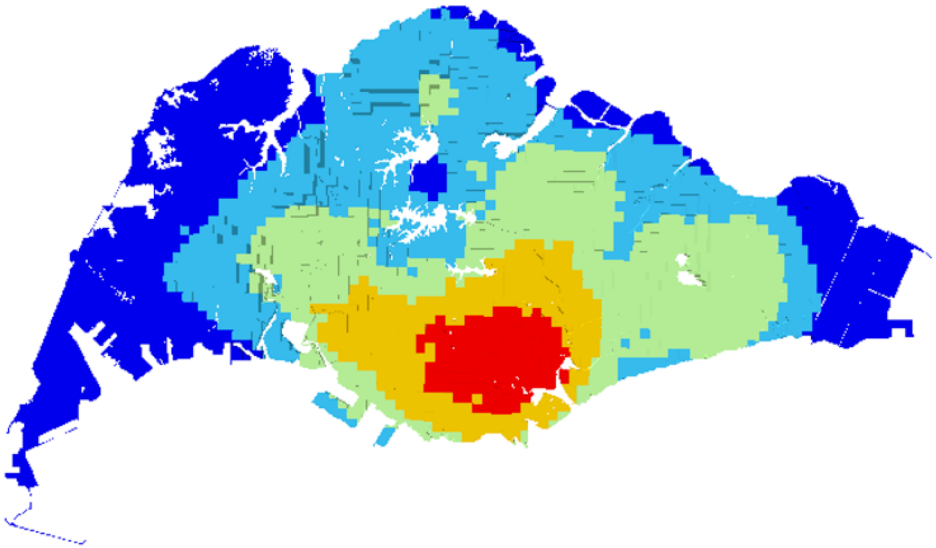


QOL Distribution of Singapore by Person's Attribute Group (Age-Gender)

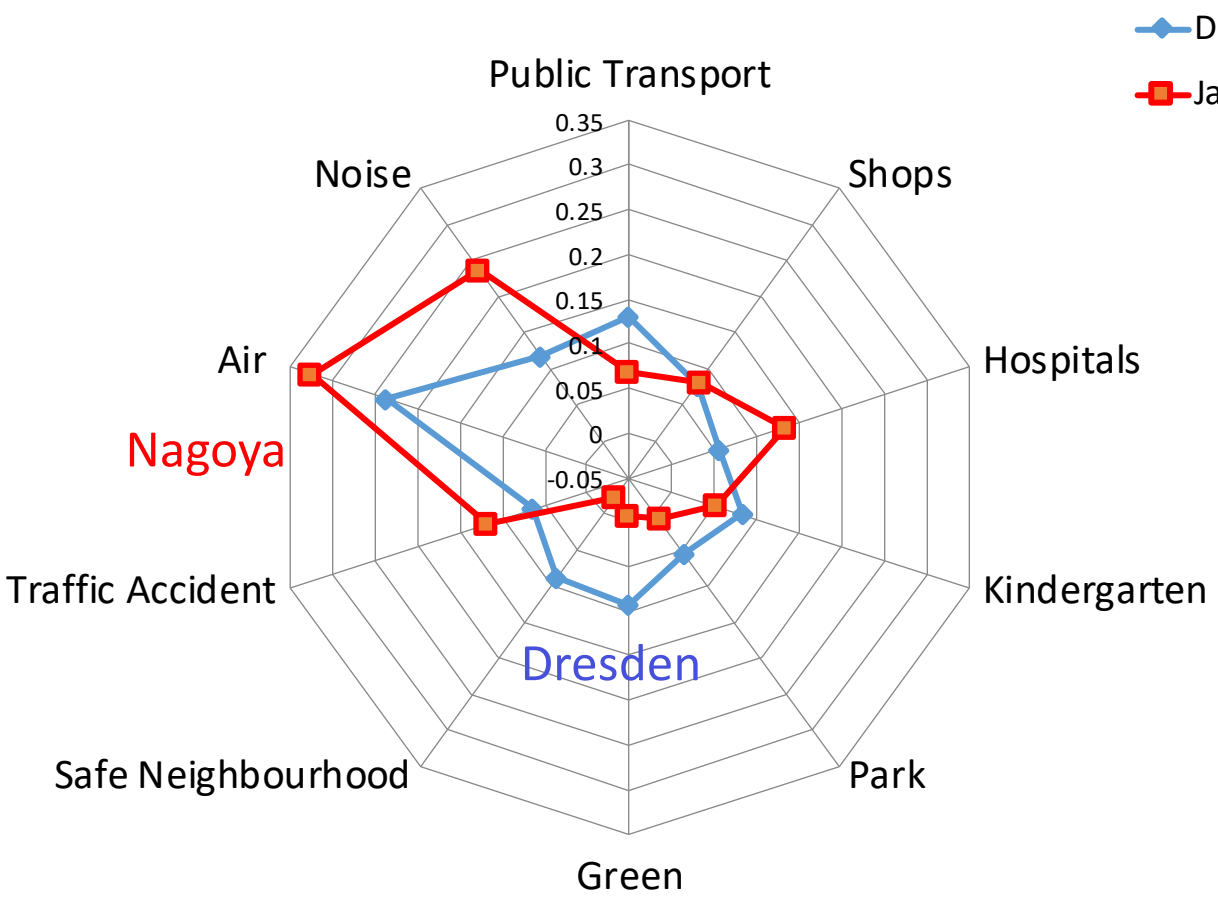


Identifying where Transport Network or Area Development/Retreat are Effective?



Weight between QOL Factors (Dresden vs Nagoya)

Subjective attitude of Female aged 31~50 years old

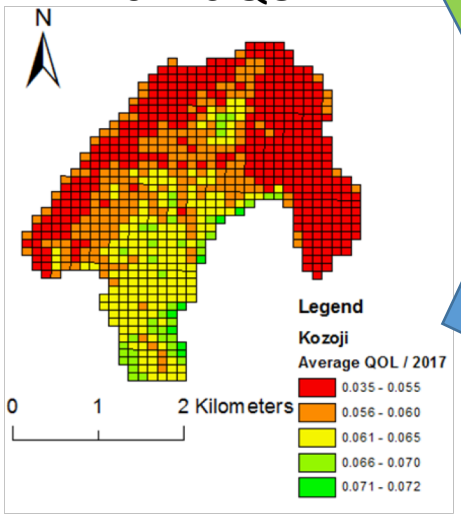


- Japanese's negative attitude towards "Greens" and "Park"
  - *There is a lack of awareness on importance of Green*
- Dresden shows that Green is highly valued
  - *The advantage of green is fully comprehended*
  - *considered to be an important part of daily lifestyle*

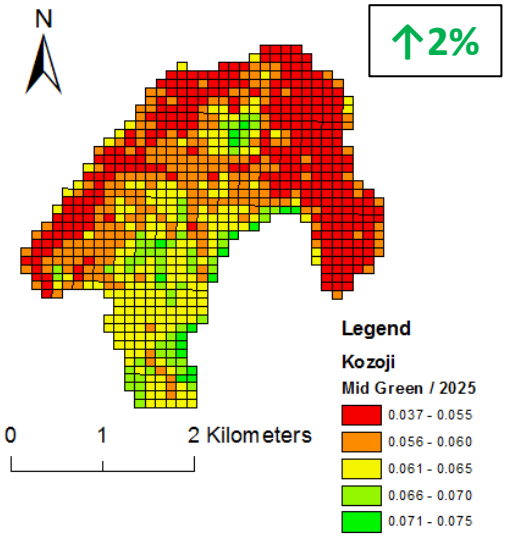
Then higher the value, the more important the factor is.

Green scenario vs. LRT scenario

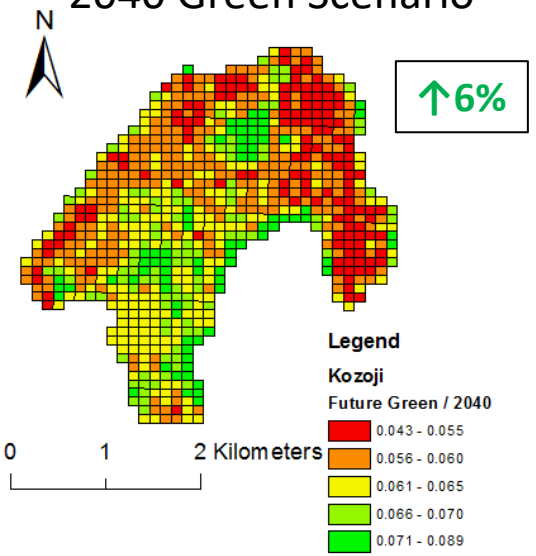
2017's QOL



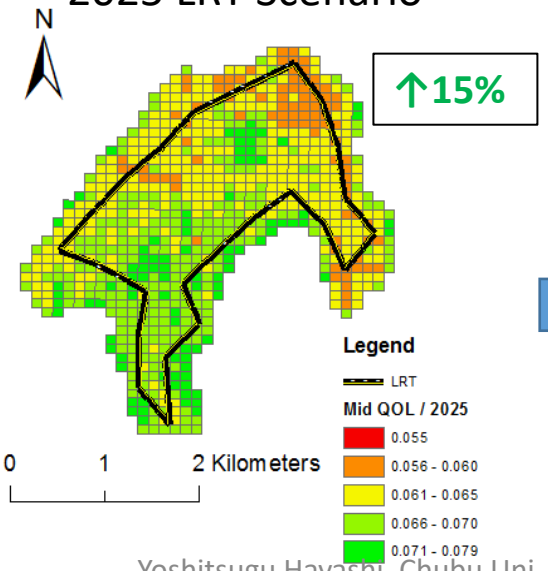
2025 Green Scenario



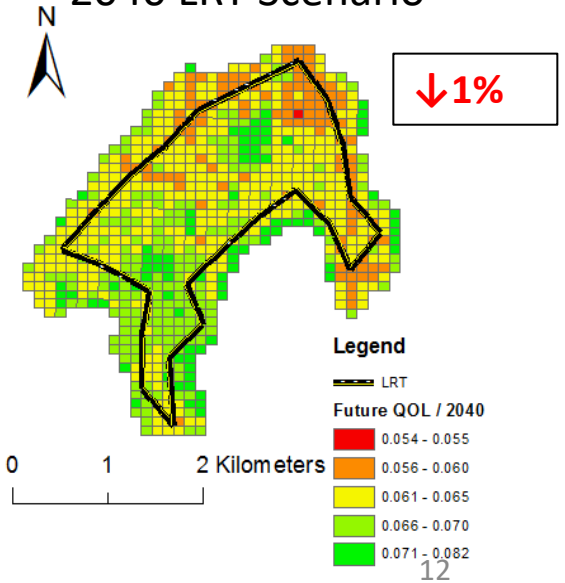
2040 Green Scenario



2025 LRT Scenario



2040 LRT Scenario



Case study: Across Chubu Motorway

Route:

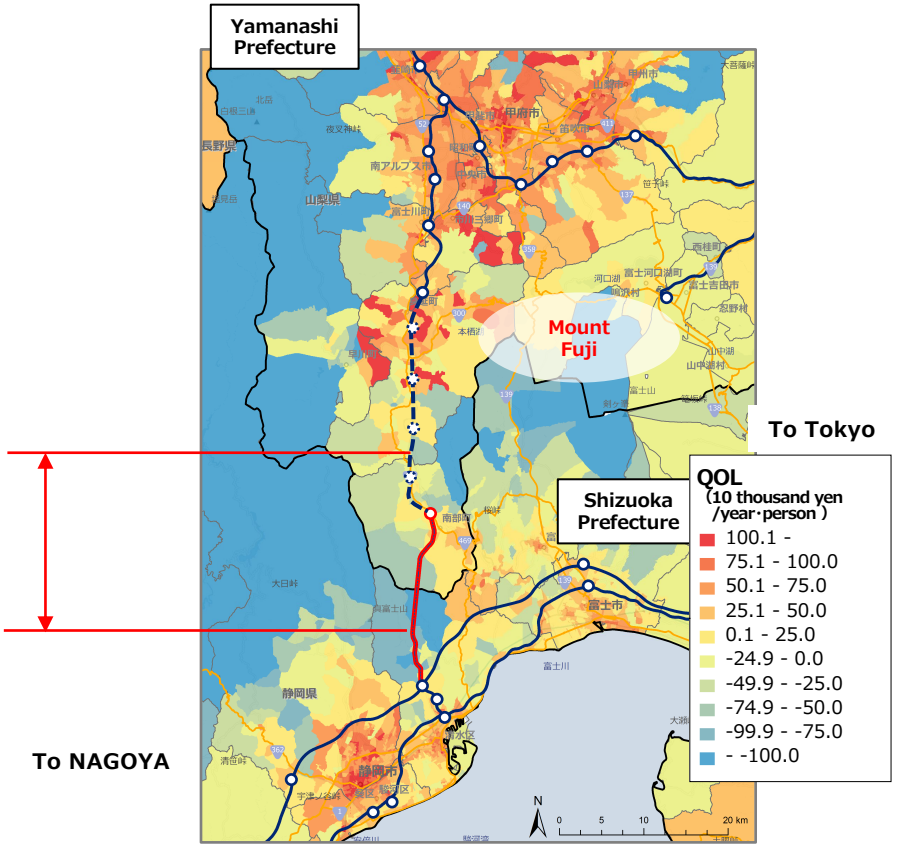
Across Chubu Motorway
(Central Japan Crossing)

Target section:
from Shin-shimizu
to Tomisawa

Length: about 21km

Number of Lanes:
2-Lane (interim)

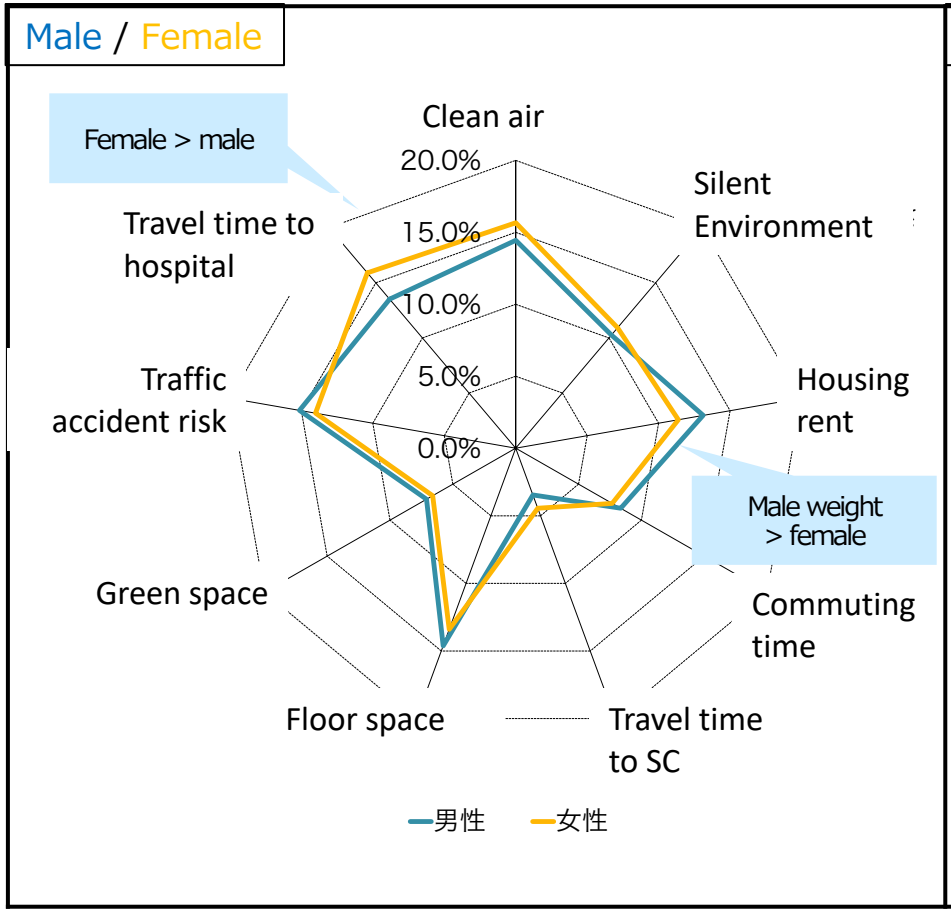
From Shin-shimizu
To Tomisawa



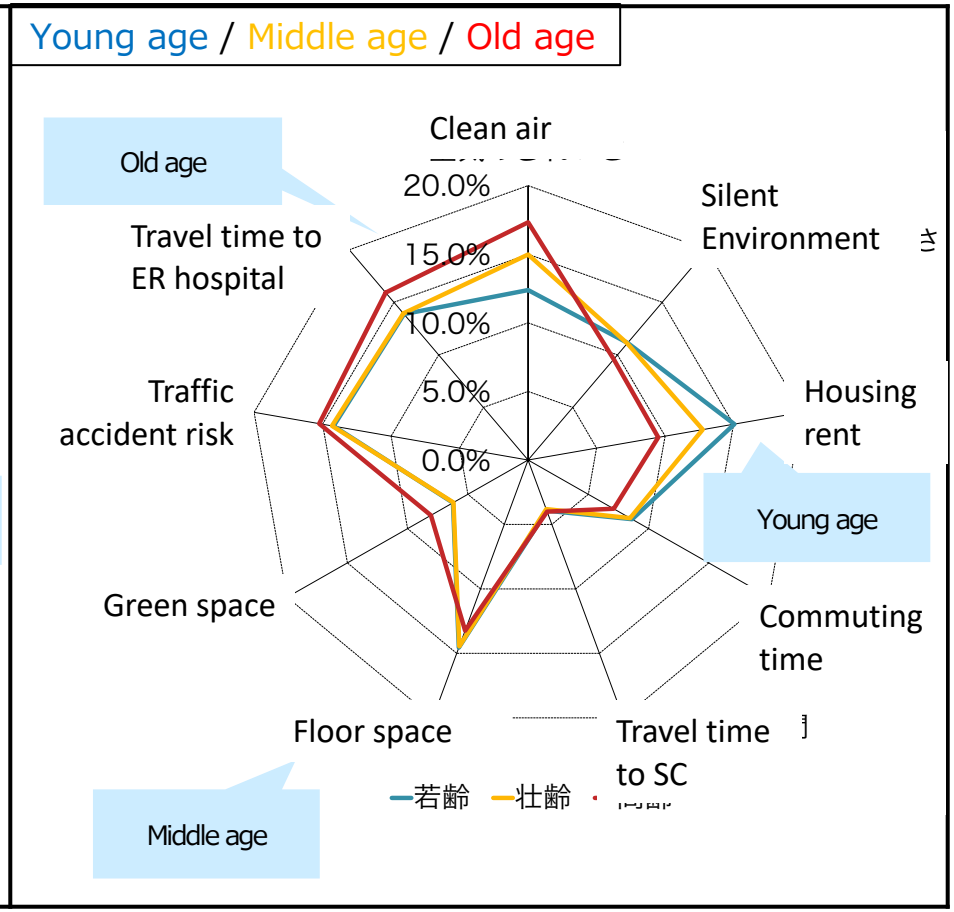
Estimated Individual Perception for QOL components in Across Chubu Motorway project

E.g. Difference in gender, age group

Male / Female



Young age / Middle age / Old age



Two Alternative Choice Experiments for Conjoint Analysis

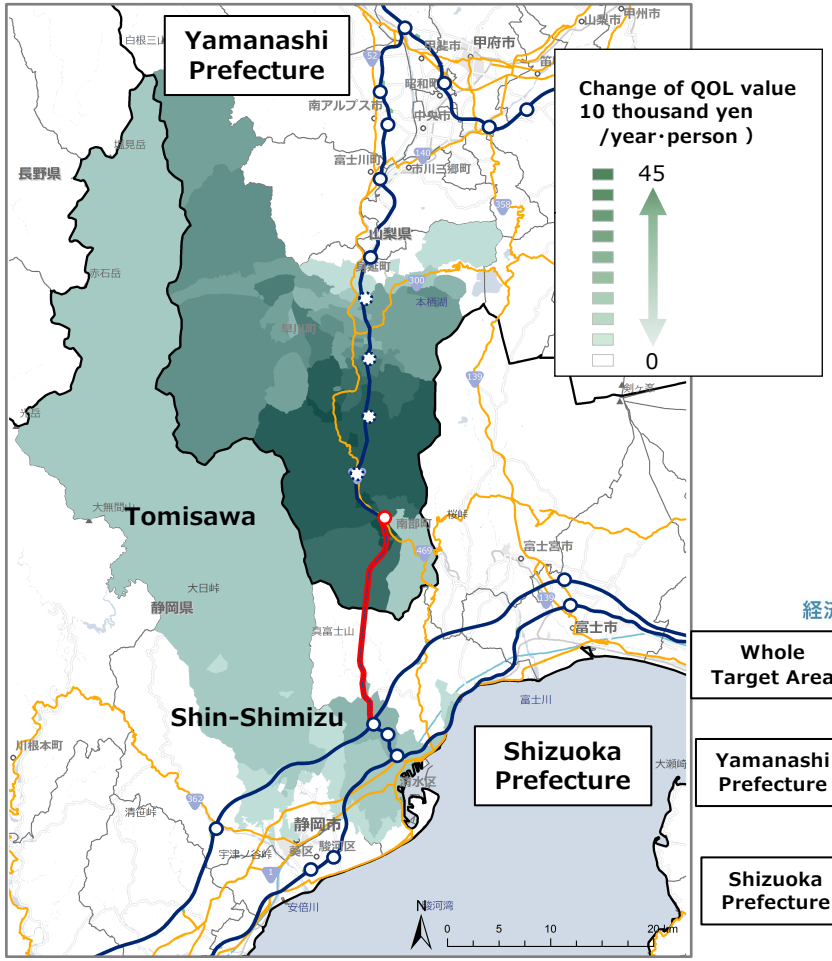
■ **Respondents select one region they want to live in from two alternatives**

Q4 Which is better for you as a residential region?

Region A	1 地域Aの方がよい	2 地域Bの方がよい	Region B
1.Commuting time 10 min shorter than the present **2.Travel time to SC** 5 min shorter than the present **3.House rent** 10,000yen higher than the present	○	○	**1.Commuting time** 10 min longer than the present **2.Travel time to SC** 5 min longer than the present **3.House rent** 10,000yen lower than the present

Case study: Motorway across Chubu Region

Change in QOL Value by Project



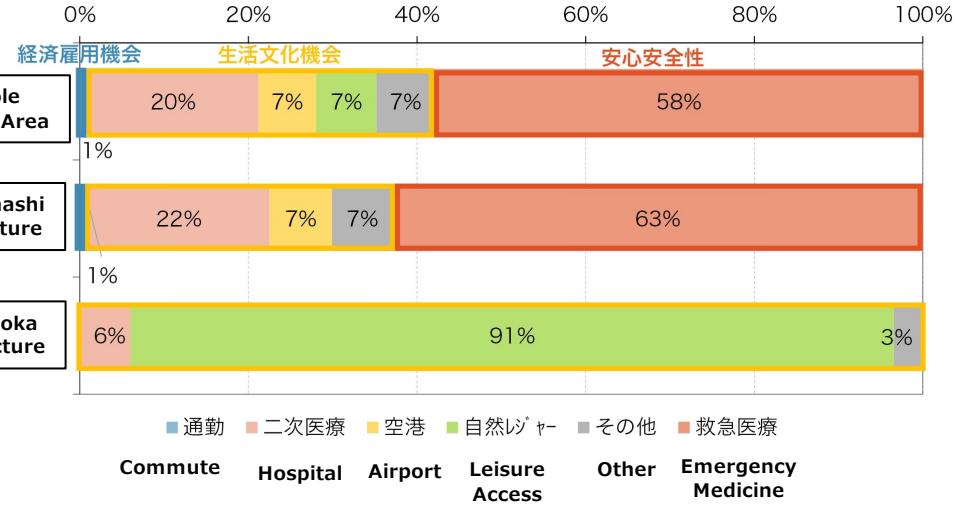
Average Value per capita in Target Area
9,700 yen/person･year

×

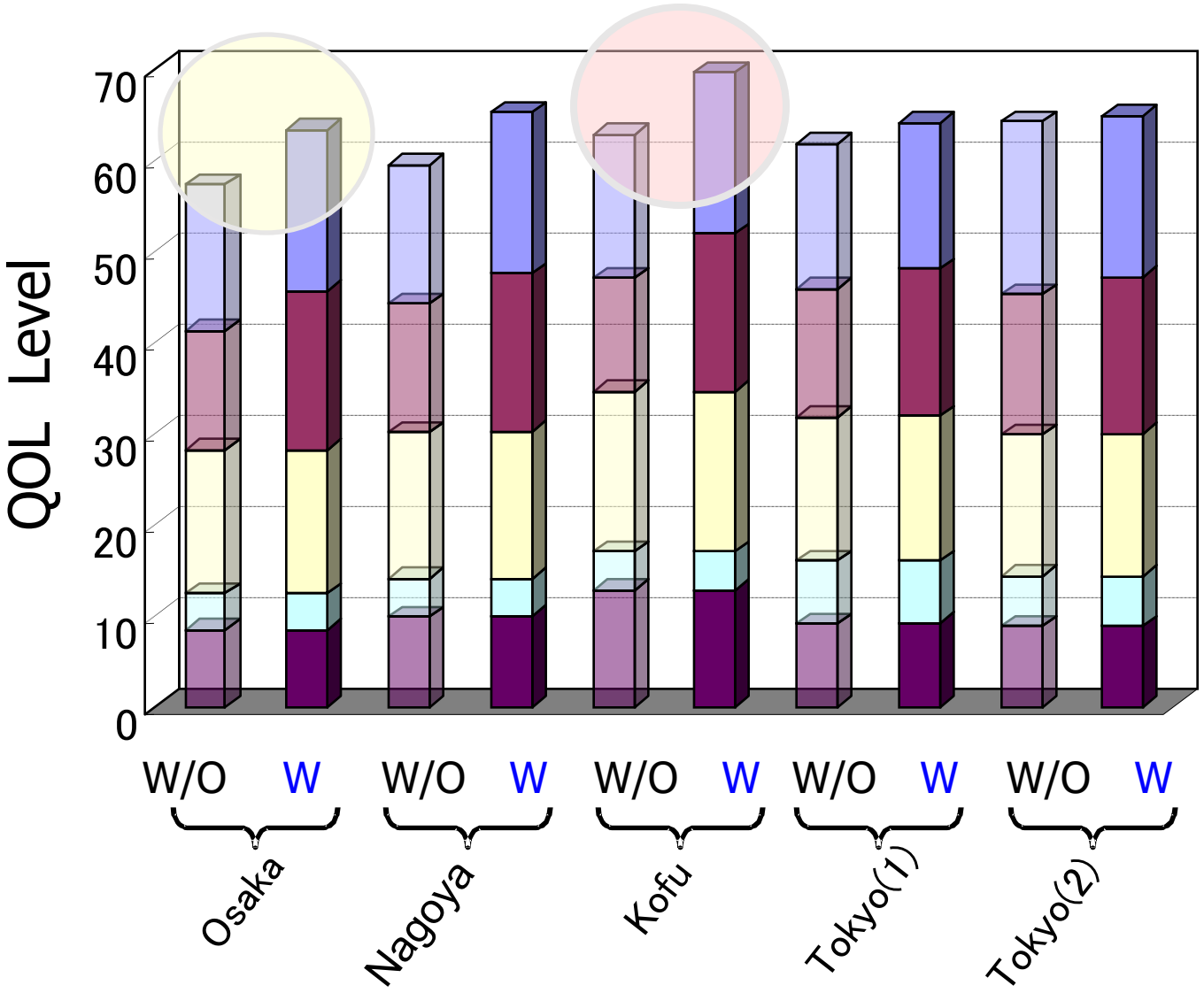
Population in Target Area
About 250 thousand

=

24.4 billion yen/ year



Evaluation of Chuo - Shinkansen by QOL



Improvement of Life-Cultural Opportunities

Summary

- Method to evaluate happiness to meet SDGs and GNH
- Evaluation based on sufficiency (individual's happiness vs Society's Burden)
- Can evaluate any hard/soft policies and their integrated sets → from B/C to Q/SB
- Smart Growth of HSR regions based on sufficiency using integrated policies of HSR-investment plus urban development/subsidy/tax reduction

Mumbai-Ahmedabad HSR

Implications to Indian HSR

- Merits
  - Safe travel
  - Economic development
  - High level medical care in Mumbai
  - Exchanging cultures →Tourism of Indians and foreigners
  - Feeling cultures observing landscapes from train window
- Demerits
  - Straw effects
    - →Preparation of foot-tight unique valueS
    - →Urban developments integrated with HSR:
      Station front development - Offices/Knowledge based firms,
      New Cultures, revival of Traditional Culture
    - →Attractive trains with quality service
- QOL-SDGs based National/Regional planning
  - Final imputation of values to citizens

Why QOL? (1)

- Different need for various categories of persons; young and old, men and women, rich and poor, etc. living in various places; city center or suburbs, and in big cities or rural areas .
- High Speed Rail (HSR) also provides access to a variety of values of linking businesses, feeling cultures, viewing superior landscapes in towns and nature, playing sports in the sea and mountains, meeting family and friends, etc. These are recognized differently by different attribute people.
- One of the most important view points of SDGs is "Inclusiveness" meaning "no one left behind".
- Can transport systems service well cover a variety of need?

Why QOL ? (2)

- Conventional cost - benefit analysis evaluates whether economic benefit, including the three components (reduction of travel cost, time and accidents), is bigger than construction and maintenance cost.
- There has been a substantial research to measure social benefits such as air pollution, noise, regional segregation, etc. done in EU research projects.
- On the other hand, there have been no concrete method yet to distinctly measure merits for different attribute persons and in different places in a consistent manner. → Value Accessibility Method (Hayahshi,et. Al. 2004, 2016)

QOL Performance based Planning

(Factor=QOL/Cost, QOL/CO_2,)

Better for Everyone! (Inclusiveness in SDGs)

Thank you for your attention !