

# Well-Being as Ultimate Goal of Smart Cities

- Key to Bridge Civic Engagement and Digital Technologies -

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Smart City  
Institute Japan

# Takehiko Nagumo



- **Currently, Executive Managing Director at Smart City Institute Japan, dedicated to designing policies and building strategic alliances for smart cities and digital government.**
  
- **Concurrently,**
  - Senior Managing Executive Officer at Mitsubishi UFJ Research and Consulting, Ltd
  - Well-Being City Indicator Committee Member, Digital Agency
  - Regulatory Reform Promotion Council Member, Japanese Government's Cabinet Office
  - Incorporated Administrative Agency Evaluation System Committee Member, Ministry of Internal Affairs and Communications
  - Advisory Board Member, Digital Architecture Design Center, Information-Technology Promotion Agency
  - Senior Advisor, the World Bank Tokyo Development Learning Center
  - Fellow, World Economic Forum The Fourth Industrial Revolution Japan Center
  - Smart City Advisor to local government of Tokyo, Kamakura, Hamamatsu, and Higashi-Hiroshima
  - Adjunct Professor at Kyoto University Graduate School of Management
  - Adjunct Professor at Tokai University
  - Adjunct Professor at Kanazawa Institute of Technology
  - Visiting Professor at Tallinn University of Technology in Estonia
  - Senior Industry Fellow at Royal Melbourne Institute of Technology
  - Senior Visiting Fellow at Global Communication Center (GLOCOM), International University of Japan
  
- **Earned Master of Business Administration from Georgetown University, Master of Science in Development Finance from University of London SOAS, and LL.B in Political Science from Keio University. Also completed Professional Fellow Program at Columbia University.**

- **Contact**

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- **Smart City Institute Japan (SCI-J)**

<https://www.sci-japan.or.jp/english/index.html>

# Motivation or "Pain" - Decreasing and Aging Population ...

## DRIVERS:

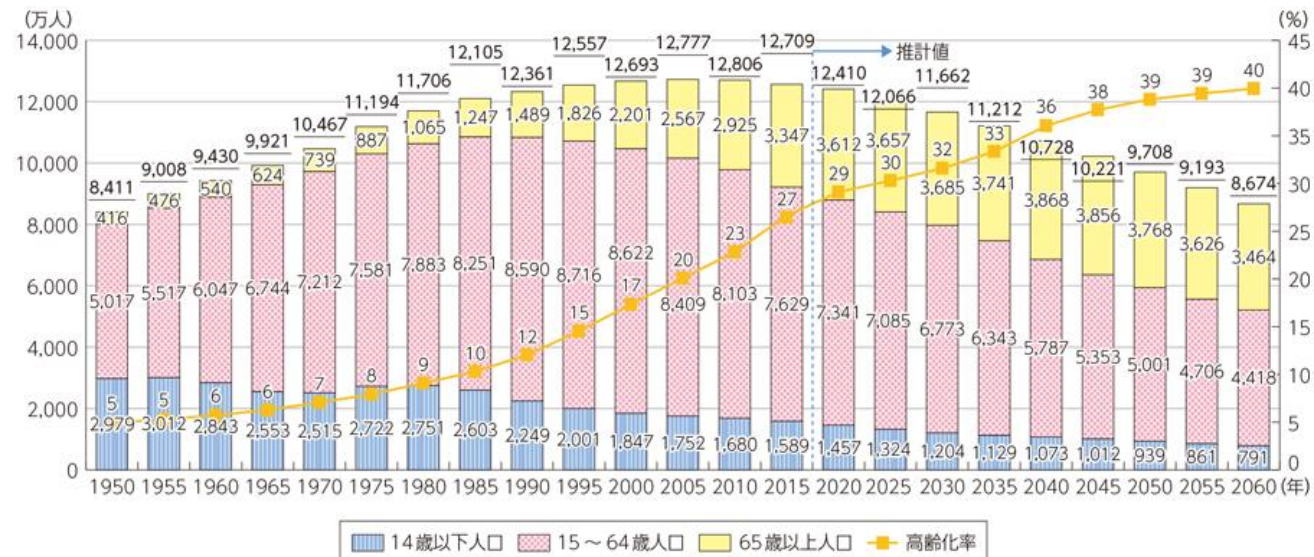
- Decreasing and Aging Population
- Excessive Concentration in Tokyo & Needs for Rural Revitalization
- With/Post-Covid-19 New Normal

**Accelerate  
DX of Japan**

## OBSTACLES:

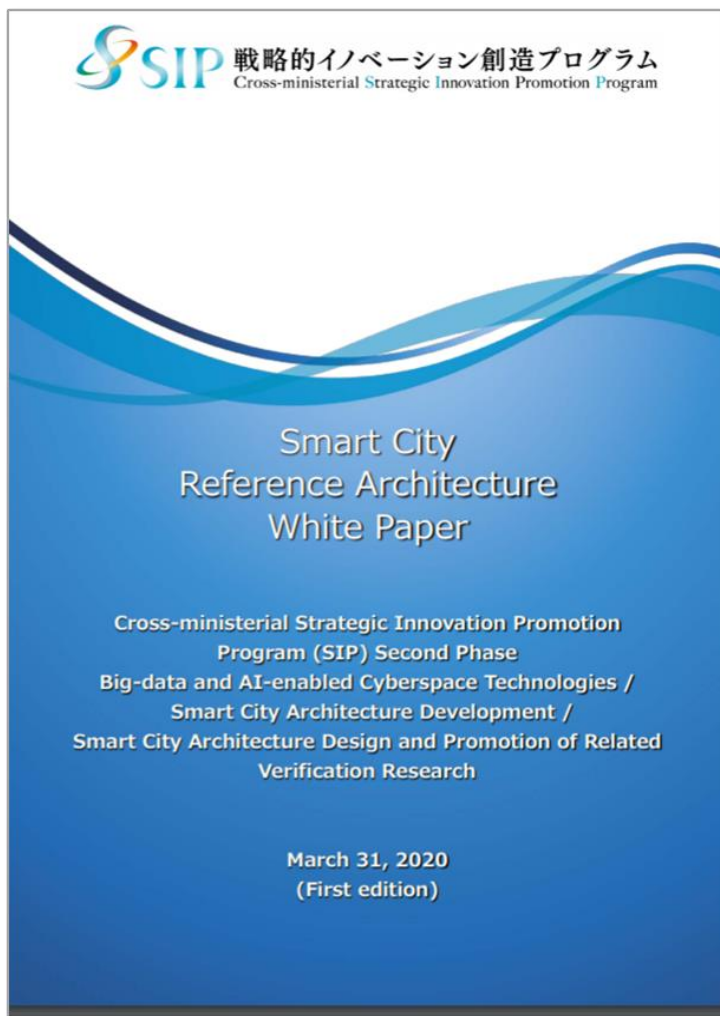
- Coming Shortage of DX Capacity
- Complex & Outdated Regulations
- Weak Trust on Gov't, Business, and Technology

**JAPAN'S DEMOGRAPHIC SHIFT TOWARDS AGING SOCIETY**





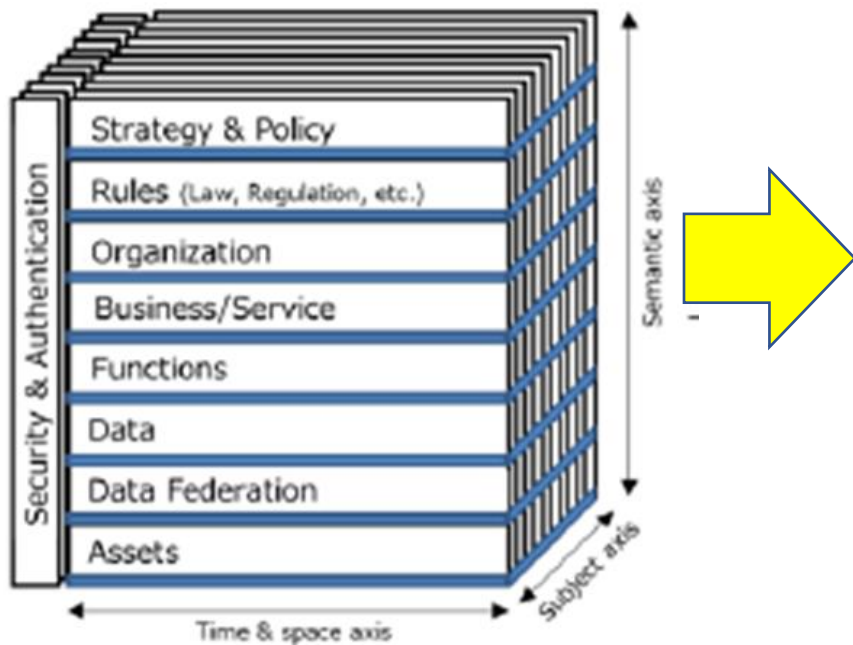
# Smart City Reference Architecture



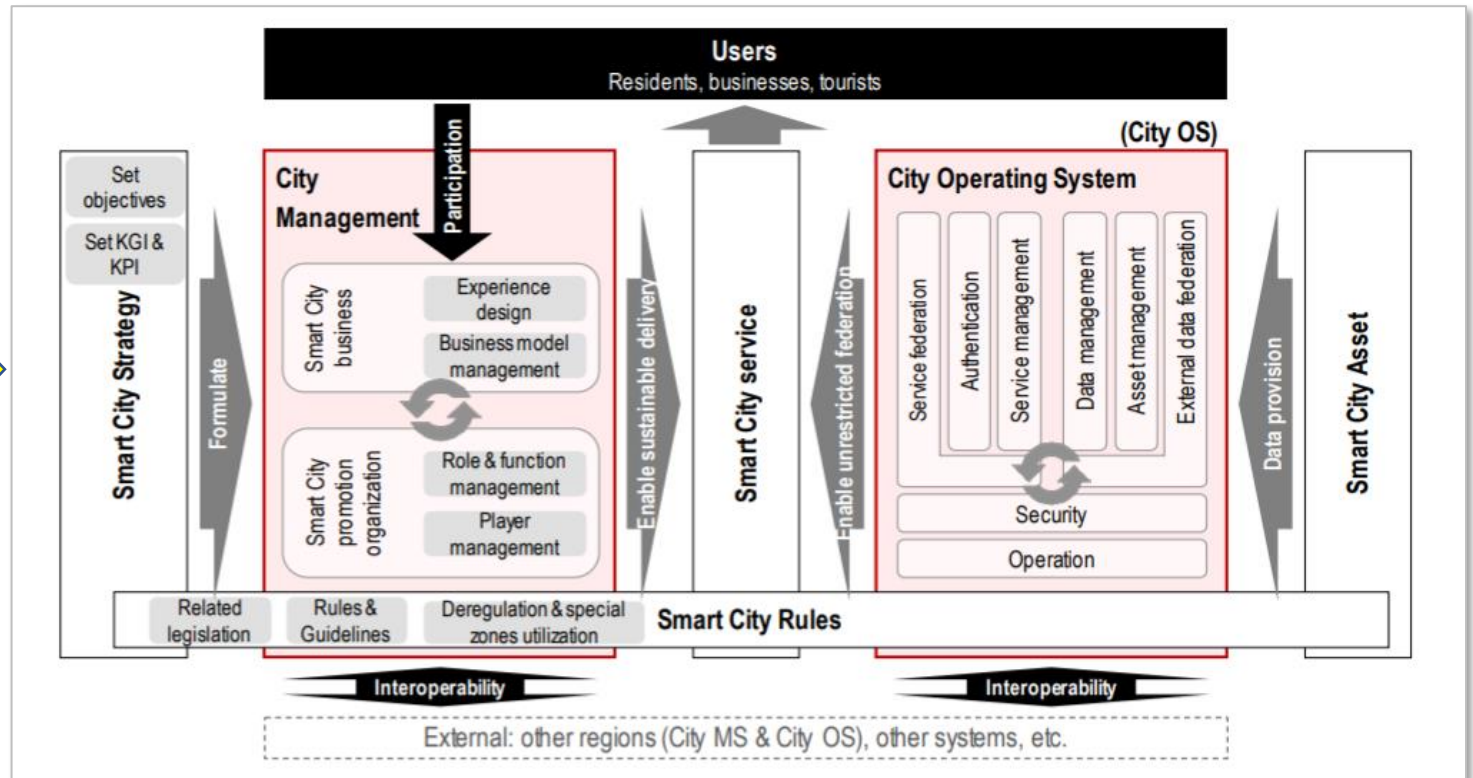
Smart City strategy		<ul style="list-style-type: none"> <li>Set objectives</li> <li>Set KGI/KPI</li> </ul>	<p>Set objectives to be achieved by Smart City based on issues and strategies of the region</p> <p>Set quantitative indexes to measure the effectiveness of Smart City initiatives against each objective</p>	Chapter 3
Smart City rules		<ul style="list-style-type: none"> <li>Comply with related legislations (laws and regulations)</li> <li>Set rules/guidelines in each region</li> <li>Deregulation/Special zones utilization</li> </ul>	<p>Understand related legislations and prepare how to comply</p> <p>Understand and formulate rules and guidelines needed for the region</p> <p>Understand and utilize the systems available to maximize effectiveness of the initiatives</p>	Chapter 4
City management	Smart City promotion organization	<ul style="list-style-type: none"> <li>Role/function management</li> <li>Player/stakeholder management</li> </ul>	<p>Extract functions and roles required for the sustained promotion and operation of the region, and manage the model</p> <p>Select players for the roles and functions constructed, and manage stakeholders</p>	Chapter 5
	Smart City business	<ul style="list-style-type: none"> <li>Business model management</li> <li>Experience design</li> </ul>	<p>Construct and operate the economic activities model amongst the players with the objective of the sustained operation of the region</p> <p>Provide regional operations and initiatives involving the residents to enable consistent resident-centric experiences</p>	
Smart City service (defined locally)		-	Initiatives in digital form such as applications, etc., managed on City OS and delivered to users	Chapter 6
City Operating System (City OS)	Function (service)	<ul style="list-style-type: none"> <li>Service federation</li> </ul>	Provide functions and API to federation various services operating on City OS	Chapter 7
	Data	<ul style="list-style-type: none"> <li>Authentication</li> <li>Service management</li> <li>Data management</li> <li>Asset management</li> <li>External data federation</li> </ul>	<p>Provide authentication method appropriate for the use case to users, services, and other City OSs</p> <p>Manage services which link to City OS, and provide the optimum combination of functions appropriate for the service</p> <p>Broker the data shared across multiple regions and other systems, and manage the data stored and accumulated on City OS</p> <p>Manage registration/deletion/etc. of the asset (devices and other systems) connected to City OS, and execute control over the assets</p> <p>Manage interfaces with assets, other systems, or other City OSs, and absorb differences in data formats and protocols</p>	
	Data federation	<ul style="list-style-type: none"> <li>Security</li> </ul>	Provide functions required to protect City OS against threats within and outside City OS	
	Common function	<ul style="list-style-type: none"> <li>Operation</li> </ul>	Provide such functions as monitoring, backup, troubleshooting, required for the IT systems operation of City OS	
Smart City asset (defined locally)		-	Assets which are capable of generating digital data to be collected by City OS	Chapter 8

# Smart City Reference Architecture

## Society 5.0 Architecture

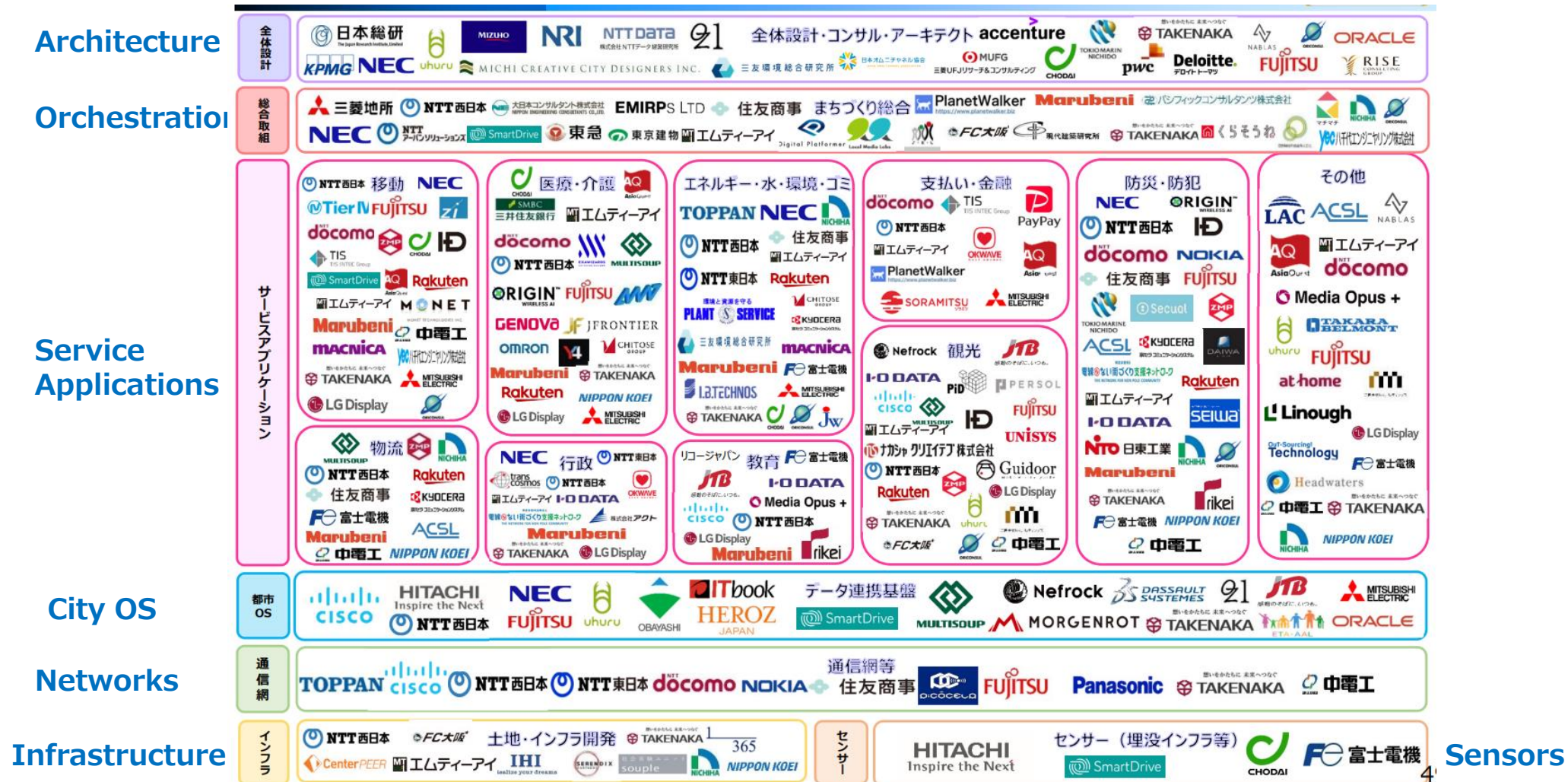


## Smart City Reference Architecture



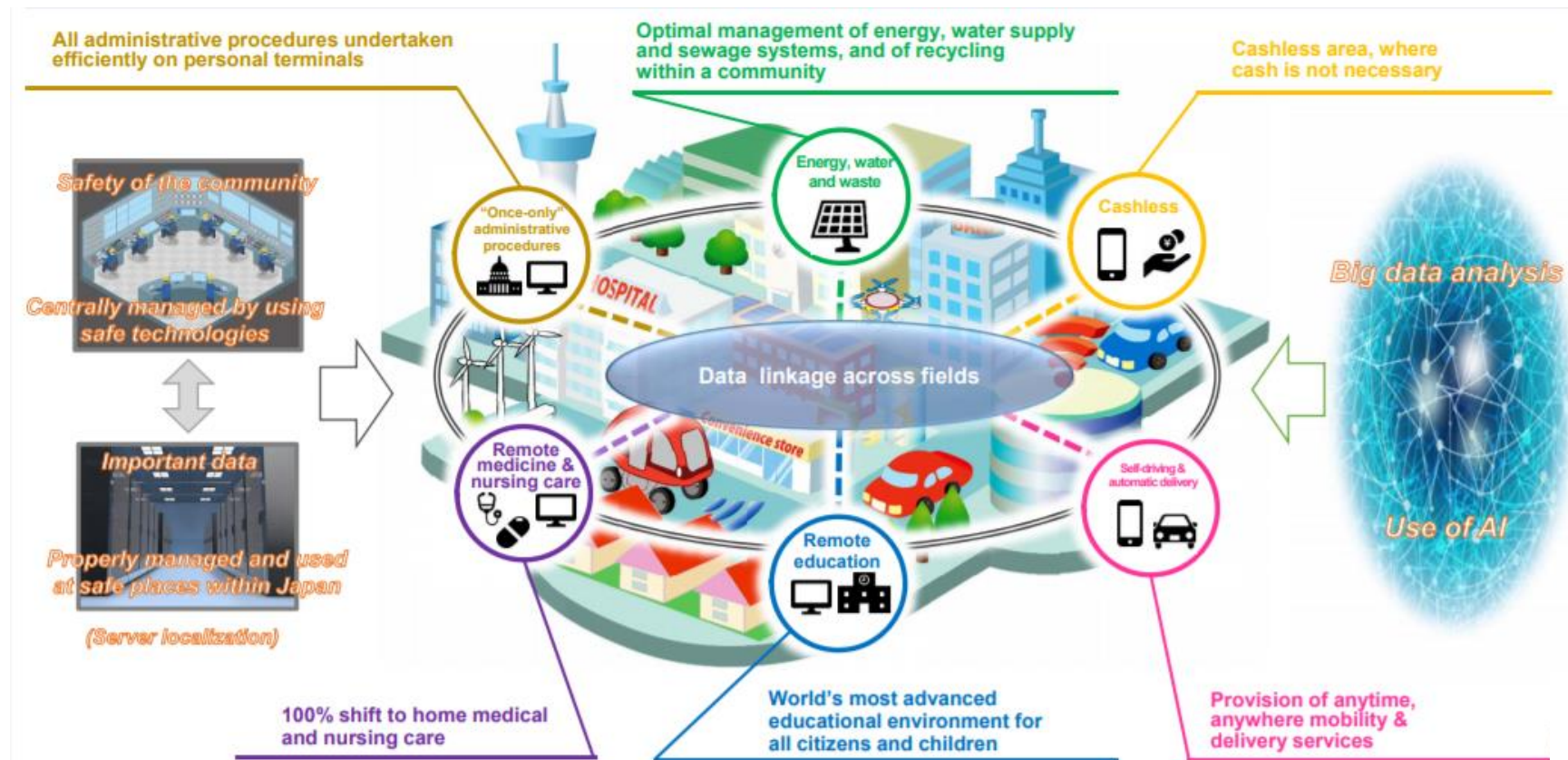
# "Super City Open Lab" to Promote Collective Action & Impact

■ 266 organizations are registered in the Super City Open Lab (as of January, 2022).



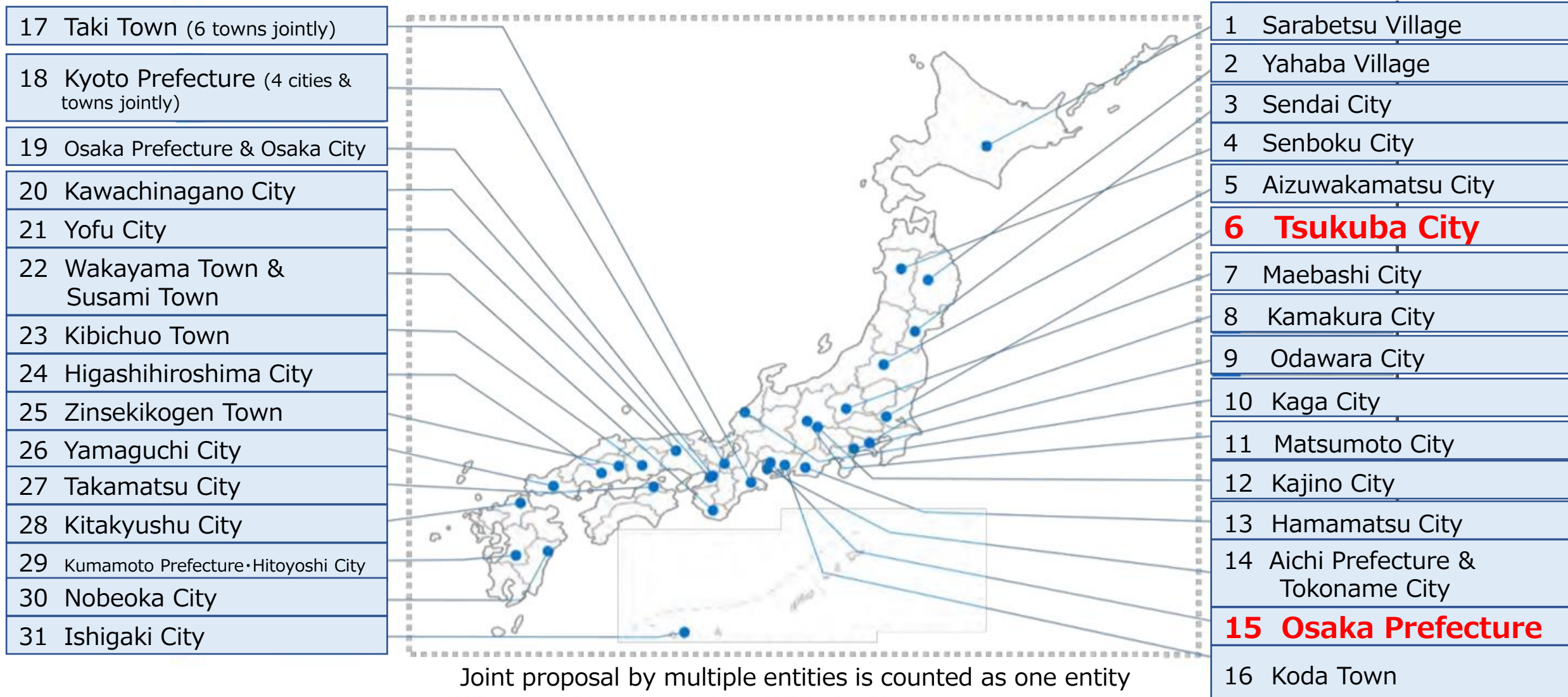
# “Super City” – Flagship Smart Cities Selected

- Showcase “holistic future state” of cities in Japan in 2030
- 5 digital solutions must be implemented concurrently to be qualified
- Use integrative architecture to efficiently enable **data interoperability**



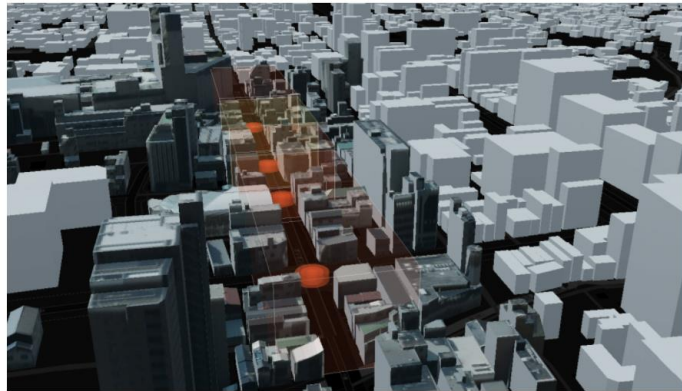
# Super City Initiative: Osaka and Tsukuba Have Been Selected.

■ 31 local governments (or groups of local governments) applied to the Super City Initiative



# New Technology Driver – Digital Twin & Beyond 5G

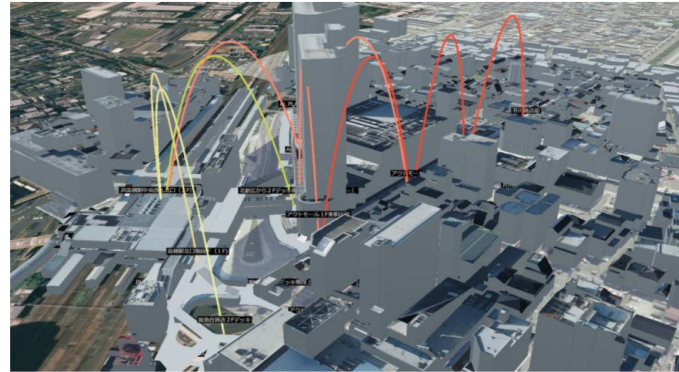
- Through Project PLATEAU, Tokyo 23 wards and more than 50 cities developed their respective 3D models. Various Projects are ongoing on urban monitoring, disaster recovery planning, etc.



UC\_ID\_1-001

ソーシャルディスタンス判定技術

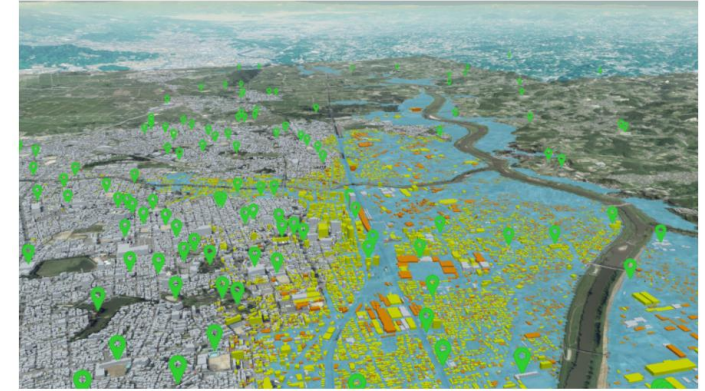
実施事業者： 日本電気株式会社  
実施場所： 栃木県宇都宮市 オリオン通り商店街



UC\_ID\_1-007

Wi-Fiパケットセンサーによる地点間移動のモニタリング

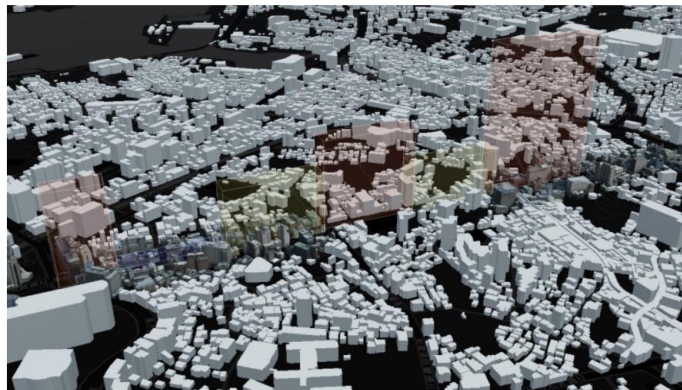
実施事業者： 株式会社社会システム総合研究所  
実施場所： 岐阜市中心部及びJR高槻駅北側エリア



UC\_ID\_2-002

垂直避難可能な建築物の可視化等を踏まえた防災計画検討

実施事業者： 株式会社三菱総合研究所  
実施場所： 福島県郡山市 郡山駅周辺等



UC\_ID\_1-006

異なるモニタリング技術の併用による人流解析

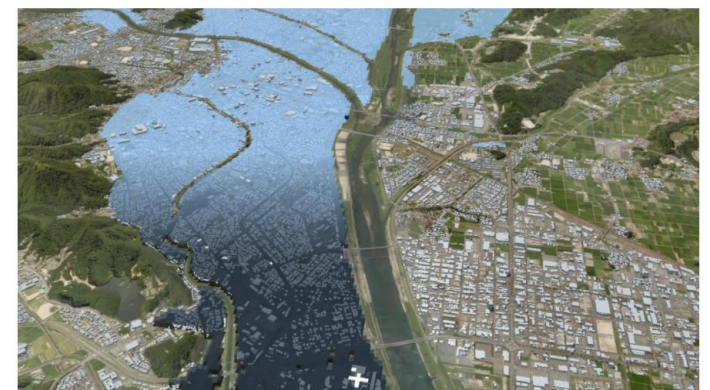
実施事業者： 日本電気株式会社  
実施場所： 沖縄県那覇市 国際通り



まちづくり

都市開発のビジョンを共有する まちづくりを科学化する

<https://www.mlit.go.jp/plateau/about/>

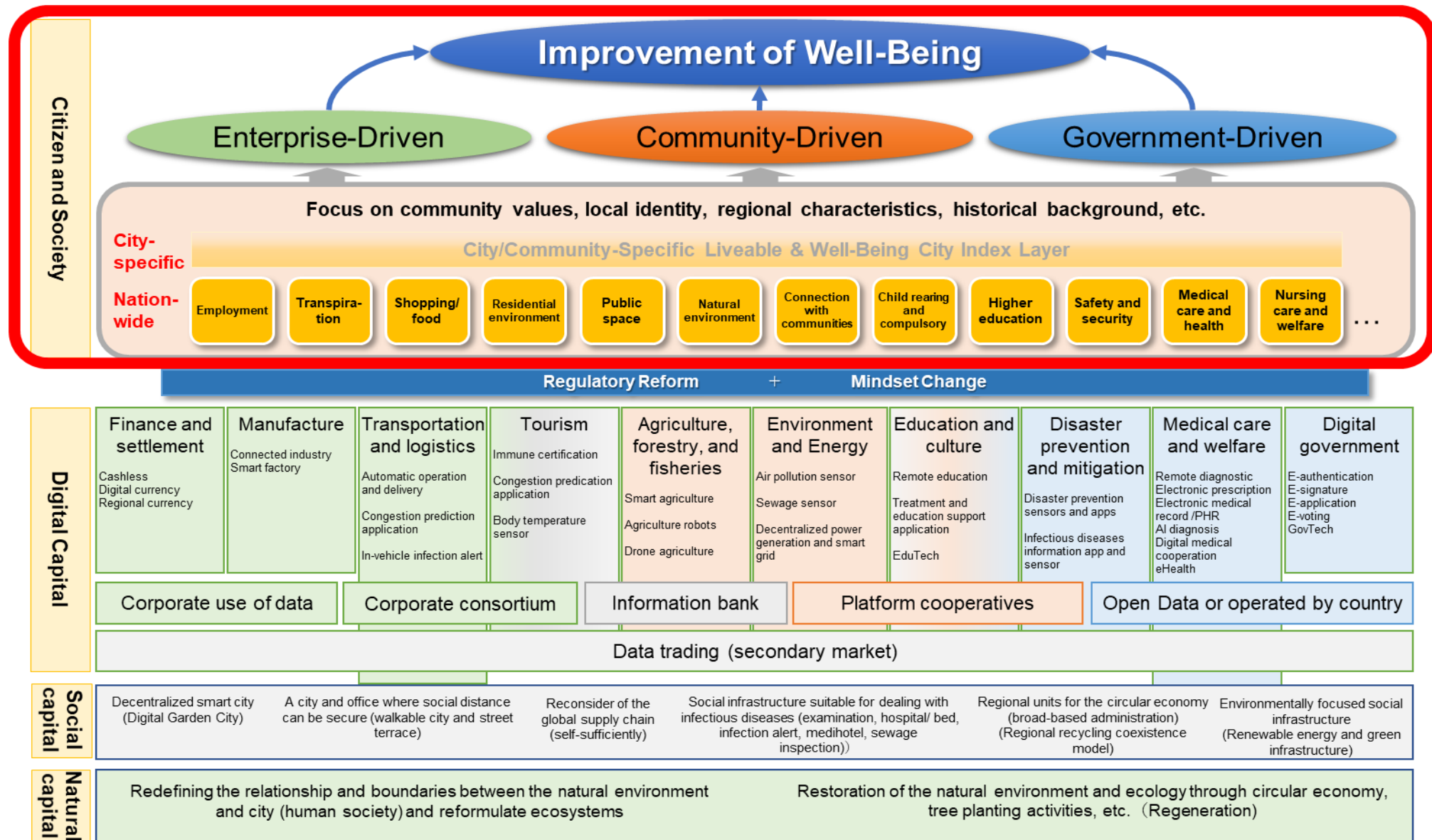


UC\_ID\_2-003

時系列浸水シミュレーションデータの3D可視化による防災計画立案・防災意識啓発

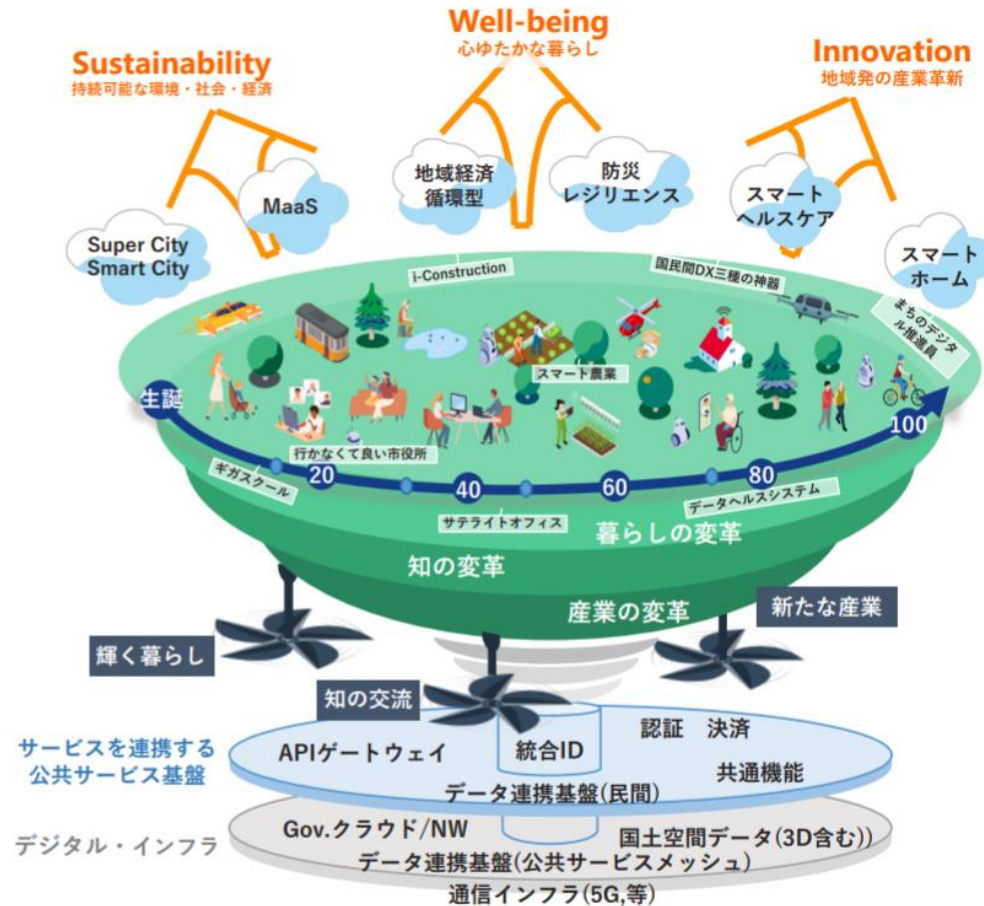
実施事業者： 株式会社三菱総合研究所  
実施場所： 鳥取県鳥取市 城北地区・大正地区・美保南地区

# Ultimate Goal – Improvement of Citizens' Well-Being

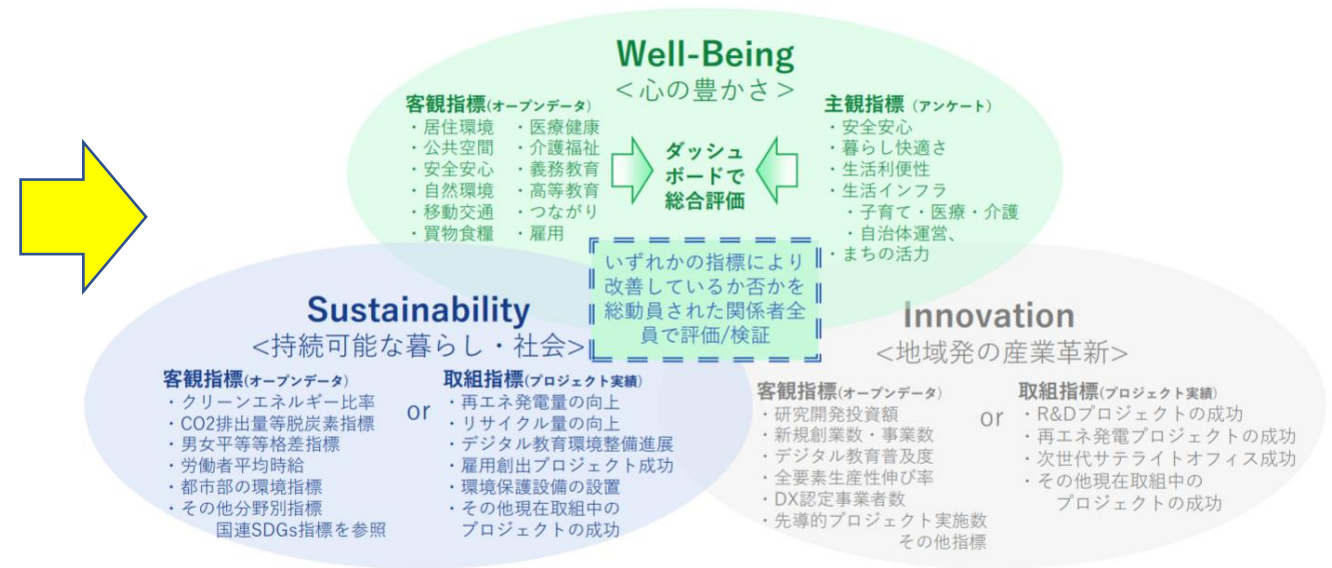


# “Digital Garden City Initiative” Requiring KPIs and EBPM for Smart Cities

## Digital Garden City Initiative



## KPI Dashboard for EBPM



# Framework for Measuring “Well-Being” of Citizens

【Maslow's Hierarchy of Need】

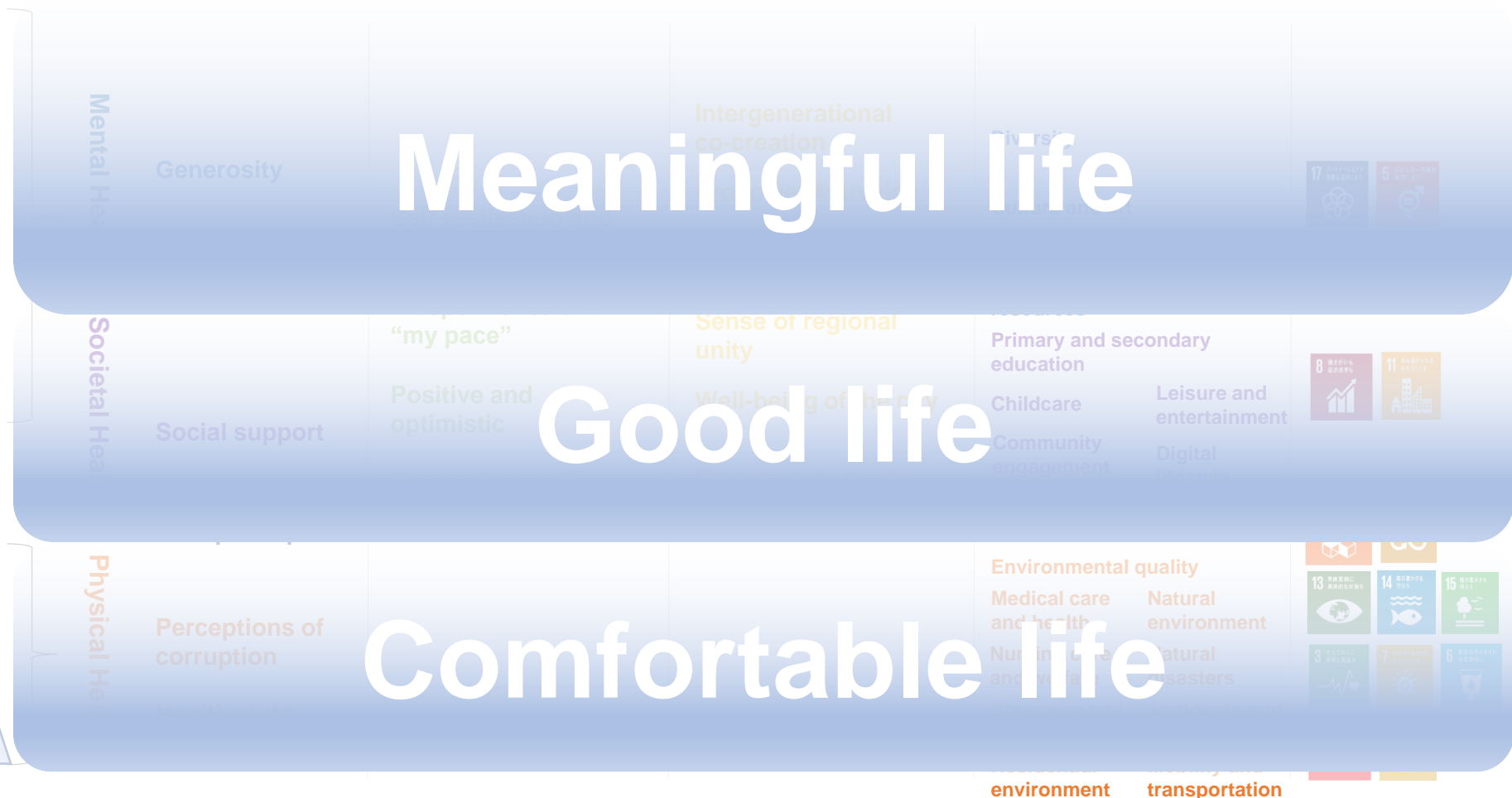
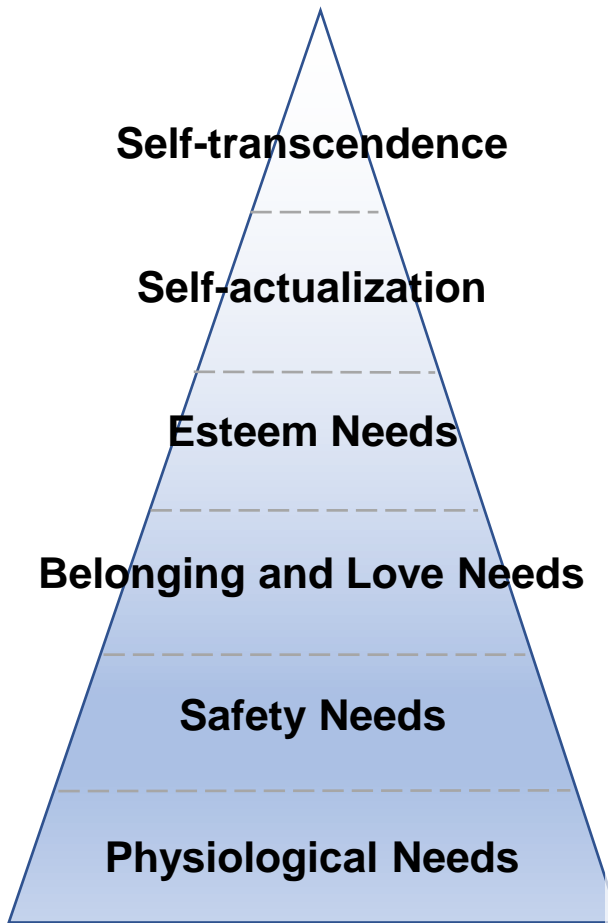
【UN Well-Being】

【Factors of Individual Well-Being】

【Interdependent Well-Being】

【Liveability】

【SDGs】



environment transportation

Implementing a sustainable smart city (holistic city development) based upon human-centricity

# Framework for Measuring “Well-Being” of Citizens

【Maslow's Hierarchy of Need】

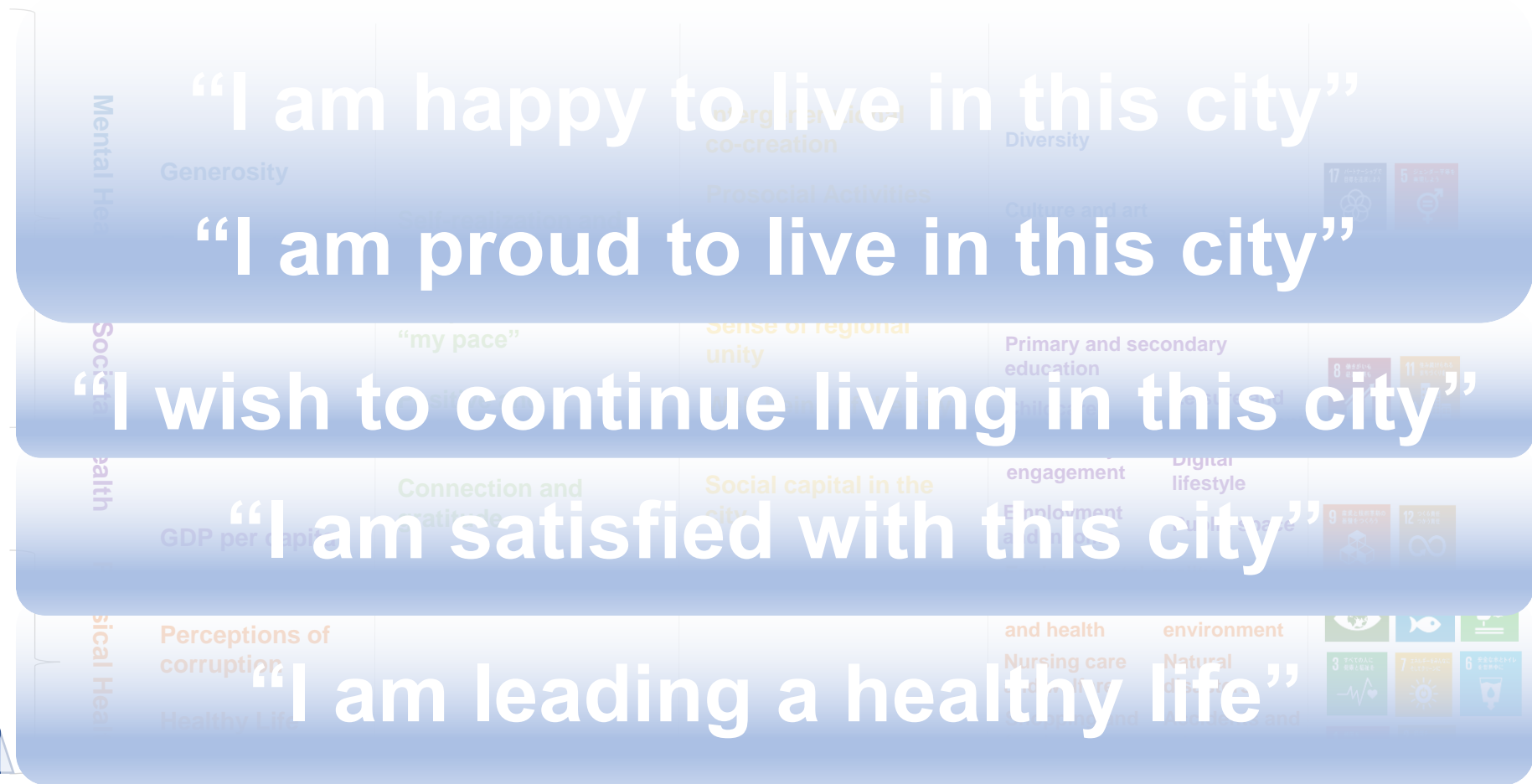
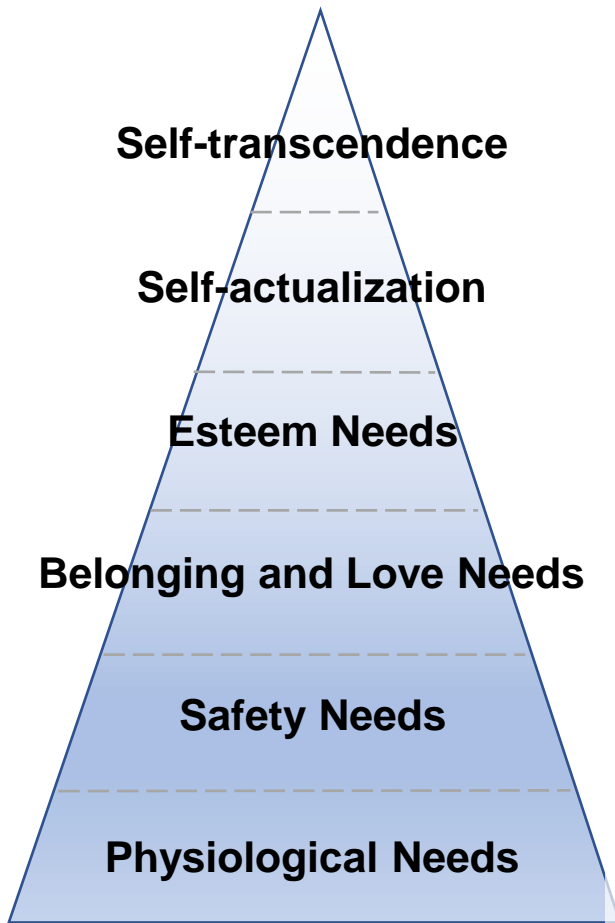
【UN Well-Being】

【Factors of Individual Well-Being】

【Interdependent Well-Being】

【Liveability】

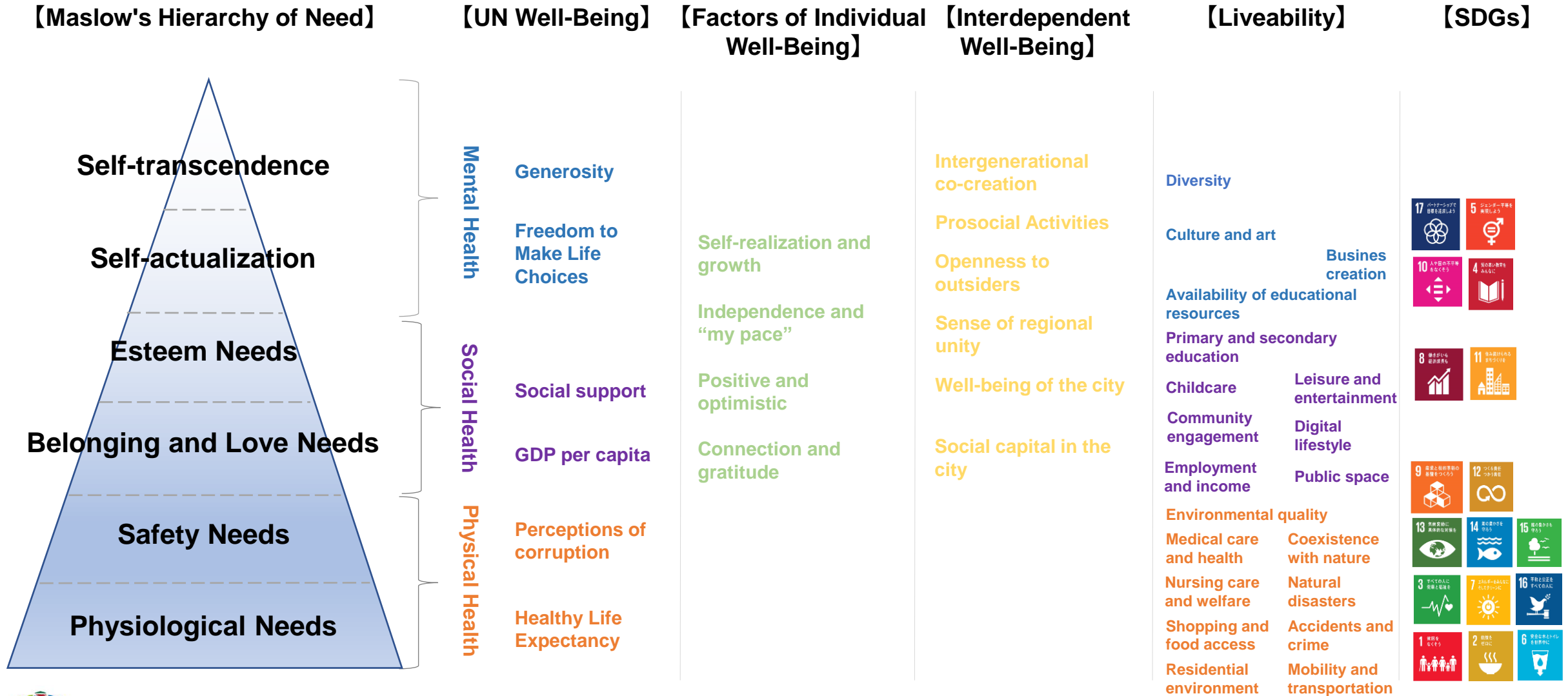
【SDGs】



environment transportation

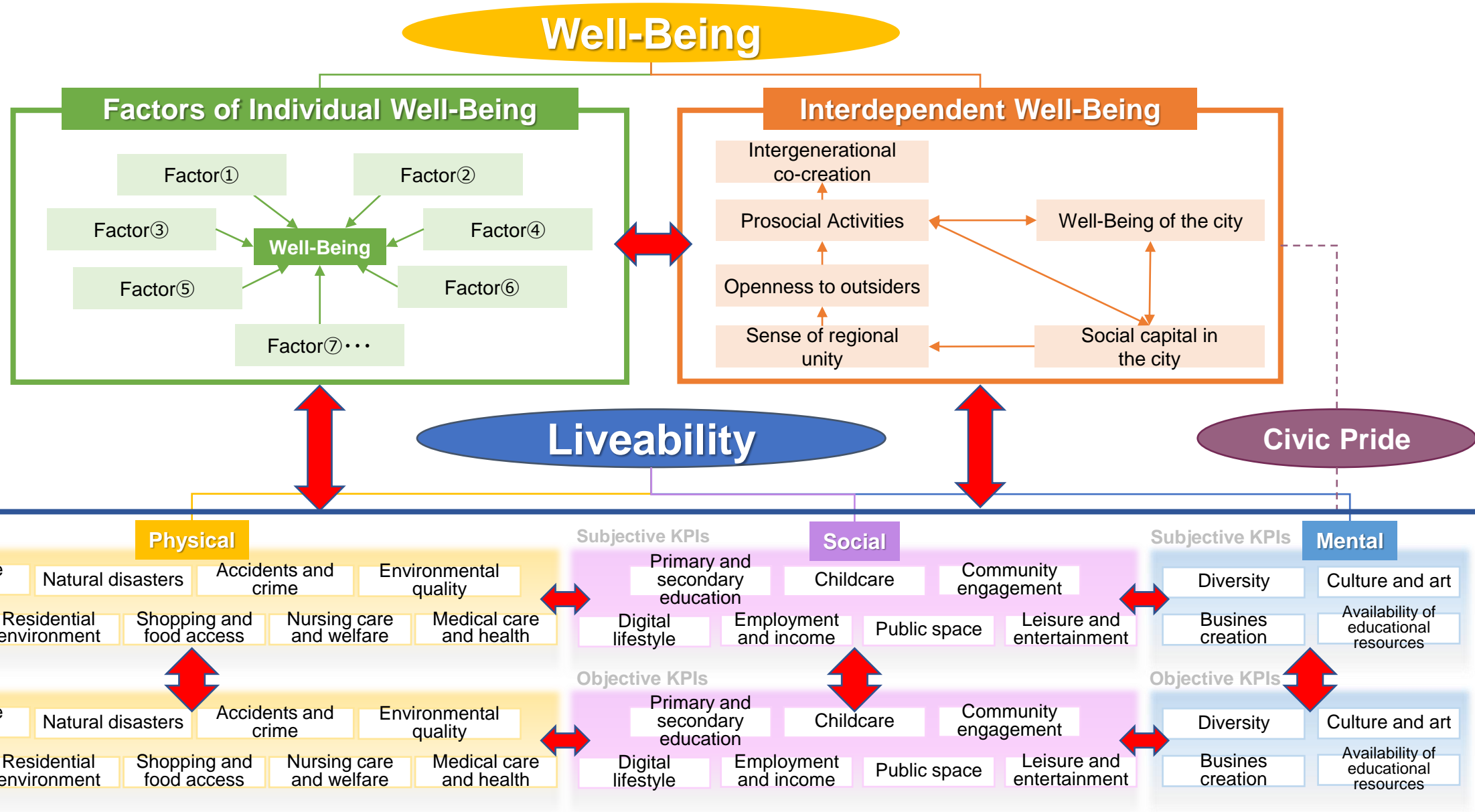
Implementing a sustainable smart city (holistic city development) based upon human-centricity

# Framework for Measuring “Well-Being” of Citizens



Implementing a sustainable smart city (holistic city development) based upon human-centricity

# LWCI = Well-Being + Subjective and Objective Assessments of Liveability



# Liveability Indicator: Objective Part

## Liveability

### Physical

#### Coexistence with nature

- Percentage of uninhabitable area (+)
- Amount of automobile CO2 emission per person (-)
- Recycling rate (+)
- Coexistence with Nature Index (+)
  - SDGs Future City
  - 2050 Zero Carbon Cities
  - Policy on Green Public Procurement
  - Participation in the Japan Climate Initiative

#### Accidents and crime

- Number of traffic accident per 1,000 persons (-)
- Percentage of pedestrian streets (+)
- Housing vacancy rate (-)
- Number of reported Penal Code offenses per 1,000 persons (-)

#### Mobility and transportation

- Percentage of population within walking distance from train station or bus stop (+)
- Population density 800m from a train station or 300m from a bus station (-)
- Per capita mileage of compact vehicles (-)
- Proportion of commuters not using cars, motorcycles, or taxi (+)
- Percentage of commuting time within 30 minutes (+)

#### Shopping and food access

- Percentage of population within walking distance of commercial facilities (+)
- Population density within walking distance of commercial facilities (-)
- Residential area / number of restaurants (-)
- Number of restaurants (per 1,000 population) (+)

#### Natural disasters

- Risk of earthquakes
- Risk of flood

#### Environmental quality

- Concentration of NOx (-)
- Concentration of PM2.5 (-)

#### Residential environment

- Gross floor space per house (+)
- Average residential land value (-)
- Rent per square meter of residence (-)
- Percentage of house ownership (+)
- Percentage of residents living in the city for over 20 years (+)

#### Nursing care and welfare

- Percentage of population within walking distance of welfare facilities (+)
- Population density within walking distance of welfare facilities (-)
- Number of child welfare facilities (per 100,000 persons) (+)
- Number of facilities for those with disabilities (per 100,000 persons) (+)

#### Medical care and health

- Healthy life expectancy (male) (+)
- Healthy life expectancy (female) (+)
- Percentage of population within walking distance of medical facilities (+)
- Population density within walking distance from medical facilities (-)
- Average cost of medical fees of those under the National Health Insurance (-)
- Average cost of medical fees of those 75 years old and older (-)
- Percentage of residents who receive annual medical check-ups (+)

### Social

#### Primary and secondary education

- Number of elementary schools (per habitable area) (+)
- Number of students per elementary school (-)
- Number of junior high schools (per habitable area) (+)
- Number of students per junior high school (-)
- Number of high schools (per habitable area) (+)
- Number of students per high school (-)

#### Community engagement

- Number of suicides per 100,000 persons (-)
- Percentage of extended family households (+)
- Percentage of those 15 and over who have married (+)
- Percentage of elderly single-person household (-)
- Participation rate in a neighborhood association (+)
- Number of political, economic or cultural organization per 100,000 persons (+)
- Number of religious organization per 100,000 persons (+)
- Number of NPOs per 100,000 persons (+)
- Voter turnout in mayoral election (+)
- Voter turnout in local assembly election (+)

#### Employment and income

- Unemployment rate (-)
- Youth unemployment rate (-)
- Percentage of regular employees (+)
- Employment rate of seniors (+)
- Ratio of high school graduates who have yet to decide their career path (-)
- Percentage of residents working within the city (+)
- Business entry rate (+)
- Average taxable income per taxpayer (+)

#### Childcare

- Percentage of residences within 1km of nearest day care center (+)
- Number of kindergartens (per habitable area) (+)
- Number of children per kindergarten (-)
- Share of public expenditure on education (+)
- Total fertility rate (+)

#### Digital lifestyle

- Usage rate of My Number Card (+)
- Percentage of online responses to the census (+)
- Digital Environment Index (+)
  - Cities partaking in MLIT Plateau Project
  - "Code for " organization in the city
  - Fab Lab in the city
  - CoderDojo in the city
  - Local IoT Acceleration Lab in the city
  - ICT related department in a university
  - College of technology in the city
  - Open data scheme by the local government
- Number of cellular carrier shops (per 100,000 persons) (+)
- Penetration rate of 5G

#### Public space

- Percentage of population living within walking distance of a park (+)
- Percentage of houses located within 500m radius of a park (+)

#### Leisure and entertainment

- Number of entertainment facilities (per 100,000 persons) (+)

### Mental

#### Diversity

- Proportion of women in managerial positions in the local government (+)
- Proportion of female assembly members in the local assembly (+)
- Foreign residents (per 100,000 persons) (+)

#### Culture and art

- Number of libraries (per 100,000 persons) (+)
- Number of museums (per 100,000 persons) (+)
- Number of theaters and concert halls (per 100,000 persons) (+)
- Number of National Treasures and Important Cultural Properties (structures) (+)
- Number of "Japan Heritage" sites (+)

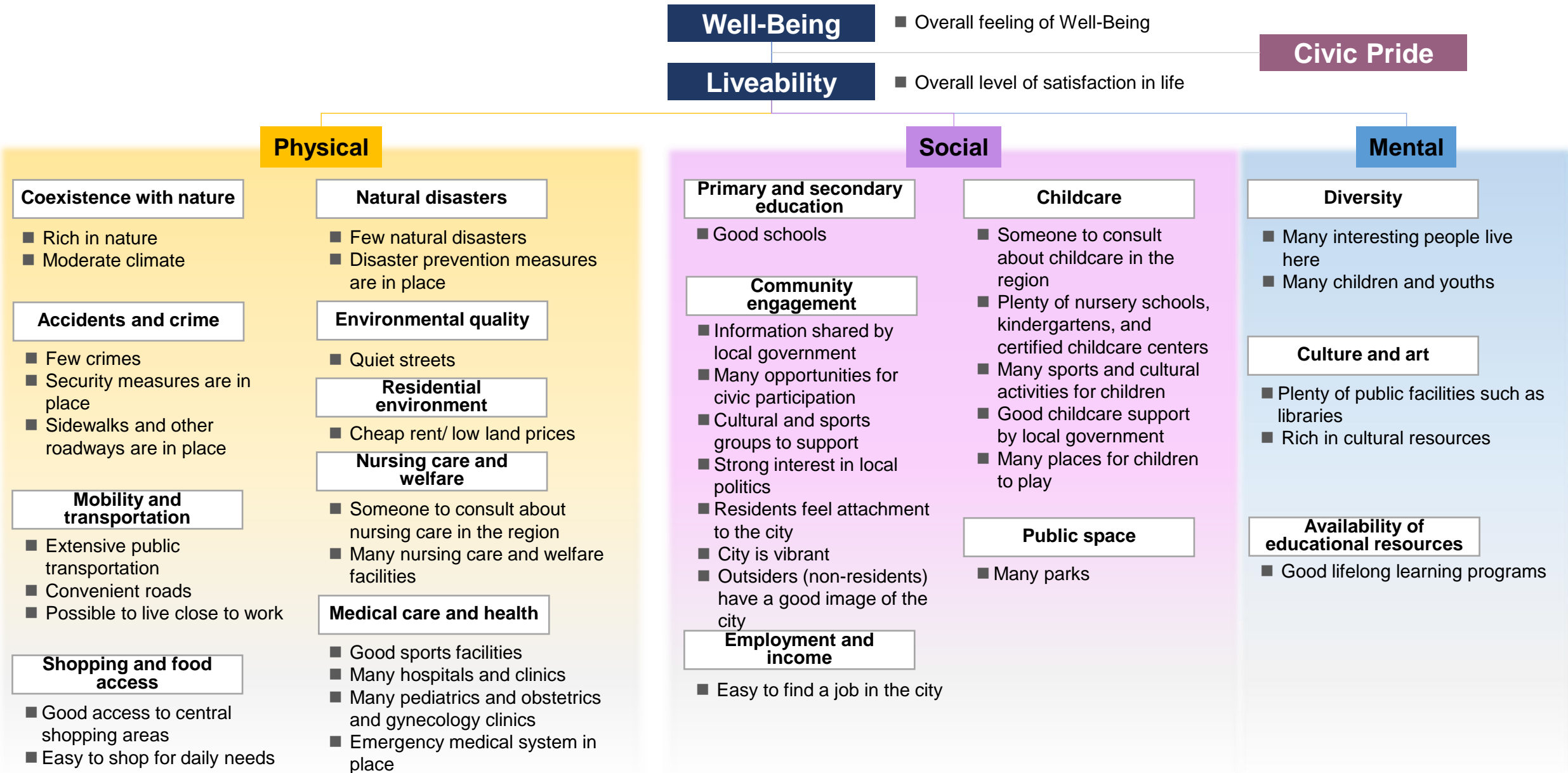
#### Business creation

- Proportion of offices/ facilities in the creative industry (+)
- Proportion of newly established corporations (+)
- Number of Startup Accelerators (+)
- Number of coworking space (per 100,000 employees) (+)

#### Availability of educational resources

- Percentage of college graduates (+)
- Number of universities and junior colleges (per residential area) (+)
- Number of national and private combined junior high and high schools (per residential area) (+)

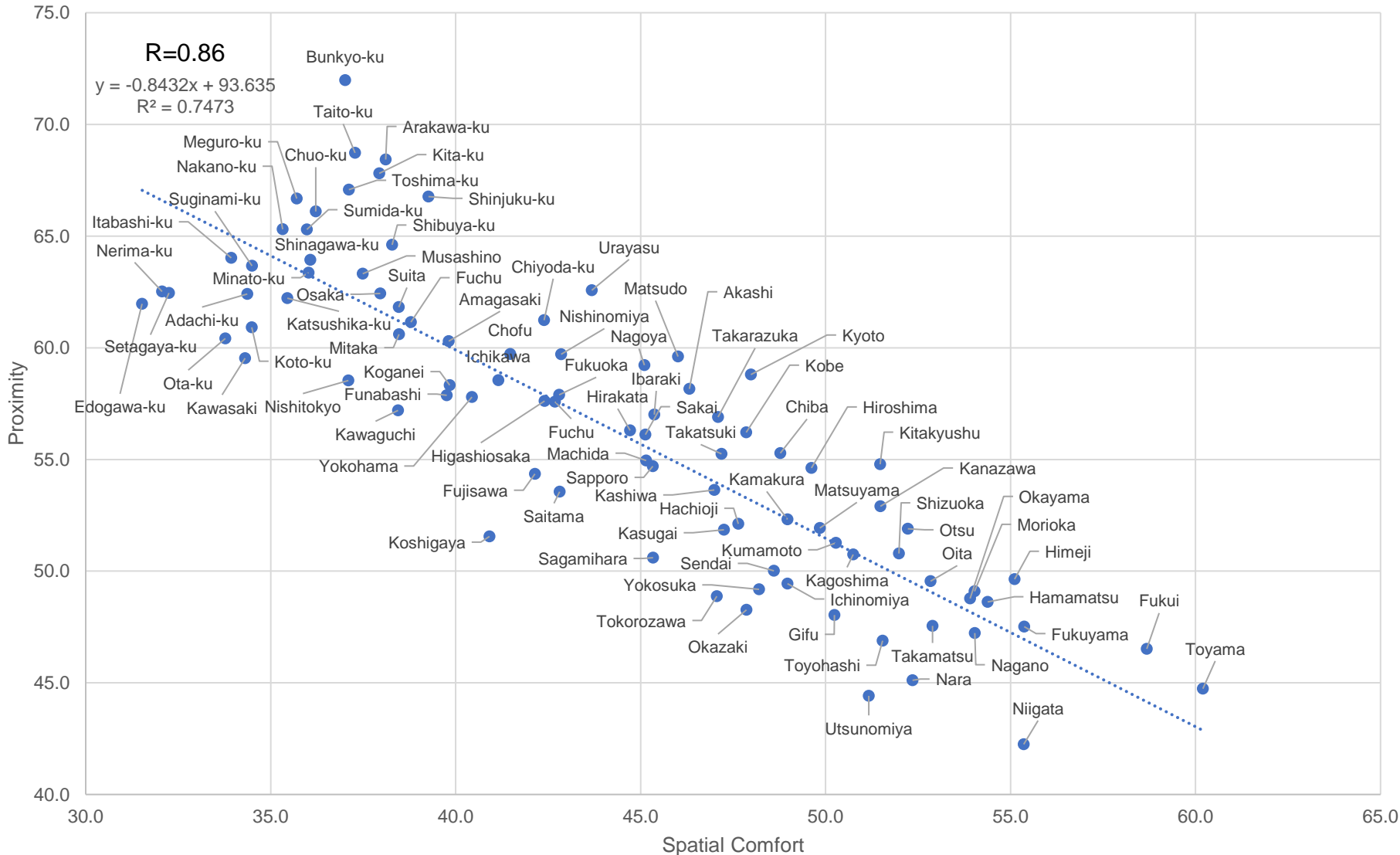
# Liveability Indicator: Subjective Part





# There is Negative Correlation between Spatial Comfort and Access (Proximity) to Facilities. Tokyo City Center Has Good Access but Lacks Spatial Comfort while Cities along the Sea of Japan Have Spatial Comfort but Lack Proximity

## Spatial Comfort vs. Proximity



### KPIs composing "Spatial Comfort"

- Average population density within walking distance from medical facilities
- Population density within walking distance of welfare facilities
- Population density within walking distance of commercial facilities
- Population density 800m from a train station or 300m from a bus station
- Number of children per kindergarten
- Number of students per elementary school
- Number of libraries per 100,000 residents

### KPIs composing "Proximity"

- Percentage of population within walking distance of medical facilities
- Percentage of population within walking distance of welfare facilities
- Percentage of population within walking distance of commercial facilities
- Percentage of population within walking distance from train station or bus stop
- Number of kindergartens (per habitable area)
- Number of elementary schools (per habitable area)

# Three-layer Design for Realizing Well-Being Co-creation

- Kamakura Super City has a total design that organically links three layers toward the realization of “Inclusive Future City.”

Citizen participation layer

**Co-create Well-Being**

Digital layer

**Solve problems digitally**

Physical layer

**Redesign city hardware**

**Kamakura City's concept of digital twin for Liveability and Well-Being**

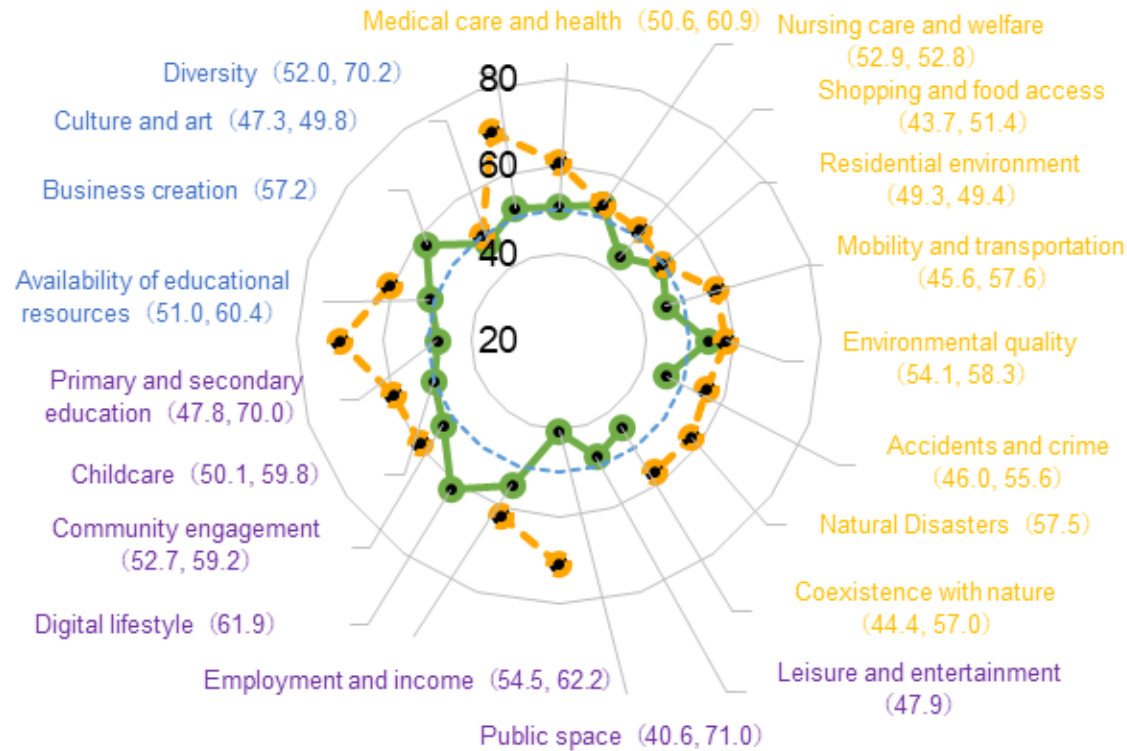
**Creation of Kamakura, the world's best region in the Well-Being**



# Dashboard to Capture 360° View of Well-Being and Liveability

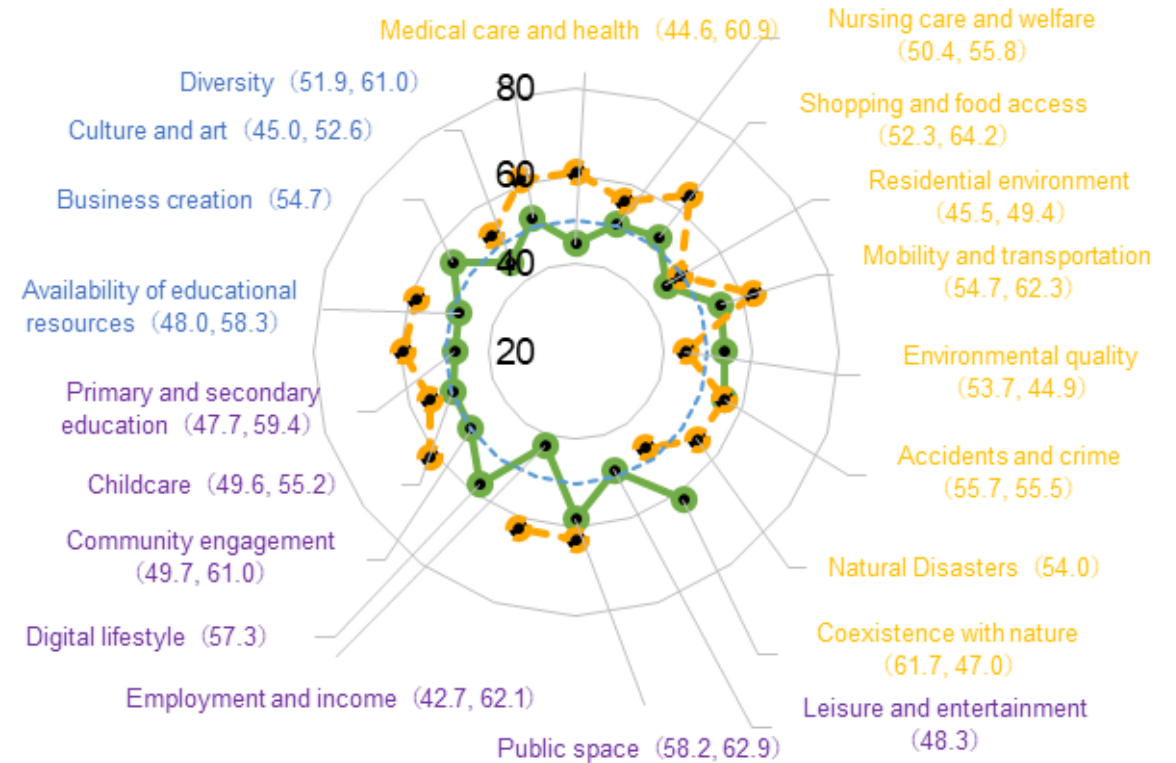
\*Legend:  
Objective —●—  
Subjective - -●-

## Tsukuba City



Objective score	50.0
Subjective score	59.0

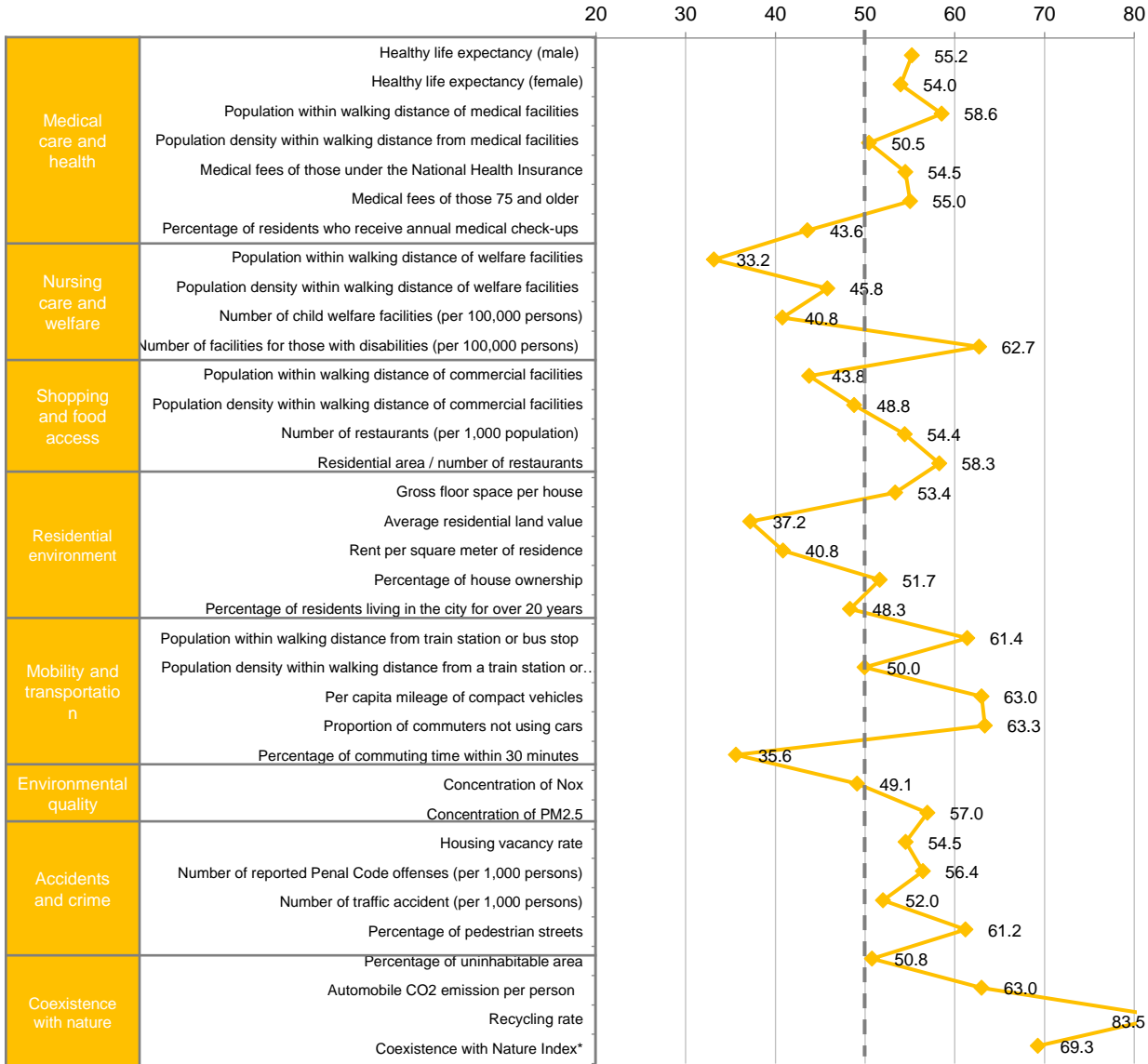
## Sapporo City



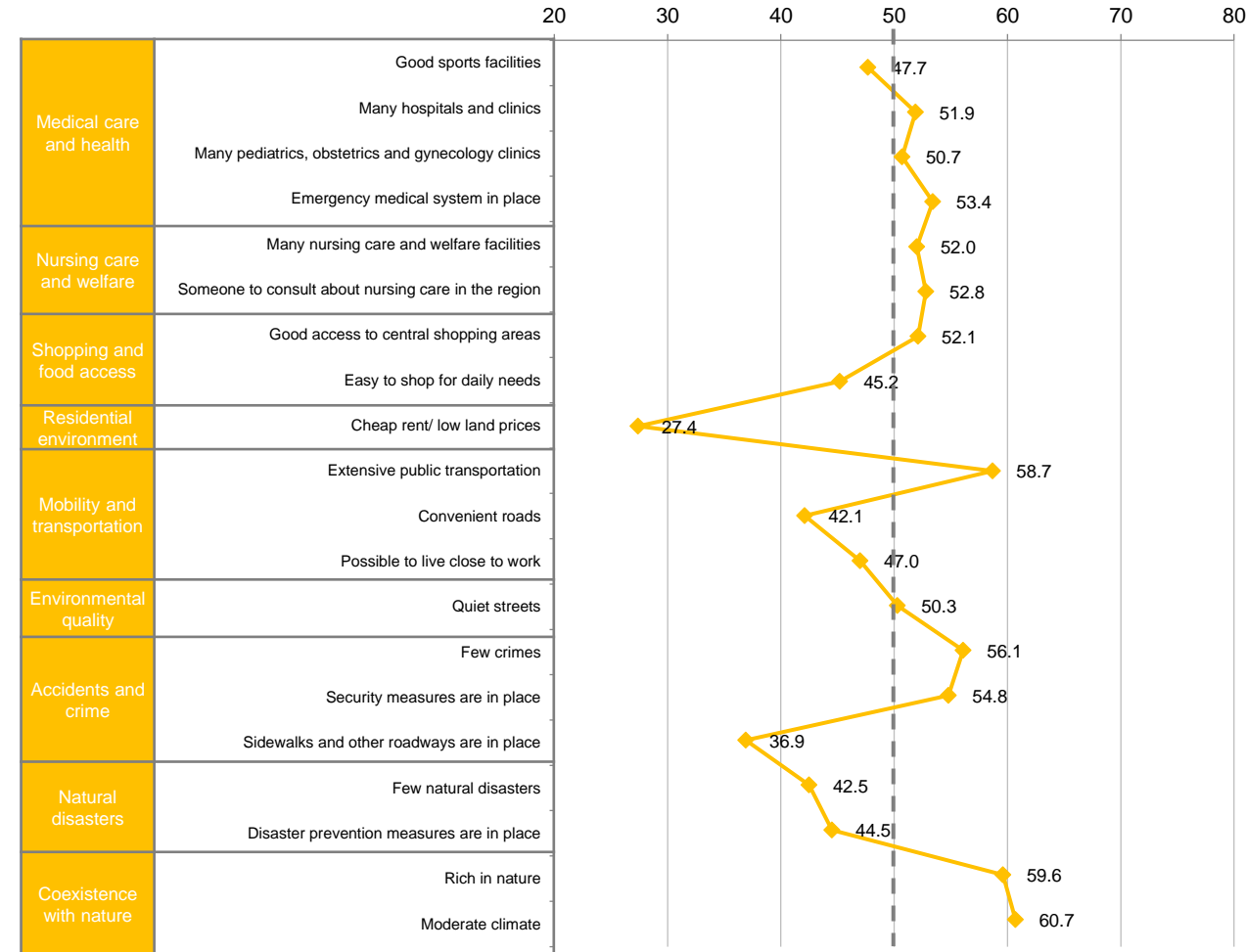
Objective score	51.1
Subjective score	56.9

# Breakdown - Physical Health Indicators

## Objective



## Subjective



\*Coexistence with Nature Index: : Index that holistically assesses the initiatives implemented by the city

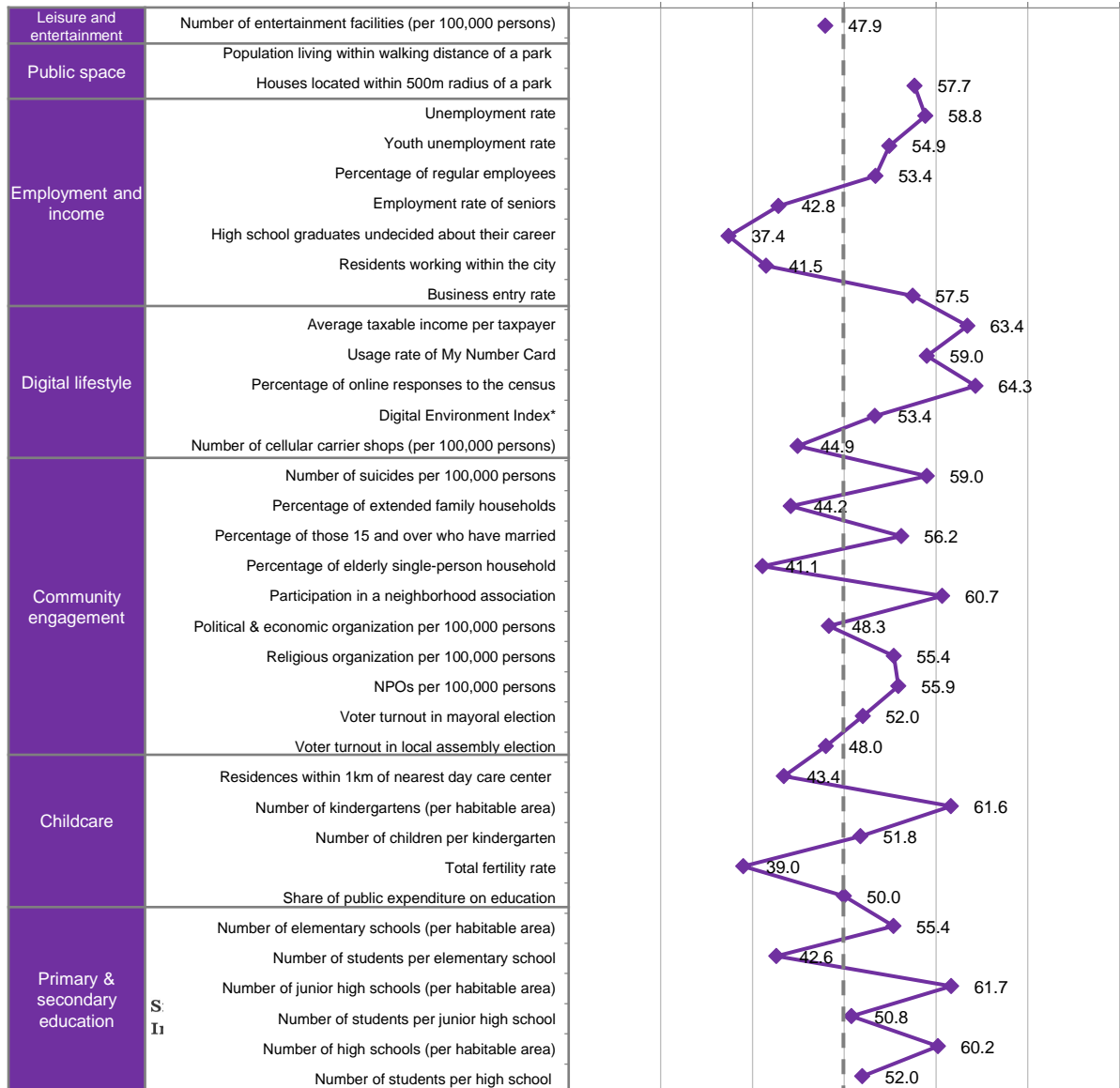
■ KPIs composing the Index

- SDGs Future City
- 2050 Zero Carbon Cities
- Policy on Green Public Procurement
- Participation in the Japan Climate Initiative

# Breakdown - Social Health Indicators

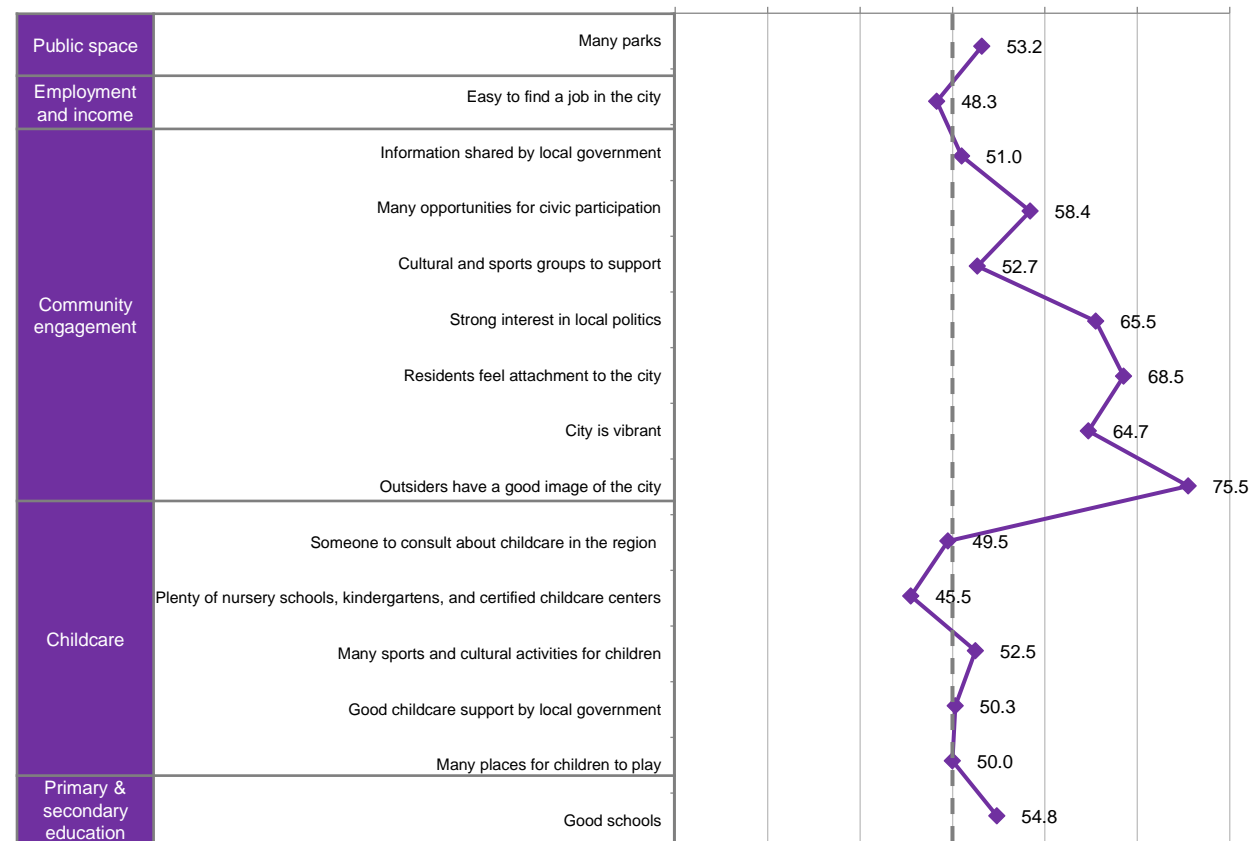
## Objective

20 30 40 50 60 70 80



## Subjective

20.0 30.0 40.0 50.0 60.0 70.0 80.0



(\*) Digital Environment Index: Index that holistically assesses the digital environment of a city

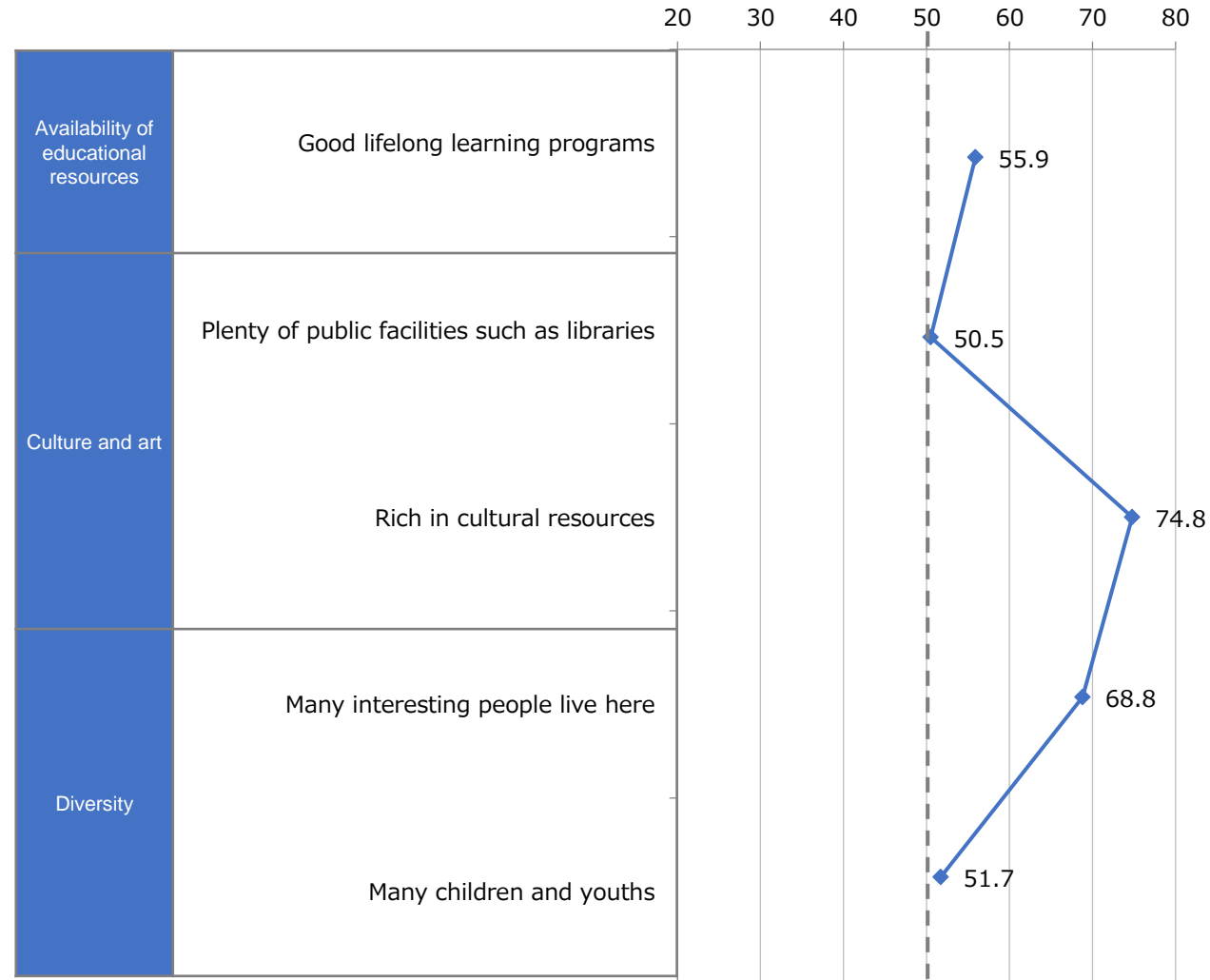
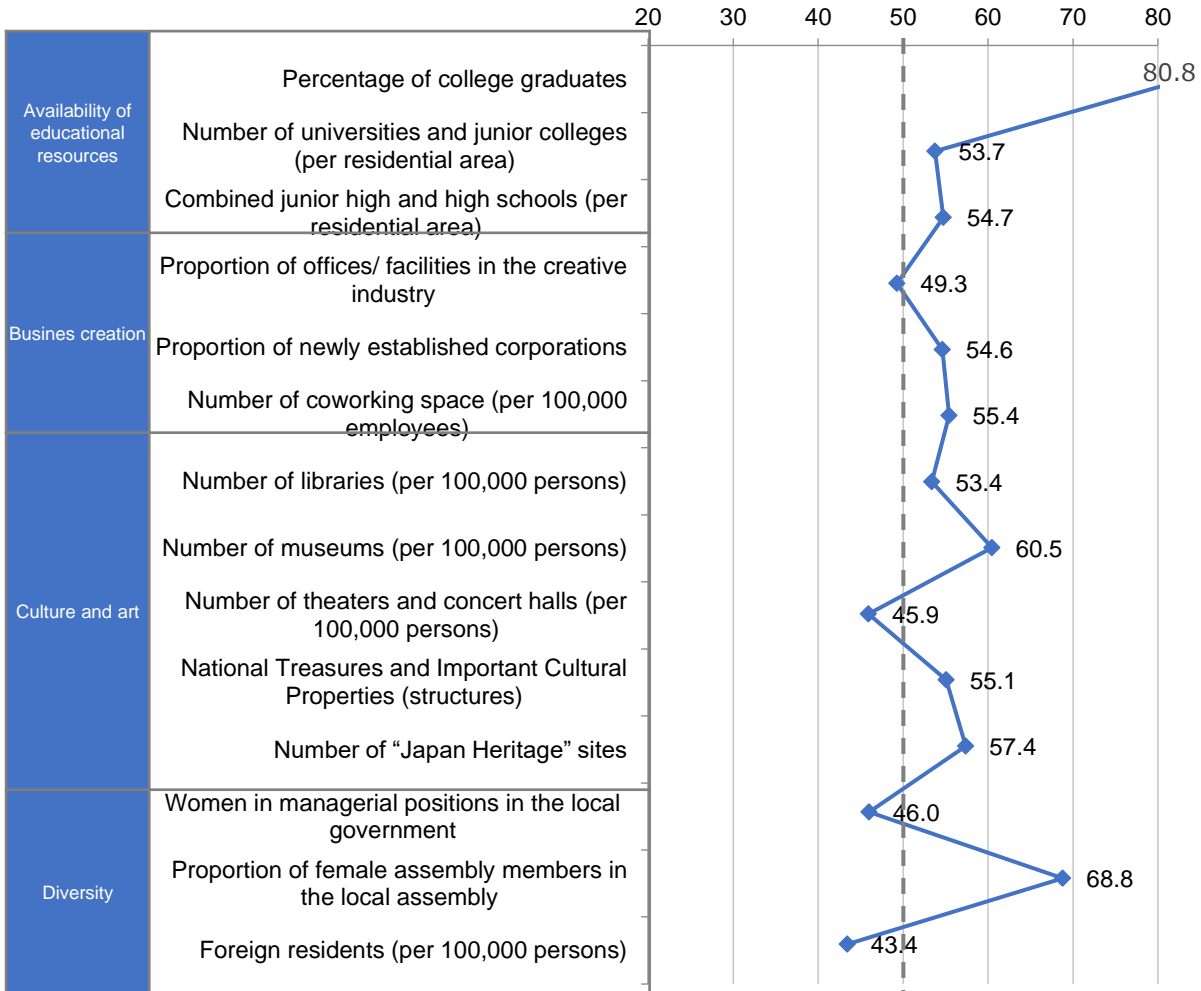
- Cities partaking in MLIT Plateau Project
- "Code for " organization in the city
- Fab Lab in the city
- CoderDojo in the city
- Local IoT Acceleration Lab in the city
- ICT related department in a university
- College of technology in the city
- Open data scheme by the local government

■ KPIs composing the index

# Breakdown - Mental Health Indicators

## Objective

## Subjective



# Sharing Narratives of Well-Being Specific to the City - Case of Coexistence with Nature

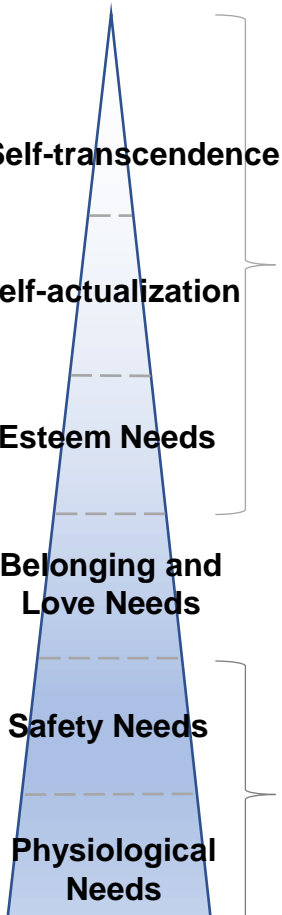
Green: Objective  
Orange: Subjective

\*KPIs composing the Coexistence with Nature Index are SDGs Future City, 2050 Zero Carbon Cities, Policy on Green Public Procurement, and Participation in the Japan Climate Initiative

## Corresponding KPIs

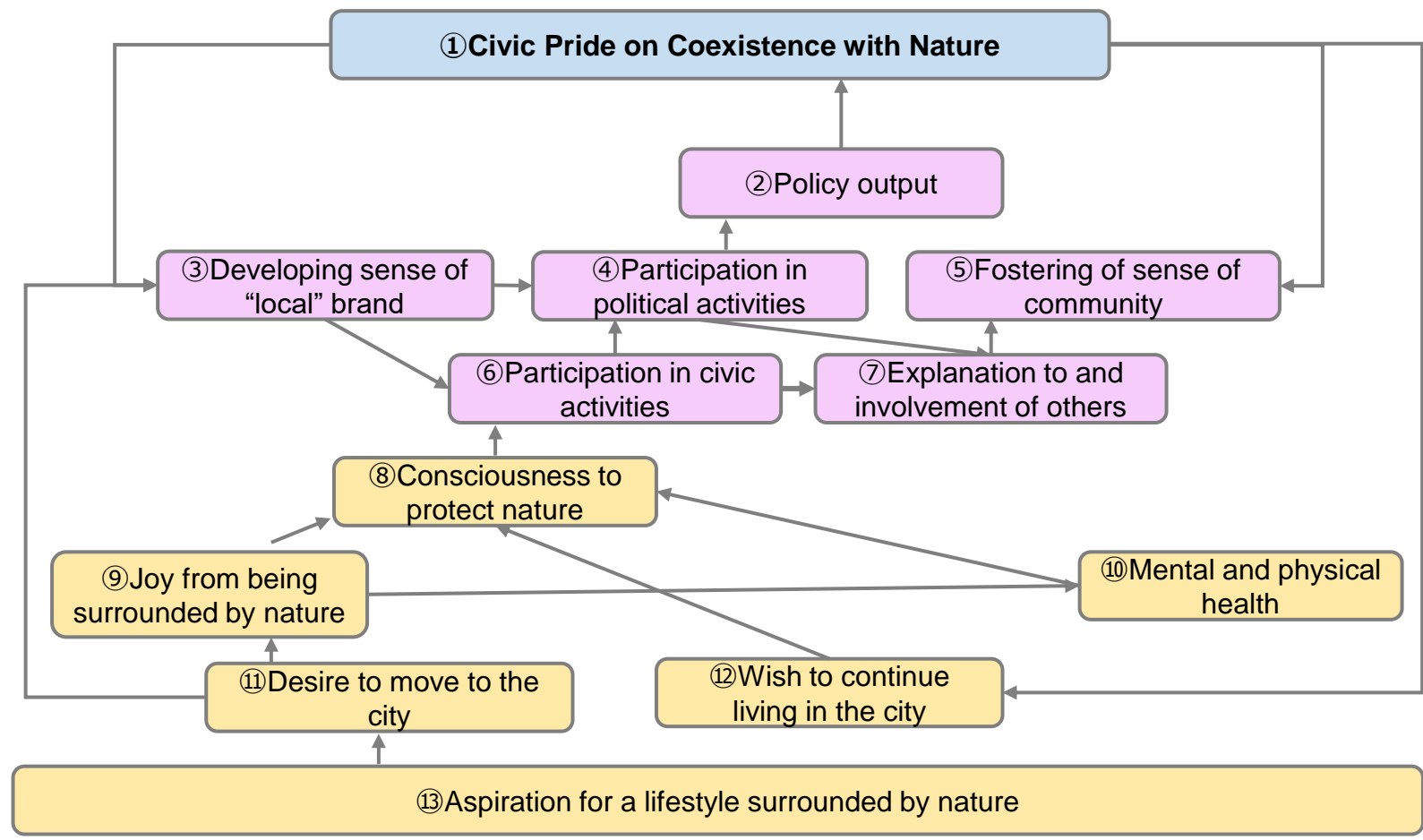
- ① Residents feel attachment to the city
- ② Recycling rate
- ② Coexistence with Nature Index\*
- ③ Outsiders have a good image of the city
- ④ Strong interest in local politics
- ④ Voter turnout in mayoral election
- ④ Voter turnout in local assembly election
- ⑥ Many opportunities for civic participation
- ⑥ NPOs per 100,000 persons
- ⑥ Participation rate in a neighborhood association
- ⑩ Healthy life expectancy (male)
- ⑩ Healthy life expectancy (female)
- ⑫ Percentage of residents living in the city for over 20 years
- ⑬ Rich in nature
- ⑬ Percentage of uninhabitable area

### Maslow's Hierarchy of Need



Mental Health  
Social Health  
Physical Health

### Hedonia Eudaimonia Medical



# Conclusion

- Under the Kishida administration, Japan has embarked on “Digital Garden City Initiative” to accelerate digital transformation of the country from regions on a bottom-up fashion.
- Implementing Liveability and Well-Being City Indicators (LWCI) is the key component of the Digital Garden City Initiative as a way of ensuring smart technology implementation realizes well-being of citizens.
- LWCI consists of subjective and objective assessment of liveability of the city and well-being of citizens at the municipality level. – Lessons Learned: Tech-driven approach is NOT enough to meet citizens’ needs/wants.
- Japanese Government has selected Osaka and Tsukuba as “Super City,” a national flagship smart city showcasing holistic future state of cities in 2030.
- Smart City Institute Japan is open to collaborate with cities or organizations abroad who are interested in the designing and implementing the LWCI.

# Thank you – Questions?