TSC Foresight Future Vision

# Future Visions of a Digital Society

## — A Digital Society That Enables Diverse Wellbeing for Every Individual

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**New Energy and Industrial Technology Development Organization (NEDO)**
**Technology and Innovation Strategy Center (TSC)**

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## Introduction

In June of 2021, the Technology and Innovation Strategy Center (TSC) at NEDO published its forward-looking report *The Prosperous Future to Be Pursued Beyond Innovation*[1] in order to support innovative initiatives that benefit a future society. The report contained a comprehensive analysis of 75 domestic and international sources including reports on wellbeing, government white papers, and future foresight studies. It drew on this analysis to identify a "core value compass" with six directions that innovation initiatives should prioritize and proposed 12 visions of society to achieve.

The report is useful as a framework for reviewing initiatives undertaken by organizations and countries, examining outcome targets, and understanding challenges associated with the advancement of specific technologies. However, because the visions are relatively abstract in the way they are presented, companies and organizations may not find the report helpful as a practical reference while they consider the challenges they face in realizing those visions. Similarly, the beneficiaries of the values and services generated through innovation may find the report does not answer their questions regarding anticipated benefits and possible risks. Therefore, while building on the visions presented in the *Prosperous Future* report, we now provide a more detailed perspective of digital technologies that serve as a common foundation across sectors in this new report, *Future Visions of a Digital Society.*

Twelve visions to be realized were identified in the *Prosperous Future* report. The following four are closely related to the future society envisioned in Japan's 7th Science, Technology, and Innovation Basic Plan:

(1) A society with high transparency and reliability
(2) A society where everyone's liberty and safety is ensured
(3) A robust and resilient society
(4) A comfortable and dynamic society

These four visions are closely related to the Basic Plan's goal of creating a prosperous, safe, and secure society; one in which every individual can pursue and achieve wellbeing and lead a life that is vibrant and full of hope both physically and mentally. They are also expected to undergo major transformation as AI and other digital technologies permeate not only cyberspace but also the physical

[1] TSC Foresight. *The Prosperous Future to Be Pursued Beyond Innovation*. NEDO, 2021. https://www.nedo.go.jp/content/100964350.pdf

world. This report's concrete "future scenarios" were developed based on the assumption of a highly advanced digital society, and it presents the potential benefits, risks, and challenges that should be addressed in relation to these future scenarios.

# Chapter 1: A Prosperous Future and a Digital Society

The *Prosperous Future* report published by TSC in June 2021 presented a core value compass with six directions that should be prioritized and 12 visions of society to achieve in pursuit of a prosperous future. This chapter provides an overview of those and then discusses their relationship to our future visions of a digital society.

*Prosperous Future* identified core values that should be prioritized in order to realize the society it envisions. Based on 29 reports concerning prosperity and wellbeing, a co-occurrence network analysis[2] was used to extract groups of words that could constitute elements of a prosperous future. Cluster analysis was then conducted across the word groups to derive six values that should be prioritized towards this goal. Figure 1 shows the values derived through this process.

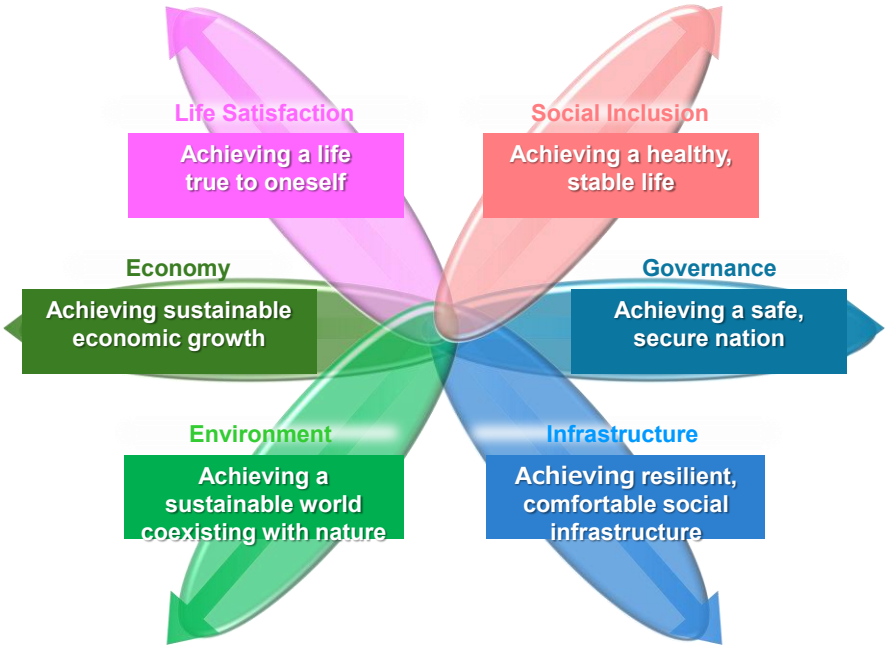



**Fig. 1: Core value compass with six directions**

Source: TSC Foresight. *The Prosperous Future to be Pursued Beyond Innovation*. NEDO, 2021.

Next, future visions of society corresponding to the six values were derived. First, keyword maps characterizing the six values were developed. The Delphi method[3] was applied to the maps to derive societal visions corresponding to each value, and those societal visions were then classified into 12 broad categories, with two visions assigned to each of the six values. Figure 2 shows the societal visions

[2] Co-occurrence network analysis: a natural language processing (NLP) method that analyzes the co-occurrence patterns of words appearing in a text and the relationships among them.
[3] Delphi method: a method for building consensus among a group of experts by repeatedly posing the same questions and providing feedback on the results of each round.

derived through this process. From its analysis, the report concluded that realizing a prosperous future requires innovation that advances the 12 visions of society while taking the core value compass with six directions into account.

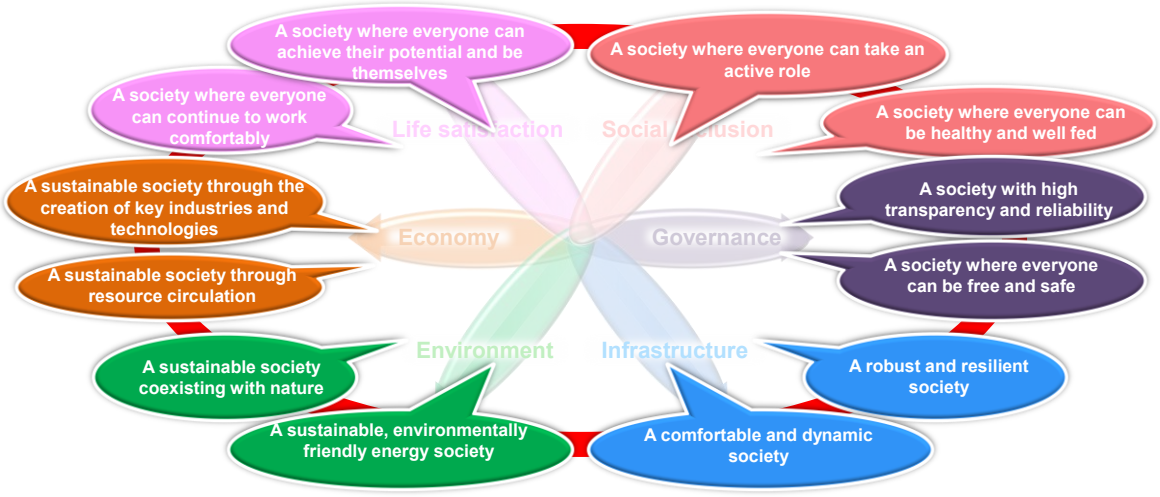



**Fig. 2: 12 visions of society**

Source: TSC Foresight. *The Prosperous Future to be Pursued Beyond Innovation*. NEDO, 2021.

*Prosperous Future* also presented 40 examples of innovations that should be pursued in contemporary society to realize its envisioned society. Mapping the examples involving digital technologies to the 12 societal visions provides a more concrete image of a digital society (Figure 3).

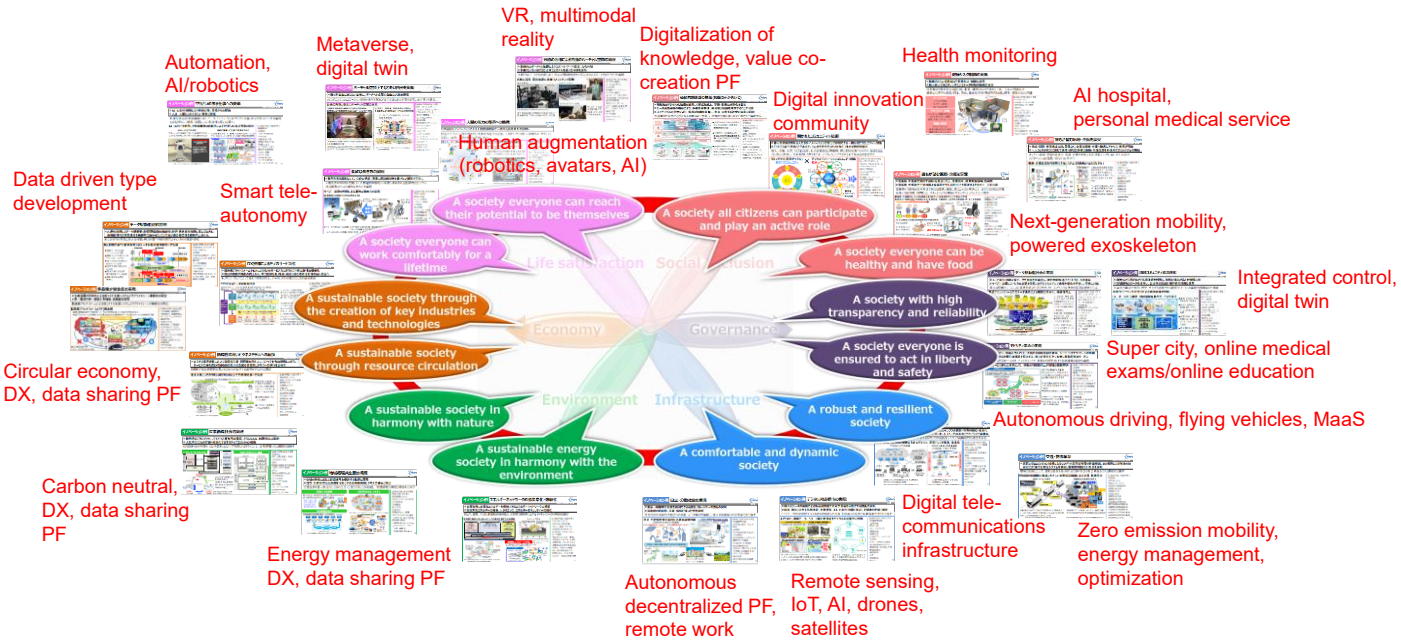



**Fig. 3: Relationship between the 12 societal visions and examples of innovations utilizing digital technologies**

As noted in the introduction, the societal visions presented in *Prosperous Future* are useful as frameworks for reviewing initiatives undertaken by organizations and countries and for examining outcome targets and challenges associated with the advancement of specific technologies. However, the high level of abstraction used to describe them made it difficult for companies and organizations to utilize them as they took on challenges related to innovating, and parties looking to uncover anticipated benefits and possible risks also found them hard to grasp. Therefore, TSC developed a more detailed vision of a future digital society by building on and further refining the societal visions presented in *Prosperous Future.* The visions, shown in Figure 3, were classified into the following four domains based on their relationship to the core values (Figure 4).

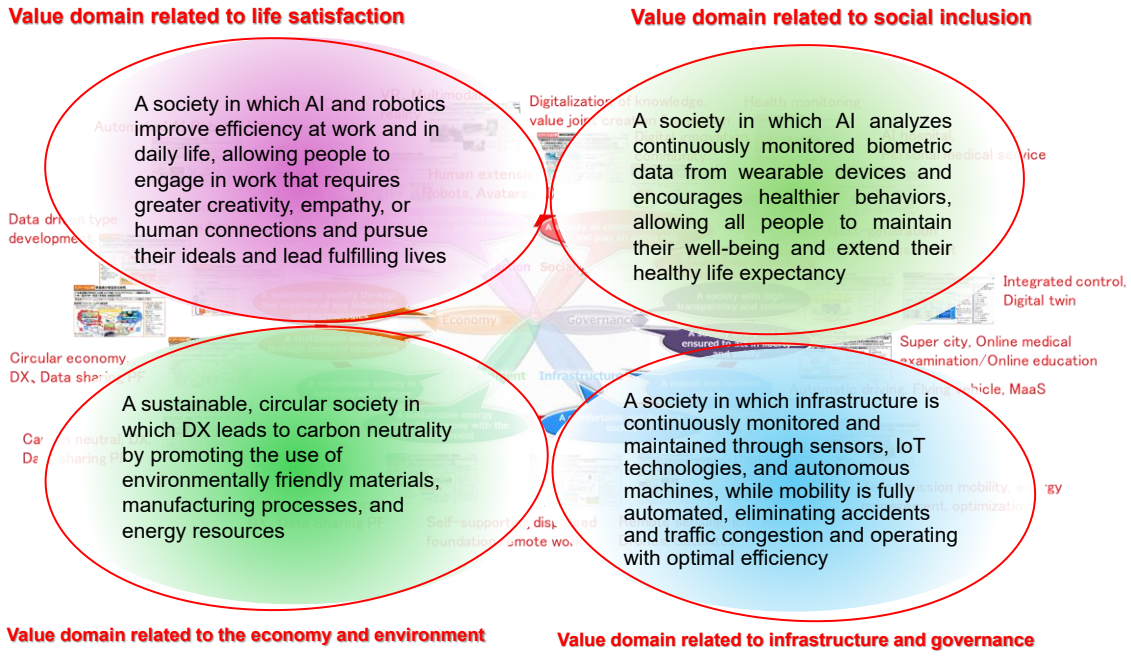



**Fig. 4: Four value domains can be extracted from innovations that use digital technologies**

1. Value domain related to life satisfaction

   AI and robotics should improve efficiency at work and in daily life, allowing people to engage in work that requires greater creativity, empathy, or human connections, and to pursue their ideals and lead fulfilling lives.

2. Value domain related to social inclusion

   If people use wearable devices and similar technologies, biometric data could be monitored as needed. AI systems would analyze this data and provide customized encouragement to individuals

so they can adopt behaviors that support their health, thereby extending their healthy life expectancy.

3. Value domain related to the economy and environment

The application of digital transformation (DX) should promote the development of materials and manufacturing processes with lower environmental impacts and the optimization of energy use. As a result, carbon neutrality could be achieved, contributing to a sustainable, circular society.

4. Value domain related to infrastructure and governance

Sensors, the Internet of Things (IoT), and autonomously mobile machines could monitor the condition of roads, tunnels, bridges, buildings, and other structures, helping to ensure the safety of infrastructure. If mobility becomes automated, accidents and traffic congestion could be eliminated, and society as a whole would operate safely and with optimal efficiency.

Among the four domains, the domain related to infrastructure and governance is most closely associated with the future society identified in the 7th Science, Technology, and Innovation Basic Plan[4]. Relevant text includes “a prosperous, safe, and secure society” and “a society in which every individual can pursue and achieve diverse forms of wellbeing, enabling everyone to lead a life that is prosperous, vibrant, and full of hope in both physical and mental terms.” The infrastructure and governance domain also corresponds to four of the 12 societal visions to be realized that were identified in *Prosperous Future:*

1. A transparent and trustworthy society
2. A society where everyone can act freely and safely
3. A resilient and adaptive society
4. A comfortable and vibrant society

These societal visions are expected to undergo major transformation as AI and other digital technologies permeate not only cyberspace but also the physical space of the real world. In addition, transformation of the four societal visions associated with infrastructure and governance is expected to

[4] Cabinet Office, Government of Japan, The 7th Science, Technology and Innovation Basic Plan. https://www8.cao.go.jp/cstp/kihonkeikaku/index7.html (Japanese) (Accessed August 2026)

generate spillover effects that transform the other three domains shown in Figure 4 through greater work efficiency, improved health, and the realization of a circular economy. That is why this report focuses on these four societal visions to develop concrete "future scenarios" for a digital society.

In developing its scenarios, this report referenced the Compact Plus Network[5] concept advocated by Japan's Ministry of Land, Infrastructure, Transport and Tourism. This proposes that urban structure must maintain public services and regional vitality even as the population declines and society ages, and that we can do so by concentrating functions such as housing, healthcare, welfare, and commerce to some extent, organically connecting them via transportation networks and digital foundations.

Our report does not aim to discuss urban planning itself. But it establishes a hypothetical "compact city" as a common assumed setting to examine future visions of a digital society. This compact city encompasses urban, rural and industrial areas and assumes a place in which all services, including housing, healthcare, industry, and public services, can be accessed without geographical constraints.

This report seeks to provide an opportunity for readers to consider the future from a personal perspective. We invite you to identify which future scenario among those examined here most closely resembles the community in which you live, and use it to imagine your community's future. As social infrastructure generally has a renewal cycle spanning several decades, discussions between the public and private sectors are already underway regarding the goals that will follow the Sustainable Development Goals (SDGs), whose target year is 2030. These beyond-SDGs goals are expected to look toward the year 2050, so the future scenarios presented in this report are set in 2050.

[5] Priority Policy Measure: "Compact Plus Network." The Ministry of Land, Infrastructure, Transport and Tourism. https://www.mlit.go.jp/toshi/toshi_ccpn_000016.html (Japanese) (Accessed August 2026)

# Chapter 2: The Future Scenarios and Challenges for a Digital Society

## 2-1 Method of Developing the Future Scenarios

This chapter looks at how we developed the detailed future scenarios of a digital society based on the four societal visions highlighted in Chapter 1 (a transparent and trustworthy society, a society where everyone can act freely and safely, a resilient and adaptive society, a comfortable and vibrant society).

Our study first used a forecasting approach to project the future based on current technological and social trends. We then combined this with a backcasting approach, starting from the desired future scenarios and working back to the present to identify challenges and needed initiatives along the path. Figure 5 shows the study's process.

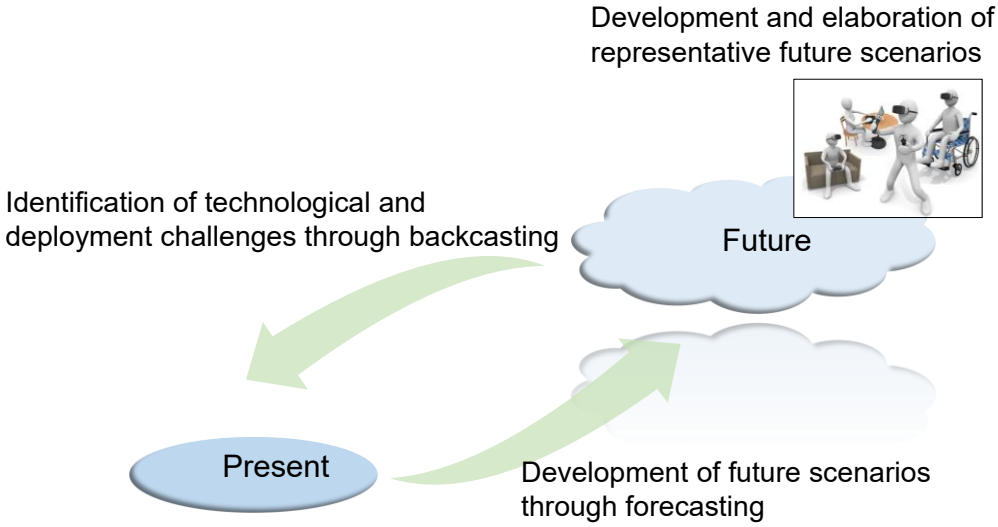



**Fig. 5: Process for examining the future scenarios**

Three processes were combined to develop the future scenarios: (1) generating ideas through workshops, (2) identifying needs through a public survey of citizens, and (3) validating and refining the scenarios through interviews with experts and local government representatives.

1. Generating ideas through workshops

    ・ We reviewed case studies of compact, smart cities in Japan and other countries and literature predicting possible infrastructure developments. NEDO personnel and contractors held workshops on the findings to discuss the potential for digital technologies to create new value and functions across sectors, industries, and organizations.

- At this stage, technical feasibility was not treated as a constraint. The discussion emphasized new values that could be created through cross-sector, cross-industry, and cross-organizational collaboration. Participants freely envisioned desirable societies that could address future social challenges, generating a diverse range of future scenario ideas.

2. Identifying needs through a public survey
   - An online survey of 200 members of the Japanese public was conducted on the 30 functions identified in the workshops. The survey looked at the need for each function, anticipated benefits, and concerns.
   - Based on the public needs identified in the survey, new functions were added, existing functions were revised, and similar functions were consolidated and reorganized into 10 future scenarios. Free-text responses were also used to organize the potential benefits and possible risks associated with each scenario.

3. Validation and refinement through interviews with experts and local government representatives
   - Interviews were conducted with university researchers, representatives of the private sector, and local government officials to examine each future scenario's technical and deployment challenges, business models, and social acceptance.
   - The study also analyzed deployment challenges and feasibility by comparing the scenarios with local government initiatives that are already being implemented in smart cities. Including these findings made it possible to refine the scenarios and organize the challenges and initiatives required for their realization.

Further details on our procedures and methods can be found in the research report *Study on Digital Technologies and Other Measures for Realizing a Prosperous Future.*[6]

[6] NEDO Project Results Database : https://www.nedo.go.jp/seika_hyoka/database_index.html (Japanese)

## 2-2 The Future Scenarios Developed for a Digital Society

Table 1 presents the 10 future scenarios developed through the process described in Section 2-1.

**Table 1: Future scenarios**

| No. | Future Scenario |
|---|---|
| **Future scenarios for a transparent and trustworthy society** | |
| (1) | A society with data-driven, efficient public administration and smart urban planning |
| **Future scenarios for a society where everyone can act freely and safely** | |
| (2) | A society where infrastructure is maintained autonomously and the city is beautified automatically |
| (3) | A society where risks are detected in advance and safety is ensured |
| (4) | A healthy society enabled by smart healthcare and pandemic-prevention healthcare |
| (5) | A society where transportation is optimized through smart mobility |
| **Future scenarios for a resilient and adaptive society** | |
| (6) | A resilient society with real-time disaster response |
| (7) | A green society where renewable energy is optimized through smart grids |
| (8) | A society with sustainable food and agricultural systems |
| **Future scenarios for a comfortable and vibrant society** | |
| (9) | A society with smart factories that respond to citizens' needs |
| (10) | An inclusive digital society where older adults and diverse talent can thrive |

## 2-3 Narratives, Impacts, and Challenges of the Future Scenarios

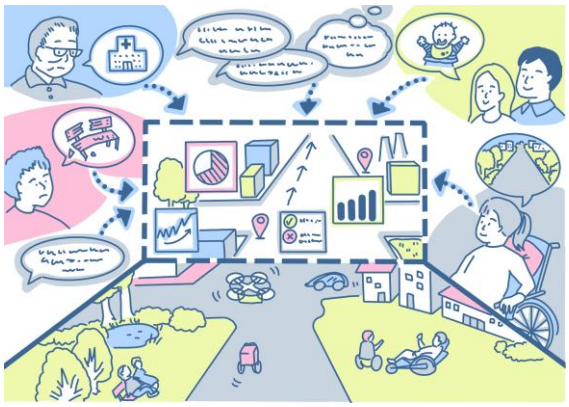
This section presents illustrated narratives for the 10 future scenarios shown in Figure 6. For each scenario, it also identifies potential benefits, possible risks, technical challenges, and deployment challenges relating to regulations and policy measures. Keywords discussed in Chapter 3 are shown in italics.




**Fig. 6: Overview of the future scenarios**

## A Transparent and Trustworthy Society

### (1) A Society with Efficient, Data-Driven Public Administration and Smart Urban Planning



- By 2050, thanks to the utilization of diverse types of data, public administration in cities has evolved significantly and serves as a foundation that supports the lives of individual citizens. Urban AI systems provide integrated analyses of economic activity, transportation, environmental conditions, and citizen feedback. These systems support policymaking and enable the implementation of policies that are transparent and broadly accepted by society.
- Specifically, budgets and policy measures are put through advance simulations using digital twins, so their anticipated effects and impacts are visualized in an easily understandable manner. As a result, city councils and citizens are able to engage in constructive, data-driven discussions, fostering a society characterized by a high level of trust in public administration and a strong sense of security in daily life.
- Digital twins are also employed in urban planning, continuously updating in real time to assess traffic congestion, environmental impacts, disaster risks, and other factors from multiple perspectives. This enables the realization of sustainable, highly livable urban spaces, improving neighborhoods and allowing citizens to experience greater safety and comfort in their everyday lives.
- Administrative services are available online and AI systems provide support on a 24-hour basis, ensuring that all citizens have equitable access to public services. Citizens are empowered to participate directly in the policymaking process through online voting, and digital platforms let them submit opinions and proposals. This has enabled the emergence of a highly participatory society; one in which people see their views and intentions reflected and where they take an active role in shaping the future.
- Public administration provides proactive, personalized support tailored to individual needs, offering comprehensive assistance in areas such as childcare, healthcare, and community activities. Digital tokens that can be spent locally create a mechanism for citizen participation and cooperation to contribute directly to regional revitalization.

Potential Benefits

- Dramatic improvements in the accuracy and efficiency of policymaking, enabling the implementation of sustainable initiatives with minimal waste. ***Greater Efficiency***
- Administrative services become more convenient and accessible to all citizens, easing everyday life and fitting flexibly into any schedule. ***Improved Convenience***
- Increased transparency and citizen participation strengthen trust, public acceptance, and civic engagement and enhance individual wellbeing. ***Wellbeing***

Possible Risks

- AI systems may undervalue minority opinions and pose ethical considerations, potentially undermining fairness and democratic principles. ***Digital Bias***
- Cyberattacks may disrupt essential urban functions. ***System Dependency***
- Some citizens may be left behind if administrative services shift to online platforms. ***Digital Divide***

Technical Challenges to Be Addressed

| |
|---|
| ・Technologies capable of correcting biased data distributions must ensure that minority perspectives are not overlooked. ***Fair Algorithms, Explainability***<br>・Robust AI technologies should maintain decision-making accuracy during system failures, disasters, pandemics, and other unexpected events. ***AI Robustness Technologies***<br>・Interface technologies must enable all citizens to access and benefit equally from administrative services. ***Interfaces*** |
| Deployment Challenges to Be Resolved |
| ・Operational frameworks must ensure that citizens who cannot easily access digital services are not left out. ***Operating Rules, Digital Inclusion***<br>・Rules to ensure privacy protection, prevent the use of data outside its intended purpose, and maintain transparency must be put in place. ***Data Governance***<br>・Institutional principles should be established, clearly defining AI systems as advisory tools while ensuring that key decisions at critical points remain the responsibility of human actors. ***Human in the Loop***[7] |

[7] Humans supervise, review, and intervene in the process of AI-driven analysis and decision making, with the ability to modify decisions when necessary.

**A Society Where Everyone Can Act Freely and Safely**

**(2) A Society Where Infrastructure Maintenance and City Beautification Happen Autonomously**




- In cities in 2050, sensors embedded throughout a wide range of social infrastructure including roads, bridges, waterworks, and sewers continuously transmit data to AI systems. This data is integrated with diverse sensing data obtained from autonomous vehicles, drones, smart glasses, and other sources, allowing infrastructure conditions to be monitored in real time.
- AI systems analyze vibrations, corrosion, water leaks, and other indicators to predict deterioration with a high degree of accuracy. Maintenance timing can be automatically calculated based on abnormal vibrations detected in bridges and roads, and optimal repair plans are developed accordingly. As a result, catastrophic failures have become extremely rare and infrastructure is kept sound.
- General-purpose robots carry out maintenance inspections and repair work, autonomously patrolling roads, repairing cracks, and inspecting tunnels and bridges. Human workers can avoid hazardous tasks and devote themselves to advanced decision-making, final inspections, and responding to emergency situations.
- Data collected from waste receptacles, environment-monitoring cameras, and citizen reports is integrated so cleaning plans are optimized in real time. During the day humans and robots work collaboratively and at night robots clean the city, make repairs, and do landscaping. As a result, the urban environment stays clean and well-maintained.

Potential Benefits

- Using sensors and advanced analytics to detect abnormalities early helps prevent accidents and ensure public safety. ***Predictive Maintenance***
- Highly efficient management of social infrastructure enables operational efficiency and safe, reliable service provision. ***Greater Efficiency***
- Beautification and maintenance are performed in a resource-efficient manner with lower environmental impact through data-driven optimization and the use of robots. ***Automation and Labor-Saving Solutions***

Possible Risks

- Older buildings and legacy infrastructure incompatible with digital technologies may not be covered. ***Digital Divide***
- Cyberattacks might disrupt urban functions and critical infrastructure services. ***System Dependency***
- Extensive automation may reduce citizens' sense of ownership and responsibility toward their communities. ***System Dependency***

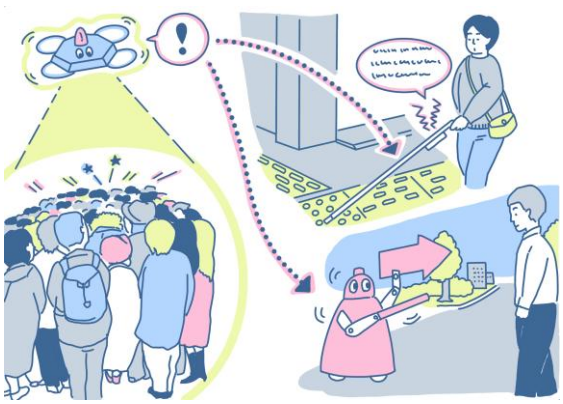
Technical Challenges to Be Addressed

- High-reliability, low-latency technologies should be integrated and share a range of sensor data. ***Data Sharing***
- Advanced analytics and decision support technologies that are capable of accurately predicting wear and tear and planning maintenance need to be developed. ***AI Utilization, Explainability***

| |
|---|
| ・Recognition, navigation, and manipulation technologies must enable robots to autonomously conduct inspections and repairs. ***General-Purpose Robots*** |
| Deployment Challenges to Be Resolved |
| ・Operating rules, responsibility allocation frameworks, and certification systems for the deployment of robots and drones must be established. ***Operating Rules***<br>・Rules have to be put in place to ensure privacy protection, prevent the misuse of data, and maintain transparency. ***Data Governance***<br>・Operational structures must cover procurement, workforce development, and citizen participation while gaining broad social acceptance. ***Social Acceptance*** |

**A Society Where Everyone Can Act Freely and Safely**

**(3) A Society Where Risks Are Detected in Advance and Safety Is Ensured**



- The status of an entire city can be safeguarded and predicted in real time by 2050, thanks to a variety of data obtained from sensors and smart devices and integrated by AI systems. Signs of disasters and accidents are detected in advance and relevant organizations coordinate immediately, making it possible to prevent damage before it occurs and respond rapidly when incidents arise.
- Citizens voluntarily share data including location information, activity histories, and health conditions with AI systems to allow personalized safety support, creating an environment in which everyone from children to the elderly can feel secure. In the event that an unexpected disaster or accident does occur, optimal evacuation guidance, protection, and rescue services—tailored to individual needs—are provided promptly, giving citizens peace of mind that comes from continuous oversight and support.
- Not only do AI systems detect abnormalities at an early stage, but they also automatically coordinate appropriate response resources such as rescue robots and receiving hospitals. During emergencies, receiving hospitals and transportation routes are optimized and remote medical support is provided, contributing to higher survival rates. These mechanisms lead to a society in which citizens can live safely and securely without constant fear of danger.

Potential Benefits

- Early detection and preventive intervention reduce the occurrence and severity of crimes, accidents, and disasters. ***Proactive Risk Prevention***
- Enhanced safeguards are extended to children, the elderly, and people requiring special assistance, ensuring that no one is left behind. ***Safety and Security***
- Seamless coordination among police, emergency services, and disaster management organizations occurs during both normal operations and emergency responses. ***Phase-Free***

Possible Risks

- There are concerns regarding constant surveillance and potential leaks of personal information. ***Privacy Infringement***
- There is a risk of unfair decisions resulting from biased data collection or deficiencies in algorithms. ***Digital Bias***
- Cyberattacks may disrupt essential urban functions. ***System Dependency***
- Excessive monitoring may discourage citizens from acting independently and expressing themselves freely. ***Reduced Creativity***

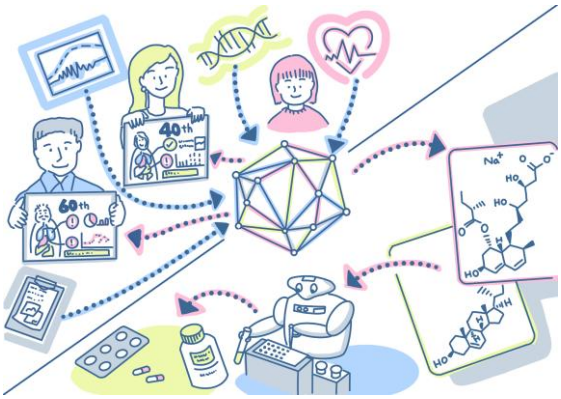
Technical Challenges to Be Addressed

- AI-based analytical technologies must be capable of accommodating diverse environmental, cultural, climate, and situational conditions while maintaining reliable performance. ***AI Utilization, AI Robustness Technologies***
- Technologies are needed to securely share, analyze, store, and process citizens' personal information. ***Confidential Data Processing, Fair Algorithms***
- Computing infrastructure must be capable of processing and analyzing large-scale data generated across an entire city. ***High-Performance Computing Infrastructure***

| Deployment Challenges to Be Resolved |
| --- |
| ・Strict governance rules must be established for the use, consent, retention, and third-party provision of personal data. ***Data Governance***<br>・The division of responsibilities between AI systems and human decision-makers must be redesigned. ***Operating Rules, Human in the Loop***<br>・Fairness and broad public understanding of these initiatives among citizens are essential, even among those who may not have access to digital technologies. ***Digital Inclusion, Social Acceptance*** |

**A Society Where Everyone Can Act Freely and Safely**

**(4) A Healthy Society Enabled by Smart Healthcare and Pandemic Prevention**




- In 2050, all medical institutions are connected through the use of electronic health records, enabling daily health data and the results of doctor's visits to be shared seamlessly. AI systems continuously monitor and analyze data collected from wearable devices and notify physicians when risks are detected. As a result, the onset and progression of disease can be prevented, creating an environment in which citizens can maintain their health as part of everyday life.
- Signs of infectious disease outbreaks are monitored across the city in real time. When anomalies are detected in wastewater or the air, appropriate countermeasures are implemented promptly at the community level. Citizens receive relevant information and behavioral guidance at the right time, allowing them to go about their daily lives with minimal anxiety and uncertainty.
- In healthcare settings, AI systems support optimal diagnoses and treatments by taking into account an individual's health records and regional trends in infectious diseases. As a result, citizens are able to receive high-quality medical care faster. Accumulated data is used to develop new treatments and pharmaceuticals and contributes to improving the overall health of society.
- Health management is seamlessly integrated into daily life so people can receive the most appropriate medical care when needed. A society is realized in which citizens can enjoy the peace of mind that comes from living long, healthy lives while maintaining a lifestyle that reflects their individual values and preferences.

Potential Benefits

- Preventive healthcare and infectious disease countermeasures are automatically provided without requiring individuals to devote significant attention to managing their health, greatly reducing anxiety about illness and the burden of obtaining care. ***Reduced Burden***
- Support that improves everyday behaviors enables citizens to enjoy healthier lifestyles without excessive effort. ***Health Promotion***
- People can live, work, and raise families with confidence regardless of where they reside thanks to reduced disparities in access to healthcare services. ***Reduction of Healthcare Disparities***

Possible Risks

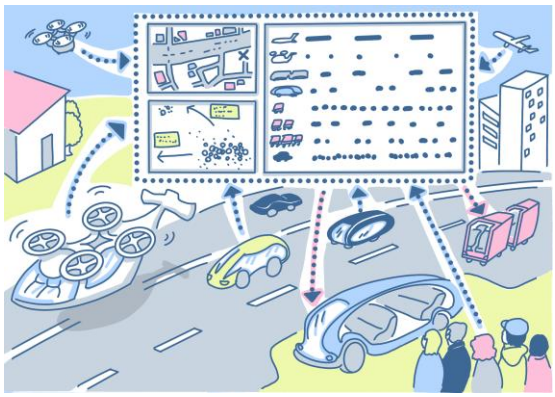
- Continuous monitoring and frequent health alerts may create a situation in which individuals feel compelled to constantly pay attention to their health, potentially undermining wellbeing. ***Surveillance Society***
- Health data may influence employment or other opportunities, resulting in disadvantages to individuals without their knowledge or consent. ***Use Beyond the Intended Purpose, Privacy Infringement***
- False detections or system failures may trigger cascading disruptions in medical decision-making and broader social responses. ***System Dependency***

Technical Challenges to Be Addressed

| |
|---|
| ・Data sharing technologies must maintain data quality, accuracy, and consistency across different devices and healthcare systems. ***Data Sharing***<br>・Technological development should produce models that combine explainability (including causal reasoning) with highly accurate predictions. ***Explainability***<br>・Robust security technology has to be capable of protecting sensitive data such as health records and biometric information. ***Cybersecurity*** |
| Deployment Challenges to Be Resolved |
| ・Rules covering consent management, data ownership, secondary use of data, accountability, and related issues must be established. ***Operating Rules***<br>・Governance frameworks that clearly define the scope of personal data use, consent requirements, and conditions for third-party provision need to be created. ***Data Governance***<br>・It will be necessary to promote understanding and acceptance of these initiatives among citizens, including those who have limited access to digital technologies or concerns about constant surveillance. ***Digital Inclusion, Social Acceptance*** |

## A Society Where Everyone Can Act Freely and Safely

## (5) A Society Where Transportation Is Optimized Through Smart Mobility



- In 2050, all modes of urban transportation are managed in an integrated manner by AI systems and traffic flows are continuously optimized in real time. Traffic congestion and accidents have been dramatically reduced, freeing citizens from the stress and anxiety associated with travel and enabling them to enjoy everyday activities with peace of mind.
- Smart mobility has become the primary means of transportation. Autonomous vehicles and on-demand mobility services work together seamlessly, allowing users to travel comfortably to their destination without needing to think about the mode of transportation they use. The need to own a private vehicle has declined significantly, and people are freed from the hassle of driving and finding a parking space. As a result, they enjoy greater flexibility, reduced stress, and increased freedom in daily life.
- Mobility services are also available in suburban and sparsely populated areas, improving access to healthcare, shopping, and social interaction. Regional disparities in transportation convenience have largely disappeared, enabling people to choose a lifestyle that suits their preferences without being constrained by where they live.
- In addition, the reduced need for parking facilities in urban areas has allowed land to be repurposed as green zones and community spaces. As a result, cities have evolved into more livable, human-centered places. Citizens are able to live in comfortable, beautiful urban environments while enjoying a sense of ease and connection.

### Potential Benefits

- There is a structural shift from a society that primarily responds to congestion and accidents after they occur to one that prevents them in advance through prediction and optimization. ***Proactive Risk Prevention***
- Reallocation of urban space currently used for parking into green zones and community areas creates more livable cities. ***Space Utilization***
- There is expanded access to employment, healthcare, and education opportunities beyond traditional support for people with limited mobility. ***Expanded Mobility Options***

### Possible Risks

- System failures or cyberattacks may trigger large-scale, cascading transportation disruptions. ***System Dependency***
- The shift from private ownership toward shared and service-based mobility models may require substantial adaptation across existing industrial structures. ***Business Model Transformation***
- Opportunities for recreational driving may decline, potentially leading to the weakening of car culture and motorsports. ***Reduced Recreation Opportunities***

### Technical Challenges to Be Addressed

- Technology must enable large numbers of vehicles and transportation infrastructure systems to share and exchange data in real time. ***Data Sharing***
- AI-based analytical technologies need to be capable of operating in complex mixed-traffic environments involving pedestrians, bicycles, and a wide range of vehicles. ***AI Utilization, AI Robustness Technologies***

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| ・Energy management technologies should optimize transportation demand and electric vehicle battery charging and discharging in an integrated manner. There should also be demand forecasting and dispatch optimization. ***Integration of Transportation and Energy Systems*** |
| Deployment Challenges to Be Resolved |
| ・As autonomous driving technologies advance, transparent, standardized operating rules must be in place to allocate responsibilities to humans and automated vehicles that include conditions for intervention. ***Operating Rules***<br>・Data formats and operational frameworks that collect and analyze data from different types of vehicles need to be standardized. ***Data Governance***<br>・Road space redesign, pricing systems, and workforce transitions associated with changes in industrial structures should be addressed. ***System Transition Support*** |

## A Resilient and Adaptive Society
## (6) A Resilient Society With Real-Time Disaster Response



- In 2050, if a disaster occurs in a city, damage will be assessed immediately in real time. Information obtained from sensors, cameras, drones, and other sources is integrated, and the data is analyzed by AI systems that instantly identify affected areas and hazardous locations, enabling a rapid initial response and activation of emergency protocols.
- During a disaster, evacuation routes are dynamically updated according to changing conditions, allowing citizens to continuously receive information on appropriate routes and reach safety. Even when communications infrastructure is damaged, satellite communications and emergency power systems ensure continued access, supporting orderly evacuations and minimizing confusion.
- Robots and drones enter hazardous areas to search for survivors and transport essential supplies. Occupancy conditions and inventory levels at evacuation shelters are continuously monitored and essential supplies are replenished as needed, providing efficient, effective support for evacuees.
- Citizens, local governments, police, fire departments, and other relevant organizations share the same information and coordinate their actions in real time. This enables flexible decision-making based on rapidly changing circumstances. Collaboration between humans and digital systems leads to resilient cities that can maintain essential social functions even during disasters.

### Potential Benefits

- An environment is established in which the entire population can reliably obtain evacuation information and everyone can evacuate safely if the need arises. ***Accessibility***
- Optimal allocation of supplies and personnel enables efficient support while minimizing gaps in assistance. ***Greater Efficiency***
- Real-time information sharing among relevant organizations ensures rapid recovery and continued operation of social functions. ***Resilience***

### Possible Risks

- Biases in AI-based decision making may lead to uneven support allocation or leave some people underserved during emergencies. ***Digital Bias***
- Growing dependence on digital systems may weaken human situational judgment and the ability to respond flexibly in the field. ***System Dependency***
- Continuous monitoring during normal times may increase concerns regarding privacy infringement and place a psychological burden on citizens. ***Privacy Infringement***

### Technical Challenges to Be Addressed

- Non-contact sensing technologies have to be capable of accurately identifying people requiring rescue. ***Sensing, Fair Algorithms***
- Highly durable sensing and communication technologies must continue to function under disaster conditions. ***Sensing, Communication Infrastructure***
- Information-gathering and rescue technologies are needed to enable the safe, coordinated operation of robots and drones. ***General-Purpose Robots***
- Technologies for real-time analysis, forecasting, and dynamic evacuation guidance based on the integration of diverse data sources are necessary. ***Data Sharing, AI Robustness Technologies***

| Deployment Challenges to Be Resolved |
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| ・Operational authority and areas of responsibility for the use of robots and drones during disasters must be codified. ***Operating Rules***<br>・Trustworthy data governance frameworks must clearly lay out boundaries on the use of personal data. ***Data Governance***<br>・Information delivery methods and evacuation training have to accommodate citizens who cannot easily access digital technologies. ***Digital Inclusion***<br>・Coordination among local governments and related organizations, as well as regular training and consensus-building activities outside of disasters, should be promoted. ***Social Acceptance*** |

**A Resilient and Adaptive Society**

**(7) A Green Society Where Renewable Energy Is Optimized Through Smart Grids**




- In 2050, renewable energy facilities distributed across the city's buildings and infrastructure are integrated through smart grids, enabling the entire city to function as an energy platform that combines power generation and energy storage capabilities. Highly accurate demand forecasting and optimized electricity generation management ensure a stable supply of energy.
- AI systems adjust electricity allocation and energy storage asset use according to weather conditions, time of day, and regional demand patterns. Sources of energy consumption such as building facilities and industrial equipment are controlled and optimized to reduce peak demand. As a result, efficient energy use centered on renewables has been achieved throughout the city.
- Citizens and businesses share electricity generated from their own renewable energy resources and surplus electricity is sent to batteries, electric vehicles, and other storage systems. By integrating power generation, storage, and consumption, a sustainable energy cycle based on local production and consumption has become part of everyday life.
- Large-capacity, long-duration energy storage facilities and intercity energy cooperation provide a framework that maintains stable electricity supplies even during disasters or periods of supply-demand stress. Because urban infrastructure as a whole functions as an energy platform, a highly resilient society has been realized.

Potential Benefits

- Expanded utilization of renewable energy significantly reduces $CO_2$ emissions and contributes to environmental sustainability. ***Sustainability***
- Electricity supply and demand optimization improves energy efficiency and reduces operational costs. ***Greater Efficiency***
- Distributed energy resources enable electricity to be maintained during disasters and supply shortages, enhancing energy resilience. ***Resilience***
- Optimized energy use creates a comfortable, stable living environment and improves quality of life. ***Wellbeing***

Possible Risks

- Cyberattacks or AI misuse may result in large-scale power outages. ***System Dependency***
- The collection of energy transaction and consumption data may raise concerns regarding privacy infringement. ***Privacy Infringement***
- Obstructed views, noise, and other impacts associated with energy generation facilities may reduce social acceptance and affect urban living environments. ***Social Acceptance***

Technical Challenges to Be Addressed

- Real-time supply and demand optimization technologies are needed to integrate distributed power generation, energy storage systems, and energy consumption. ***Data Sharing, Explainability***
- Large-capacity, long-duration energy storage technologies must go beyond electricity to include thermal, pressure-based, gravitational, and other forms. ***Energy Storage Technologies***
- Power-generation forecasting and grid-control technologies capable of stabilizing electricity systems must accompany the high penetration of renewable energy sources. ***Power System Control***

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| ・It is critical to have advanced technologies for detecting and defending against cyber threats to power networks and enhanced infrastructure resilience. ***Cybersecurity*** |
| Deployment Challenges to Be Resolved |
| ・Market rules must ensure transparency and fairness in peer-to-peer (P2P) electricity trading. ***Operating Rules***<br>・Rules for the use of distribution networks that accommodate the widespread deployment of distributed energy resources must be developed. ***Operating Rules***<br>・Shared-utilization models should be created to enable participation by individuals and organizations that face difficulties installing energy generation or storage facilities themselves. ***Digital Inclusion*** |

## A Resilient and Adaptive Society

## (8) A Society With Sustainable Food and Agriculture Systems



- Data from households, restaurants, producers, and distribution networks is interconnected by 2050, enabling food supply and demand across the entire city to be optimized in real time. Production and distribution are adjusted based on inventories and consumption trends, resulting in an efficient system in which food waste is minimized.
- In the agricultural sector, AI systems and robots automate operations from planting through harvest, enabling optimal production based on weather conditions, soil characteristics, and demand forecasts. Production plans linked to highly accurate demand forecasting ensure stable supplies with neither surpluses nor shortages.
- In distribution and retail, automated orders and deliveries based on inventory levels and sales forecasts are commonplace, allowing fresh food from outside the city to be brought in efficiently. In addition, plant factories and alternative food production facilities have become widespread within cities, establishing a stable food supply that is less vulnerable to the impacts of climate change. An integrated system connecting production and consumption creates a society in which people have safe, sustainable dietary choices.

### Potential Benefits

- Optimizing production, distribution, and inventory management significantly reduces environmental impacts and food loss. ***Food Loss Reduction***
- Personalized meals and nutrition improve health and overall quality of life. ***Wellbeing***
- Demand-responsive production and distribution enhance supply stability and overall supply-chain efficiency. ***Supply-Demand Balance***

### Possible Risks

- Continuous collection of dietary and health-related data may raise concerns regarding privacy infringement. ***Privacy Infringement***
- Increasing automation may alter employment structures and lead to the gradual loss of skills traditionally held by farmers and culinary professionals. ***Employment Structure Transformation***
- System failures or cyberattacks may disrupt food production and supply chains. ***System Dependency***

### Technical Challenges to Be Addressed

- Highly accurate crop growth forecasting and production optimization technologies must be capable of responding to climate change. ***AI Utilization, Data Sharing***
- Real-time demand forecasting and supply-control technologies should respond dynamically to fluctuations in supply and demand. ***AI Utilization, Data Sharing***
- Recognition and manipulation technologies for general-purpose agricultural robots will need to operate properly even in challenging environmental conditions. ***General-Purpose Robots***
- Standardization technologies and systems for food traceability and quality management are required. ***Quality Management***

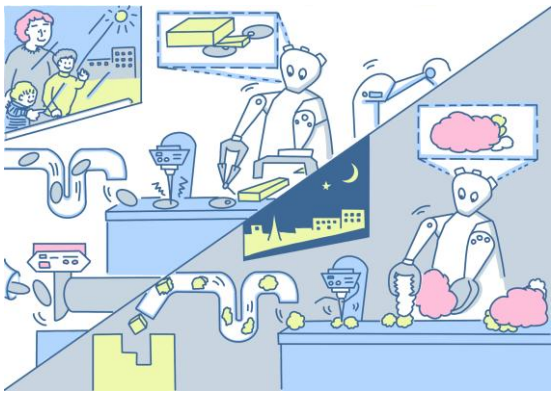
### Deployment Challenges to Be Resolved

- Data governance frameworks must clearly define how food and health data is used and offer consent management. ***Data Governance***

- New food safety and hygiene standards suited to automated production, food preparation, and distribution systems should be developed. ***Operating Rules***
- Shared infrastructure and implementation support mechanisms are needed to enable participation by small-scale farmers and food-service providers. ***Digital Inclusion***
- Reskilling programs should be created to support smooth workforce transitions and facilitate adaptation to increasing automation. ***Human Resource Development***

## A Comfortable and Vibrant Society

### (9) A Society With Smart Factories That Respond to Citizens' Needs



- Cities in 2050 have widespread distribution of smart factories powered by AI systems and robots that make products tailored to the needs of each individual, designed and manufactured on demand. Order information is automatically reflected in product design and production processes, allowing highly efficient, precise manufacturing to take place as a routine part of society.
- Production lines are highly modularized, allowing flexible switching between a wide variety of products, small-lot production runs, and different manufacturing purposes. During disasters, production can be rapidly redirected toward medical supplies and daily necessities, so manufacturing systems serve as a foundation for urban resilience.
- Factories are interconnected through network infrastructure and information regarding operational status, inventory levels, and production capacity is shared in real time. If one facility is forced to suspend operations, production is automatically reallocated to other locations, ensuring stable supplies across the city as a whole.
- Automation has significantly reduced hazardous work, allowing people to focus on advanced decision-making, process improvement, and other high-value-added activities. In addition, factories are open to local communities as places for education and observation, strengthening connections between industry and citizens and fostering an inclusive and vibrant industrial foundation.

Potential Benefits

- Personalized products can be supplied rapidly through flexible, high-mix, low-volume manufacturing. ***Greater Efficiency***
- Optimization of resource inputs and reductions in inventory help minimize environmental impact. ***Sustainability***
- Reduced exposure to hazardous work and a shift toward higher-value activities improve workplace safety and job satisfaction. ***Wellbeing***
- Data sharing among factories stabilizes supplies and enables rapid responses to changing demand. ***Data Sharing***

Possible Risks

- Advanced automation and autonomous factory operations may reduce local employment opportunities and diminish the accumulation of on-site experience and skills. ***Employment Structure Transformation***
- Disruptions affecting the citywide manufacturing network may result in large-scale interruptions to product supply. ***System Dependency***
- Extensive collection of citizen-demand data may lead to over-monitoring of individual preferences and behavior. ***Privacy Infringement***

Technical Challenges to Be Addressed

- Safe and highly accurate robot perception and control technologies should enable collaboration between humans and robots, with end-effector technologies being capable of flexibly adapting to changing tasks. ***General-Purpose Robots***

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| ・Technology for real-time data sharing among factories and highly accurate digital twins must be developed. ***Data Sharing***<br>・Cybersecurity across manufacturing systems and supply chains must be strengthened based on zero-trust principles. ***Cybersecurity***<br>・Technologies for automated design and production optimization have to enable high-mix, low-volume manufacturing. ***AI Utilization*** |
| Deployment Challenges to Be Resolved |
| ・Rules governing design and production data sharing across companies should be established. ***Data Governance***<br>・Mechanisms to support workforce transitions through skills conversion and reskilling programs must be created. ***Human Resource Development***<br>・Operating frameworks must be designed to ensure humans remain involved in supervision, decision-making, and continuous improvement, even in fully automated environments. ***Human in the Loop*** |

## A Comfortable and Vibrant Society
## (10) An Inclusive Digital Society Where Older Adults and Diverse Talent Can Thrive



- In the cities of 2050, AI systems that support older adults and people with disabilities have been widely adopted. Safeguards and support are woven naturally into everyday life. Those who need it can have their health condition observed continuously, and if anything seems amiss, the information can be shared with healthcare providers, caregivers, or family. As a result, people can live independently with peace of mind.
- At work, AI systems suggest a working style that best fits each person's abilities, circumstances, and preferences. Remote work, flexible hours, and project-based roles have become the norm. All individuals are able to participate in society and work in ways that play to their individual strengths, regardless of childcare responsibilities, caregiving obligations, or disabilities.
- The metaverse is an established platform for work, allowing people to carry out tasks and manage facilities remotely without geographical constraints. Advanced multilingual support also lets people from different backgrounds and countries collaborate seamlessly. Creating value through diversity is now part of daily life.
- Digital technologies are deeply embedded in everyday activities, education, and social interaction, fostering connections that transcend generations and geographic boundaries. An inclusive and vibrant society has been realized in which everyone can contribute through roles suited to their abilities and experience while maintaining meaningful relationships with their communities.

### Potential Benefits

- Healthcare, caregiving, and employment-support services are optimized, enabling personalized social services tailored to the circumstances of each individual. ***Personalization***
- Flexible opportunities for work and social participation throughout different stages of life promote overall happiness and contentment. ***Wellbeing***
- Shorter commutes and less need for travel lower personal burdens and environmental impacts while contributing to regional economic revitalization. ***Sustainability***

### Possible Risks

- A lifestyle centered on online interactions may weaken face-to-face relationships and reduce the vitality of local communities. ***Social Isolation***
- Biases in data and algorithms may result in certain groups being treated unfairly or placed at a disadvantage. ***Digital Bias***
- Differences in access to devices and communication infrastructure may widen disparities in service availability and use. ***Digital Divide***

### Technical Challenges to Be Addressed

- Highly reliable data integration and data sharing platforms that connect healthcare, welfare, and employment systems must be established. ***Data Sharing***
- Technologies that accommodate diverse users must be developed, including multilingual support and visual and auditory assistance. ***Interfaces***

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| ・Edge-processing technology is necessary to ensure privacy protection while enabling advanced digital services. ***Confidential Data Processing, Privacy Protection*** |
| Deployment Challenges to Be Resolved |
| ・Mechanisms that allow individuals to decide the extent to which AI systems may be used and how their data may be shared must be provided. ***Operating Rules, Human in the Loop***<br>・Social participation should be encouraged through a combination of device provision programs, digital literacy support, and hybrid models that integrate both in-person and online engagement. ***Digital Inclusion***<br>・Rules that support flexible work arrangements must be developed, including greater transparency regarding minimum protections and evaluation criteria for part-time, short-term, and gig-based employment. ***Operating Rules*** |

## 2-4 Common Benefits and Impacts Across the Future Scenarios

In the 10 future scenarios presented in Section 2-3, digital technologies such as AI systems, sensors, and robots have permeated not only cyberspace but also the physical world. This has resulted in a vision of the future where social systems that have long depended on human labor and experience are transformed into efficient, sustainable systems that continuously predict and optimize operations on their own, improving wellbeing in ways that suit every individual.

But at the same time, depending on how these new technologies are introduced into society, they could also give rise to social problems such as digital bias, system dependency, privacy infringement, and the digital divide, in addition to potential disruptions to urban functions.

Realizing a prosperous future requires weighing not only the benefits but also the negative impacts and challenges that must be overcome. Figure 7 summarizes major negative impacts that are common in the 10 future scenarios developed for a digital society and the corresponding technical and deployment challenges that should be addressed.

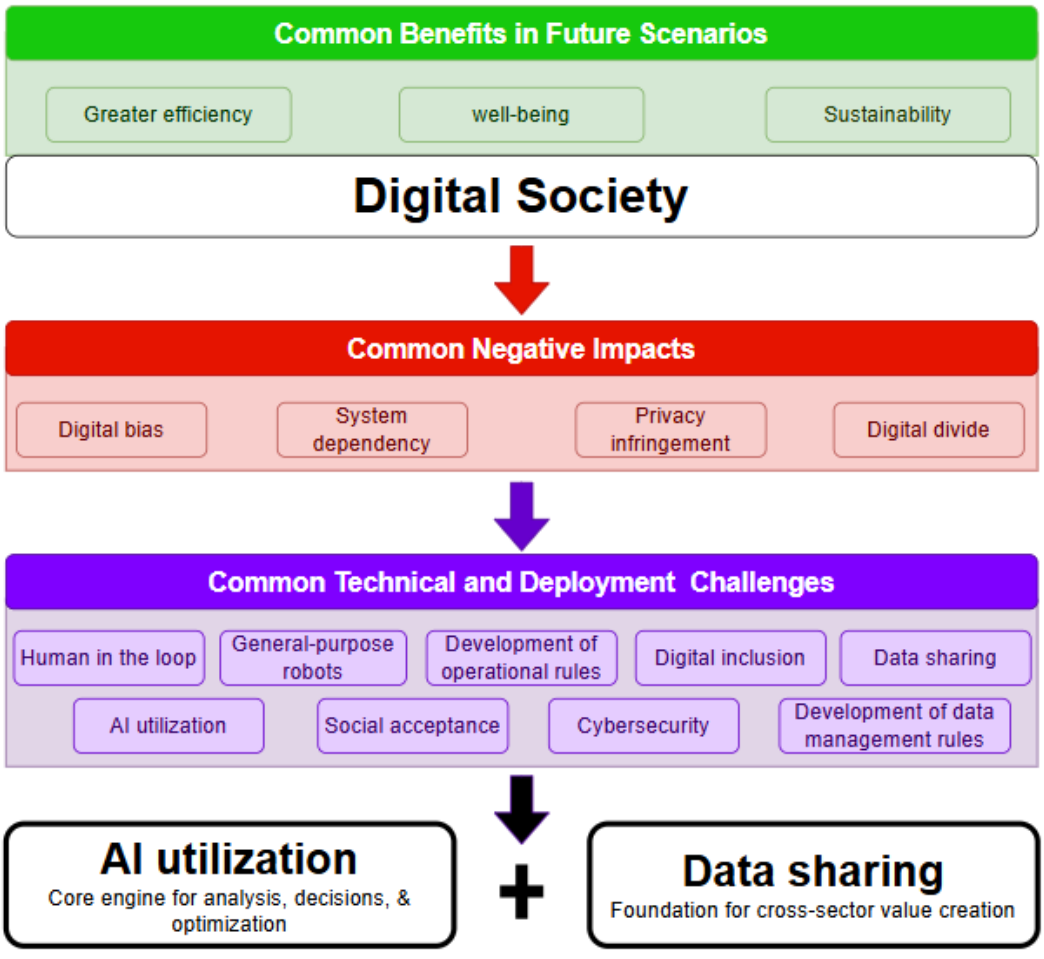



**Fig. 7: Summary of common benefits, impacts, and challenges in the future scenarios**

The following section provides an overview of the principal negative impacts and challenges that commonly appear in the 10 future scenarios. A review of the 10 future scenarios identifies four recurring negative impacts: digital bias, system dependency, privacy infringement, and the digital divide.

- Digital bias: the risk that AI and data analysis outcomes may be influenced by preferences for specific attributes or historical data and lead to unfair decisions or discriminatory treatment. The impact increases as AI plays a greater role in decision support for public services, healthcare, mobility, and other fields.

- System dependency: system failures and cyberattacks have greater impact as society becomes more digitalized. The loss of human judgment and experience may also reduce response capabilities during emergencies.

- Privacy infringement: integrating and analyzing data from various sensors and services may contribute to pervasive surveillance or inappropriate use of personal information.

- The digital divide: differences in digital skills and access environments can widen inequalities across regions, generations, and income groups. Even if advanced services become available, their value to society as a whole will remain limited if some people cannot benefit from them.

Because these negative effects are not specific to individual future scenarios but are structural impacts common to many, avoiding them requires building cross-cutting social foundations and governance frameworks that function across multiple scenarios.

A review of the technical and deployment challenges also identifies recurring issues with AI, which we group under the following keywords: AI utilization, fair algorithms, explainability, AI robustness technologies, human in the loop, and general-purpose robots. Data-related issues include data sharing, confidential data processing, data governance, and cybersecurity. The principal common challenges are summarized below.

- AI utilization is foundational for analyzing a variety of data and enabling prediction, optimization, and decision support. AI can address issues that conventional human judgment and control alone cannot, such as operating complex social systems and providing services tailored to diverse needs.

- Fair algorithms and explainability ensure that AI-based analysis and decisions are impartial and transparent. AI decisions must not be biased against particular attributes, and users and operators should be able to understand the basis for them.

- AI robustness technologies and having a human in the loop ensure reliability and safety when AI is deployed in society. AI is used for predictions and decision making in fields with significant social impact, such as transportation, disaster management, and healthcare, so systems must operate stably even under abnormal or unforeseen conditions. In areas affecting life and liberty, there should always be appropriate human oversight and involvement in final decisions.

- General-purpose robots are needed to execute the results of AI-based analysis and decisions in the physical world. In future scenarios such as infrastructure maintenance, disaster response, agriculture, and manufacturing, simply analyzing collected data is not sufficient. It is also necessary to act on the physical world based on the results of that analysis. This requires general-purpose robots that can flexibly adapt to diverse conditions and autonomously perceive environments, make decisions, and manipulate objects.

- Data sharing is a foundational issue when data held by different stakeholders in different sectors is used to create new value. Advanced services and social systems in smart mobility, healthcare, disaster management, and energy require cross-sector data sharing. Because AI performance depends heavily on the quality and volume of data, this sharing is also essential for advanced AI utilization.

- Confidential data processing and data governance must be employed to achieve safe, sustainable data sharing. As future scenarios increasingly use sensitive data such as health and location information, secure processing technology and rules that clarify permitted uses and management responsibilities are essential.

- Cybersecurity is a foundational challenge for any digital society. As social infrastructure and public services become more sophisticated, automation through AI utilization and system interconnection through data sharing will expand; therefore, every effort must be made to minimize the effects of cyberattacks and unauthorized access and ensure the reliability of the social system as a whole.

- Digital inclusion and social acceptance are important deployment challenges. If the benefits from AI-enabled and data-driven services are only seen by some, the digital divide may widen. Deployment will also stall if concerns or distrust remain regarding data sharing and AI-based decisions. We must accommodate a variety of users and foster broad social understanding.

Overall, many of the technical and deployment challenges common across the scenarios can be organized under the themes of “AI utilization” and “data sharing.” These are comprehensive,

foundational issues that would support multiple future scenarios and are central to realizing a digital society. Chapter 3 therefore focuses on the roles and challenges of AI utilization and data sharing.

# Chapter 3: Toward Realizing a Digital Society

## 3-1 Common Challenges to Be Addressed

AI is a core technology that supports value creation and predicts and avoids risks across all fields through advanced decision making and greater operational efficiency. Its utilization therefore directly affects the feasibility of all future scenarios. Data sharing enables information to be integrated and used across sectors and organizations and provides a foundation for new services and social systems.

Because both AI utilization and data sharing are foundational issues supporting a diverse range of future scenarios, understanding trends and challenges in these areas is important to gain a comprehensive view of the direction of a digital society as a whole.

### 3-1-1 AI Utilization

A review of the future scenarios reveals a society in which AI utilization underpins social foundations, integrating, analyzing, and combining a variety of data in real time to forecast the future with high accuracy. Using its results to choose the best approach and make decisions will fundamentally transform the way we react and respond, which today is often ad hoc, intuitive, and reliant on individual expertise. AI will also make it possible to anticipate events and act in advance, informed by lessons learned from past experience. As a result, the future visions that emerge show society as a whole advancing in terms of efficiency, labor-saving solutions, and optimization.

As shown in Figure 8, this AI utilization process can be broken down into the following four stages:

1. Collection of data through sensors and other devices
2. Analysis by AI
3. Decision making by people or AI
4. Action by people, AI, robots, or other actors

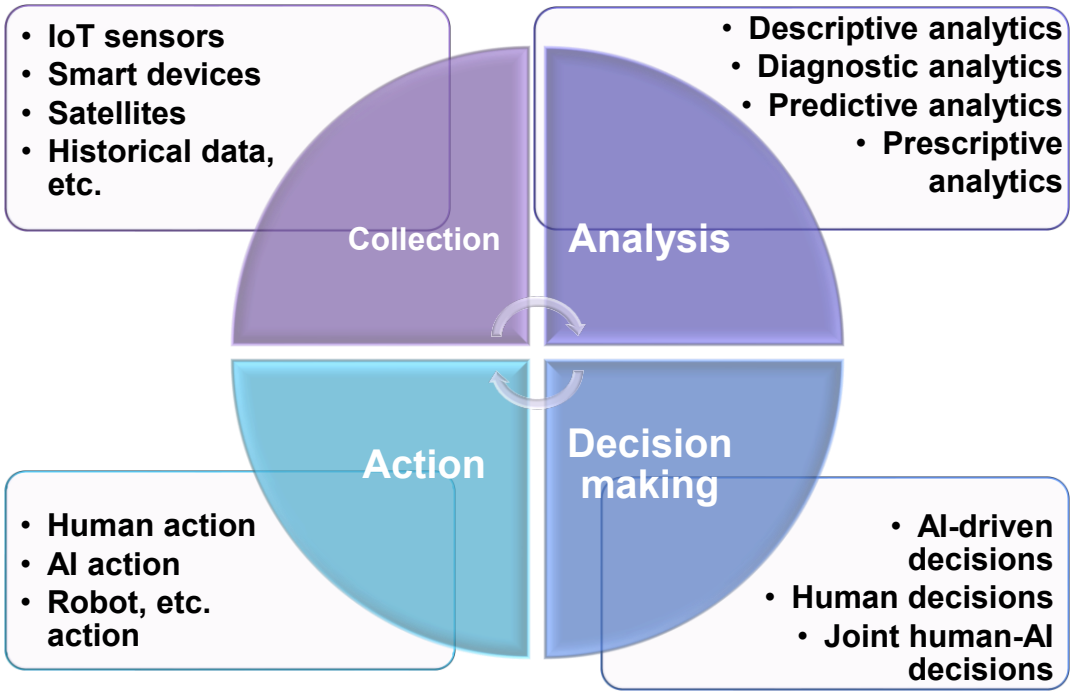



**Fig. 8: AI utilization process common to the future scenarios**

We also envision a system in which the results of actions themselves are sensed, and as this cycle repeats on a platform that integrates cyberspace and the physical world, society should be able to detect and address problems early, optimize resource allocation, and improve services.

The following discussion examines in greater detail stages 2 and 3, which directly involve AI. For stage 2, analysis by AI, Gartner defines four levels of analytics maturity:[8]

(a) Descriptive analytics: What happened?

(b) Diagnostic analytics: Why did it happen?

(c) Predictive analytics: What is likely to happen?

(d) Prescriptive analytics: What should be done?

As analytics progresses from (a) to (d), the technical difficulty rises, but this higher level of maturity is necessary to lay the groundwork for realizing the 2050 scenarios. To ensure transparency, trustworthiness, and inclusion at the same time, it will also be important to use analytical methods that are impartial and equitable for all citizens, including fair algorithms and methods for correcting data bias.

For (3), decision making by people or AI, the guiding principle is “human in the loop,” with people making decisions at critical points. In practice, however, drawing the line between what people should decide and what to leave to AI is difficult to determine when deploying such systems. Designing this boundary requires consideration of the following factors:

- Magnitude of impact, including the effects on life and human rights and the scale of potential economic losses
- Uncertainty and prediction error, covering the breadth of the prediction range and robustness to changes in assumptions
- Degree to which decisions involve social values, including criteria that cannot be determined solely on the basis of numbers
- Accountability and responsibility, including whether decisions can be explained to citizens and legislative bodies

These factors, together with explainability and social acceptance, must be considered comprehensively when determining whether decisions should be fully automated by AI, shared between people and AI, or made solely by people.

[8] https://www.gartner.com/en/topics/data-and-analytics (Accessed August 2026)

### 3-1-2 Data Sharing

Deploying and utilizing AI in cities as described here presents many data sharing challenges, like the fact that in many organizations, incompatible interdepartmental systems and siloed data stand in the way of integration. When AI is introduced sector by sector, the benefits tend to be confined to efficiency gains and workforce reductions within those sectors. Value creation and market potential remain modest. Consequently, economies of scale are difficult to achieve, and in many cases it is challenging to monetize services sufficiently to recover initial investment and operating costs.

Creating new value through AI analysis and establishing sustainable business models require more than data sharing and optimization within individual sectors. Cross-sector data sharing and ecosystem development must take place so that data and services from multiple sectors can connect and build on one another. Cross-sector data sharing has the potential to generate substantial synergies in urban services. It can create new value by combining heterogeneous data and improve productivity by repurposing and reusing data.

Existing systems cannot be disregarded when advancing cross-sector data sharing. A practical approach is to build individually optimized connections within each sector from the bottom up, gradually widen the scope of sharing and integration, and ultimately move toward the desired system architecture. As the scope expands, it is important to recognize that wide-area services such as mobility require coordination not only within a city but across multiple cities (Figure 9).

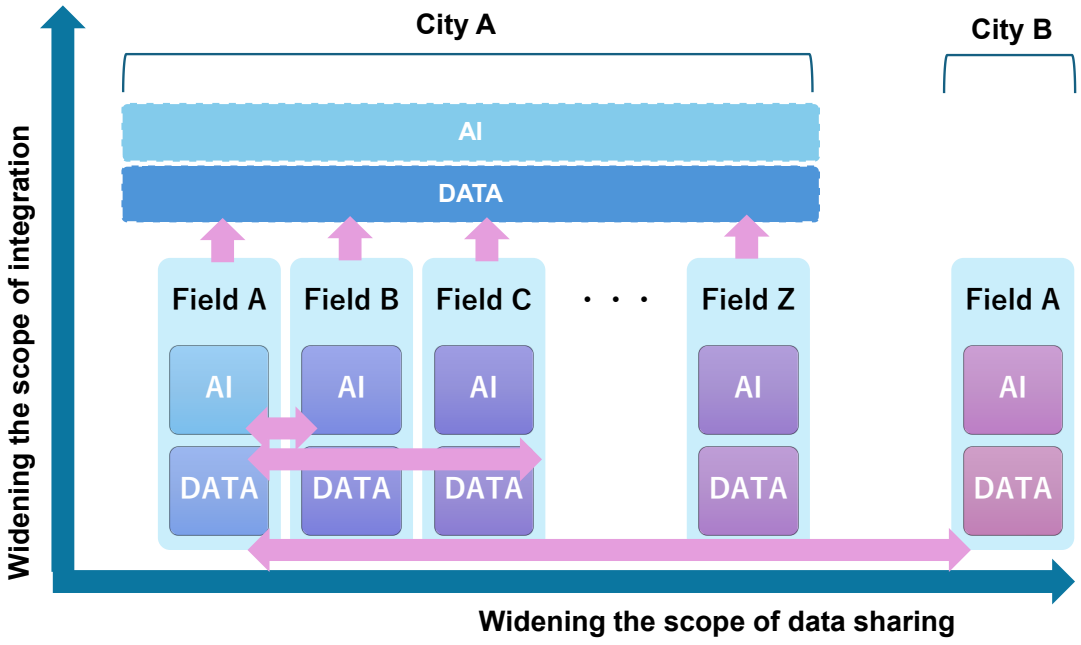



**Fig. 9: Expansion of data sharing and AI utilization systems**

Although the potential synergies of data sharing are understood in principle, data sharing has not advanced sufficiently in practice. Concrete operational challenges include uncertainty regarding who should bear the cost of preparing and providing data, new burdens that arise from the need to coordinate different data formats and specifications across sectors and organizations, and concerns about data leaks and privacy infringement. Stakeholders who regard data as a source of competitive advantage or revenue may also be concerned that providing data could diminish their own value or allow others to use it without compensation. This encourages data hoarding and creates a structure in which the significance of cross-sector data sharing is understood but incentives to provide data remain weak (Figure 10).

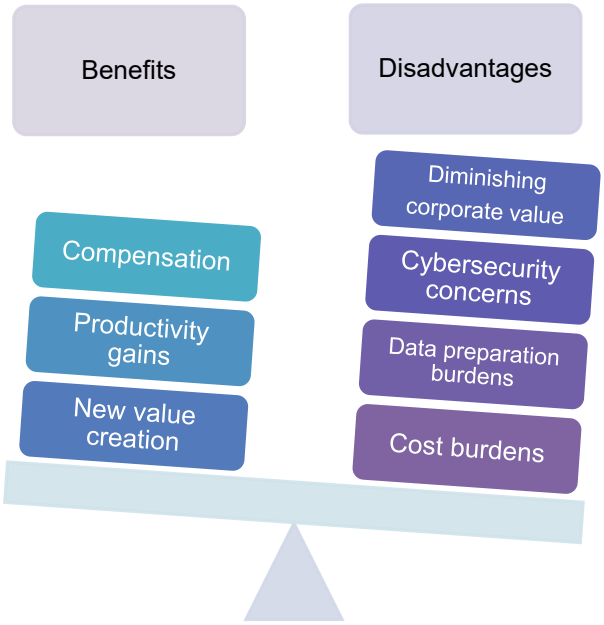



**Fig. 10: Practical benefits and disadvantages of data sharing**

In summary, while AI utilization is a hurdle that must be overcome in order to realize a digital society, enhancing its effectiveness requires establishing foundations for the other main challenge: data sharing. The next section examines a concrete ecosystem for realizing a digital society, specifically, what types of data sharing foundations (digital services) can create value through AI utilization.

## 3-2 Examining an Ecosystem to Address Challenges

### 3-2-1 Approach to Ecosystem Development

A digital-service ecosystem built on data sharing is more than a mechanism for aggregating and publishing data. In such an ecosystem, data that is collected, integrated, and shared feeds AI-based analysis, prediction, and optimization to create digital services with new value, allowing data, value, and compensation to circulate sustainably among stakeholders (Figure 11). For such an ecosystem to function, the roles of three groups must be clear: data providers, digital service providers, and digital service beneficiaries. Furthermore, each group must have a clear incentive to take part.

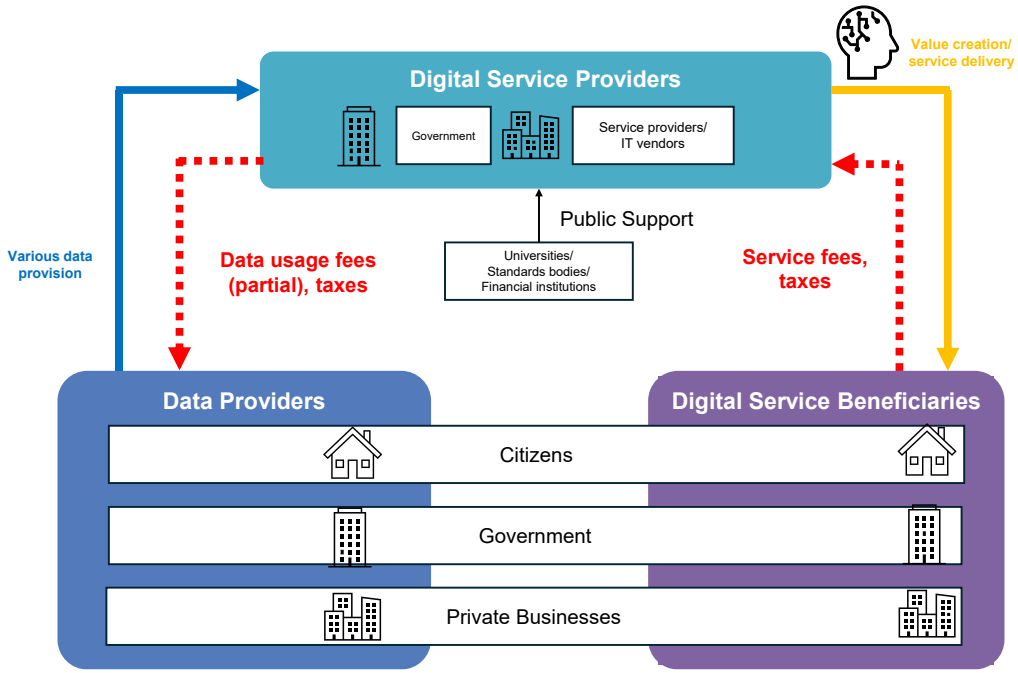



**Fig. 11: Approach to developing a digital service ecosystem built on data sharing**

- Data providers: diverse actors including citizens, public authorities, infrastructure managers, transportation operators, electric utilities, and private sector businesses. The data these stakeholders possess is generated through business activities and daily life and often stays locked within each organization. Within the ecosystem, the standardized, anonymized, and securely-managed provision of this data to external parties provides a starting point for new value creation. In return, data providers should receive value such as a share of data usage fees, improved service quality, or greater operational efficiency.

- Digital service providers: public authorities, private service providers, and IT vendors. These stakeholders combine multiple datasets and add value through analysis, visualization, and prediction to create and provide services that respond to social challenges and user needs.

- Digital service beneficiaries: coming from society as a whole, this group includes citizens, public authorities, and private sector businesses. They receive value in the form of greater convenience, lower costs, increased sales, or improved safety through services paid for by usage fees or taxes. When compensation is returned to data providers through service providers, or when the value created is shared with them, they continue to be incentivized to provide data.

Building a relationship in which each of these three groups recognizes tangible value is the key to establishing the ecosystem as a sustainable social foundation rather than a temporary initiative.

### 3-2-2 Examining an Ecosystem Using "Future Scenario 5, Smart Mobility" as a Case Study

This section illustrates how a cross-sector ecosystem begins to operate, amplifies value, and reduces costs. Since covering every sector in detail here is impractical, we use "Future Scenario 5, Smart Mobility," as a concrete example. Readers can adapt this template to the sectors and local conditions most relevant to their own region when envisioning an ecosystem.

The following section maps the flows of data (blue arrows→), value (yellow arrows→), and funds (red arrows→) in smart mobility services among users, local governments, service providers, technology infrastructure providers, and operations management (Figure 12).

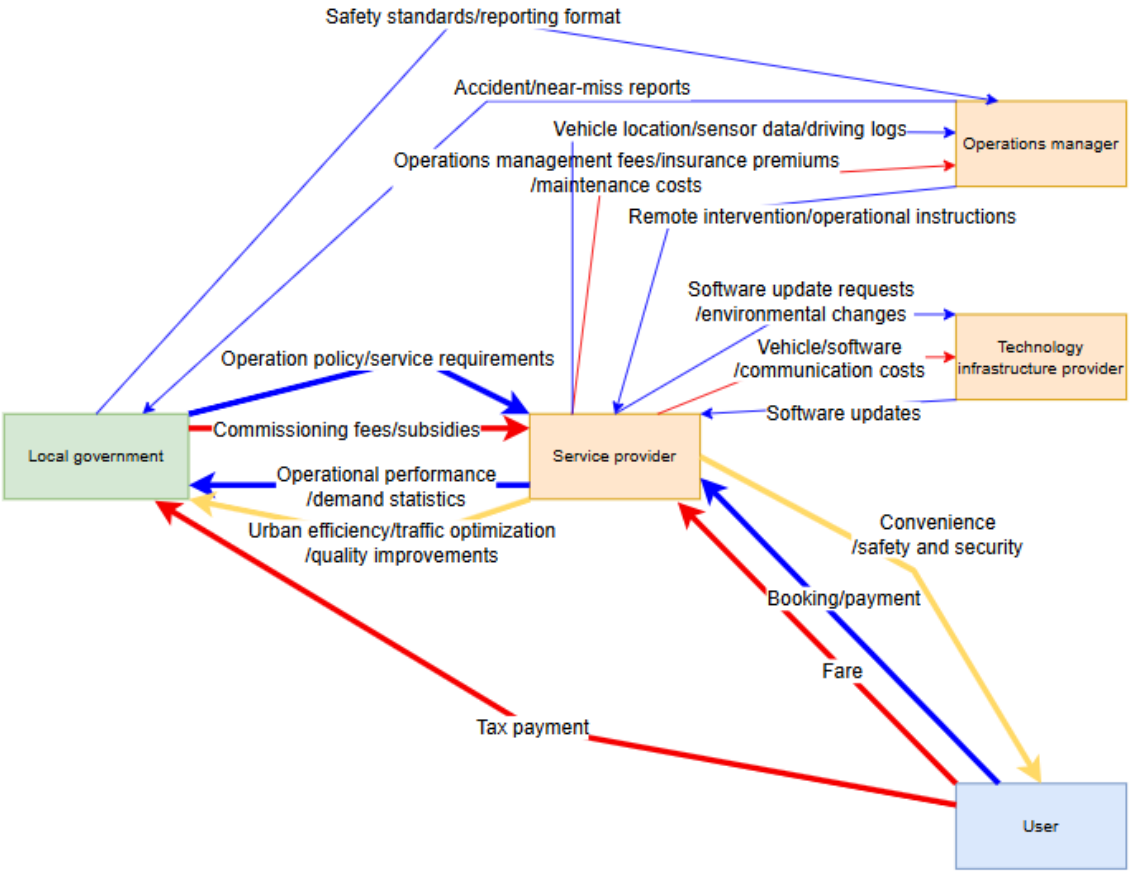



**Fig. 12: Smart mobility deployment ecosystem**

In a smart mobility services ecosystem, users' booking, payment, and ride data (boarding and alighting), together with vehicle sensor data and driving logs, are aggregated by service providers and used for operations planning and safety management. Operations managers remotely monitor vehicles and issue intervention instructions, while technology infrastructure providers update software and maintain communications environments. Local governments support the overall service through operating policies, contracts, and subsidies.

Under this structure, however, data sharing is largely limited to operations and safety management. As a result, costs—of operating and maintenance, fleet renewal, communications, and data preparation—are each incurred separately, which limits gains in cost effectiveness.

Addressing this limitation requires the same data to be extended to and shared across other sectors, including infrastructure management, cleaning and beautification (Future Scenario 2), as well as efficient logistics (an element of Future Scenario 8).

Figure 13 shows how value is amplified when data acquired through smart mobility services is extended to other sectors. Vehicle sensor data and driving logs obtained from automated vehicles can be repurposed for infrastructure management, cleaning and beautification, and logistics. For example, data detecting road obstacles and surface conditions can be shared across infrastructure management and cleaning and beautification functions to improve the efficiency of repairs, cleaning, and safety.

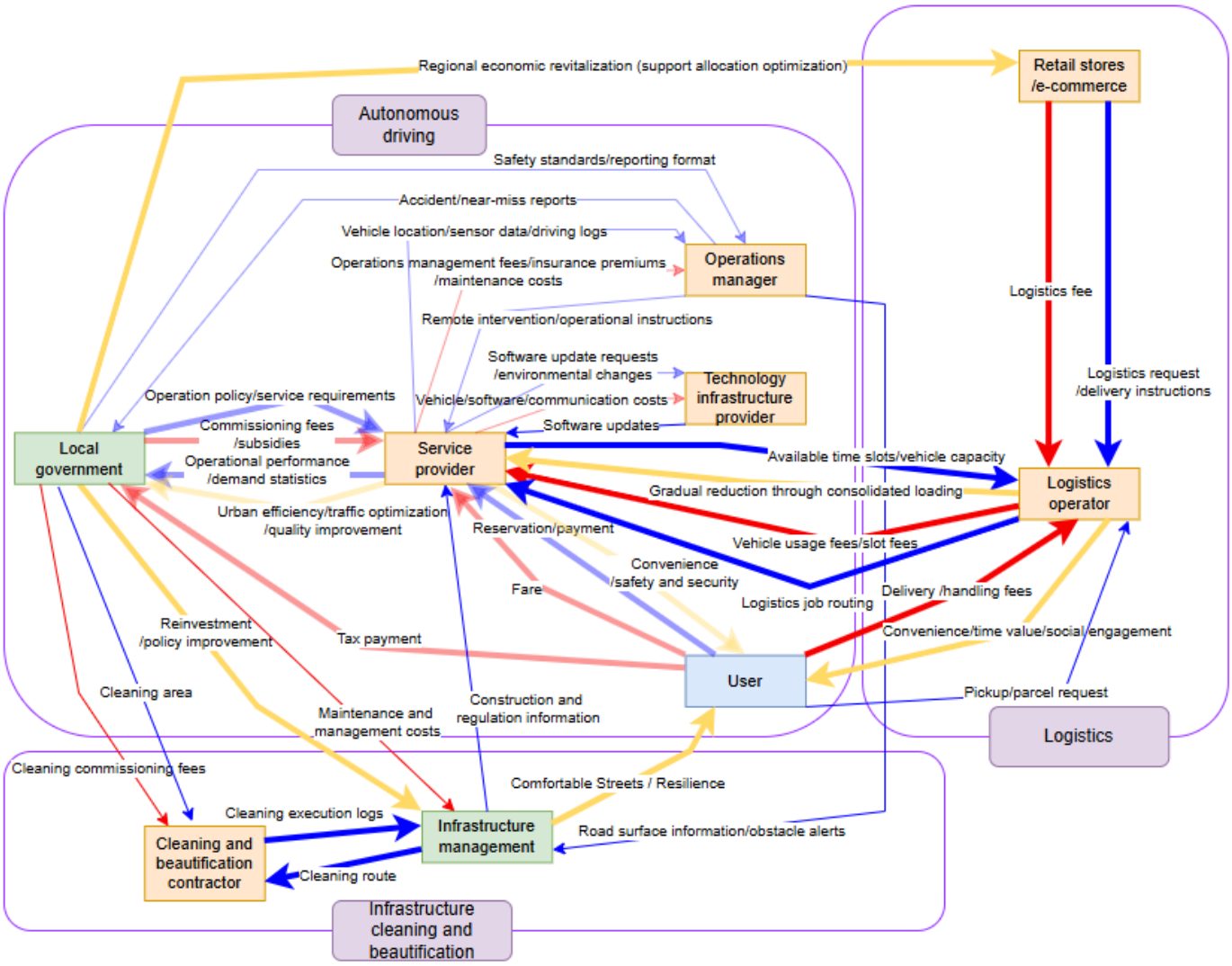



**Fig. 13: Expansion of the smart mobility ecosystem to logistics and infrastructure beautification**

When the same data is extended beyond operations and safety management to multiple activities such as infrastructure maintenance, beautification, and logistics, value can be multiplied while avoiding duplicate data collection. In other words, reusing the data fundamentally reshapes the cost structure. It simultaneously controls costs and increases service value, improving cost effectiveness for each stakeholder and advancing optimization of the ecosystem as a whole.

Increasing the scalability of a cross-sector ecosystem in this manner can also be expected to improve cost effectiveness (Figure 14).

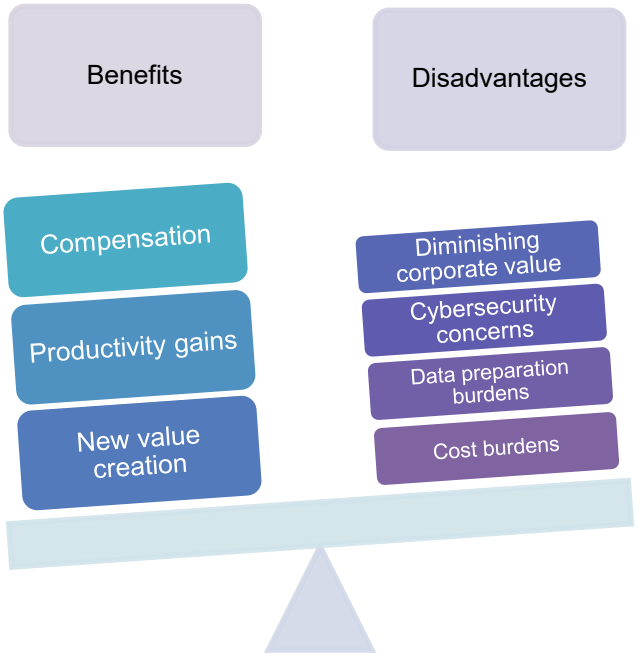



**Fig. 14: Value amplification and improved cost effectiveness through data sharing**

## Conclusion

In this report, we developed future scenarios by focusing on four societal visions: a transparent and trustworthy society, a society where everyone can act freely and safely, a resilient and adaptive society, and a comfortable and vibrant society. These four visions support the realization of a society in which every individual can pursue and achieve their own form of wellbeing. We then reviewed the future scenarios as a whole and identified a range of challenges common to many of them.

Our analysis made clear that AI utilization and the data sharing that underpins it are the foundations that cut across sectors to achieve both value creation and risk management. On that basis, our report explored what an ideal cross-sector ecosystem might look like, assuming it is supported by rules and technologies for the appropriate handling of a variety of data including sensitive personal information. Going forward, realizing value creation through AI utilization and cross-sector data sharing will require not only technological development but also comprehensive efforts that include institutional design and the promotion of social acceptance.

A digital society will not emerge automatically. It will be shaped by the choices and actions we take today. The future scenarios in this report are not meant to offer definitive answers, but rather to provide a framework for exploring desirable directions for the future. NEDO TSC intends to use this report as a reference in developing new projects and to further refine future visions through continued dialogue with diverse stakeholders.

In preparing this report, we received valuable comments and insights from numerous experts who represent companies, universities, and research institutions in Japan and abroad. We would like to take this opportunity to express our sincere appreciation for their cooperation and for the time they generously devoted to this effort.

# TSC Foresight Future Vision

Future Visions of a Digital Society
— A Digital Society That Enables Diverse Wellbeing for Every Individual

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