

Leveraging Emerging Technologies to Overcome Mobility Challenges Caused by Population Ageing: A Case Study of Japan

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Key Points

- ▶ Population ageing is accelerating globally, posing challenges to mobility, a key area where emerging technologies are widely expected to tackle challenges.
- ▶ By analyzing experiences from Japan, this study examines the mobility-related problems, expectations regarding utilizing technological innovations, and implementation barriers.
- ▶ Population ageing in Japan is creating interlinked and self-reinforcing mobility problems.
- ▶ Tensions between strong expectations about technologies and the starker reality confronting them are revealed, and policy implications are considered.

A self-driving bus in Sakai Town in Ibaraki Prefecture, Japan.

Policy Focus

In today's era, population ageing is an accelerating trend affecting all countries, especially in the global north and eastern Asia. The ageing and shrinking population can cause negative impacts on economic growth, medical and fiscal systems, and the socio-economic vitality of communities and cities. Overcoming these challenges is now an important task for technology. With the development of autonomous (self-driving) vehicles and Mobility-as-a-Service (MaaS), mobility becomes a particularly important area where technological innovations are expected to address problems.

Japan, home to the world's most rapidly ageing population, has been testing novel mobility technologies

and services in response to population ageing and shrinkage. This provides an ideal opportunity to observe how emerging technologies can tackle mobility challenges. This policy bulletin introduces a study by G. Trencher et al. (2024) that examines Japan's experiences to address the following questions:

- What types of mobility problems are occurring due to population ageing and decline?
- What are the expectations of key stakeholders about how emerging mobility technologies could mitigate these problems?
- What are the main barriers standing in the way of achieving these expectations?

Study Methodology

The study employs a qualitative approach, utilizing an emergent thematic content analysis. The analysis is based on data from 16 semi-structured interviews with 28 practitioners and researchers, supplemented with documentation from project actors and research organizations. The data was collected between September 2022 and March 2023.

The analysis focuses on the experiences of stakeholders involved in state-supported mobility projects, specifically those using MaaS and autonomous vehicles. Table 1 summarises the goals and typical cases of each innovation.

Table 1 Key models of next-generation mobility services under trial in Japan

Technology	Objective	Description
Mobility-as-a-Service (MaaS)	Carry individuals to a destination (medical facility, shopping district, etc.)	On-demand and shared vehicles provide door-to-door transport service in regional or rural settings, using AI and app-based reservations to optimise route selection and scheduling (location of example case: Maebashi City in Gunma Prefecture).
	Bring vehicle-based services to the individual	Medical MaaS: Vans equipped with medical equipment and a nurse visit elderly persons at the domicile, providing online doctor consultations and a basic medical check-up (Ina City in Nagano Prefecture, Taki Town in Mie Prefecture). Town-hall MaaS: Vans equipped with public administration equipment visit a fixed point in a rural or regional setting, providing services usually conducted in the town hall, such as issuing residence certificates or social security numbers (Iwaki City in Fukushima Prefecture, Shonai Town in Yamagata Prefecture).
Autonomous vehicles	Partially or completely replace human drivers in shared vehicles	Self-driving carts provide on-demand and door-to-door ridesharing services in suburban housing estates (Kasugai City in Aichi Prefecture, Nagano City in Osaka Prefecture). Self-driving buses serve fixed routes in the commercial centre of a regional city according to a pre-determined schedule (Sakai City, Ibaraki Prefecture).

Findings and Analysis

Interlinked Mobility Problems Caused by Population Ageing

Interviews reveal that Japan's ageing and shrinking population is causing mobility problems for three main groups: elderly people, transport providers and municipalities. Figure 1 shows how these problems are connected and self-reinforcing, which collectively exerts a negative impact on the socio-economic vitality of

communities, towns and cities.

Safety risks: The inconvenience of fixed schedules and routes, and downscaled services due to profit losses in public transport mutually causes many people to drive despite their deteriorated physical and cognitive functions, posing potential safety risks.

Reduction of ridership, transport networks and access to mobility: This set of issues are mutual reinforcing, creating a vicious cycle. Besides, barriers to accessing local services hurt the socio-economic health of communities, contributing to the collapse of communities when residents move to larger towns to gain better access to services and mobility.

Driver shortages: The ageing and retirement of drivers leads to driver shortages, which further causes the bus and taxi companies to cut back on service routes.

Deterioration of health and welfare: Exacerbated personal mobility decreases elderly people's opportunities to access essential services and engage in social activities, which negatively impacts their health and well-being.

Expectations about the Potential of Emerging Technologies to Tackle the Challenges

Safety risks: Introduction of autonomous vehicles and MaaS is expected to reduce road accidents by making public transport more accessible and convenient, by integrating on-demand and optimised schedules, and by increasing affordability via ridesharing.

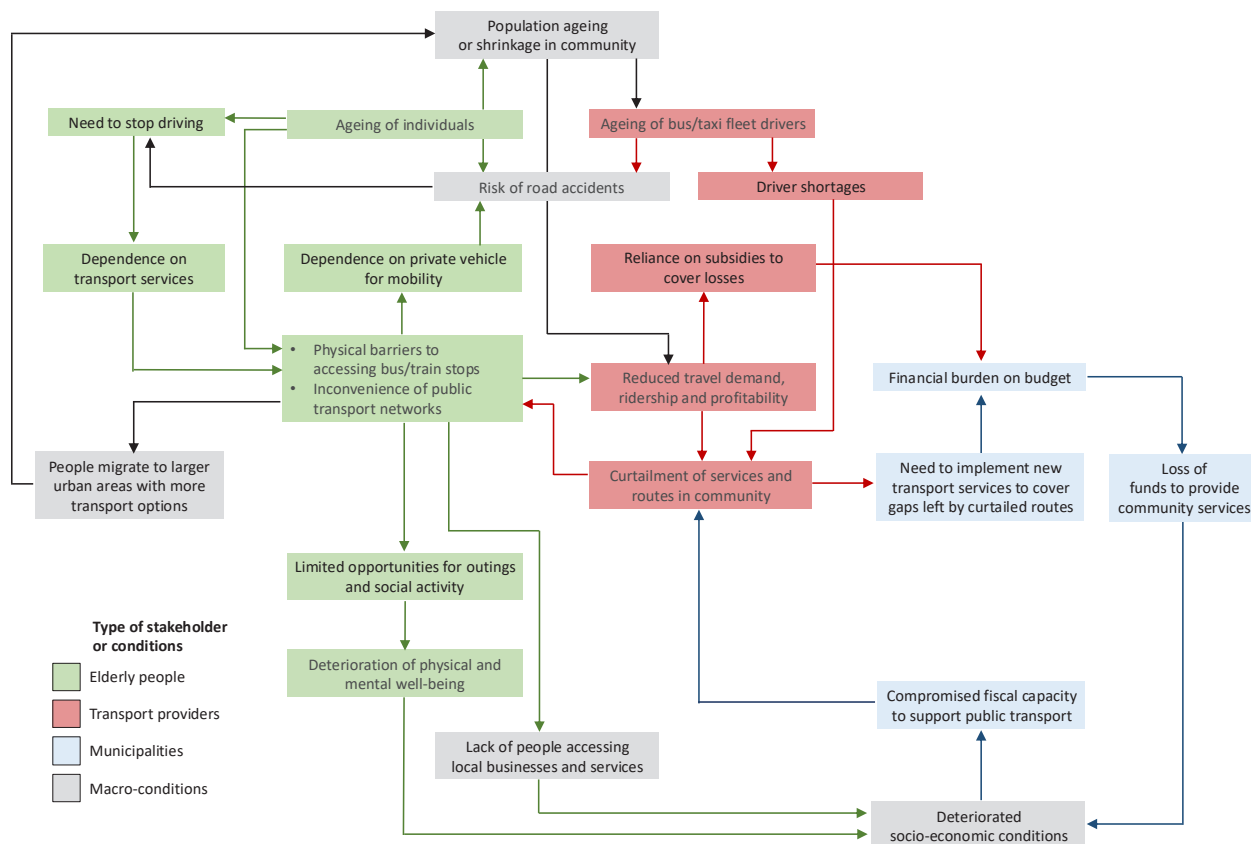
Reduction of ridership, transport networks and access to mobility: Innovations are expected to halt the self-reinforcing cycle, by allowing operators to use data to optimise routes, and utilise autonomous driving to reduce driver-related expenses, and by making it easier for the elderly to access public transport and local services.

Driver shortages: Self-driving technologies are expected to reduce the demand for drivers or alleviate license requirements of drivers.

Deterioration of health and welfare: Respondents expect that emerging technologies will increase chances for outings and socialisation, as well as direct access to medical facilities, thereby contributing to health and well-being.

Socio-economic conditions: It is anticipated that individual health and well-being will accumulate at the societal level, creating healthy and dynamic communities. Meanwhile, improved transportation will increase residents' visits to local businesses and local spending. Some projects also consider that shifting from building-based to vehicle-based town halls or medical services could save money for municipalities.

Figure 1 Mobility challenges caused by population ageing and shrinkage



Barriers to Smooth Implementation and Diffusion

Despite the strong expectations for emerging technologies to tackle mobility challenges, the interviews reveal multiple barriers standing in the way of realizing these expectations, as Table 2 summarises.

Table 2 Core barriers to implementation and diffusion

		MaaS	Autonomous vehicles
Human resources	Lack of human resources and expertise	●	●
	Resistance to change or difficulties in aligning interests	●	●
Organisational	Data availability and use	●	○
	Lack of incumbent automakers driving vehicle innovation and market creation	○	●
Financial	High purchase and operation costs	●	●
	Low profitability	●	●
Societal	Low digital literacy among the elderly	●	●
	Low ridership or uptake of service	●	○
Technological	Inferiority or limitations of solutions	○	●
Environmental	Unique geographic or socio-economic conditions	●	●
Institutional	Restrictive laws, regulations and institutions	●	○
	Legal responsibility in case of accidents	○	●

Note: ● indicates barriers with a strong obstructive impact; ○ indicates barriers with weaker or no impact.

For example, as for human resources, there are not enough experts who can lead mobility innovation projects especially in rural areas, drivers and volunteers, as well as maintenance staff for the intricate technologies. Also, the high purchase and operation costs, including the costs of remote monitoring and cloud-based data systems, further increase the financial burdens on municipalities, who are seeing declining fiscal capacity due to population ageing. Low IT literacy among elderly people is another major obstacle to the implementation and upscaling of emerging solutions.

Recommendations

Pay Closer Attention to Negative Impacts of Population Ageing on Innovation

The study reveals that the shared expectations among industry and government stakeholders about the potential of emerging technologies to solve complex challenges caused by population ageing are stimulating the development and implementation of innovations in transport. However, population ageing can also impede innovation, since a society's resources and creativity – including workers, cognitive and financial capacity, and the willingness to adopt new practices – can shrink as the population ages. Researchers and policymakers interested in the development and implementation of emerging technologies should be aware of these potentially negative impacts of population ageing.

Consider Low-cost, Low-risk and Easy-to-implement Solutions

From Japan's experiences, the study identifies obstacles in applying emerging technologies to address problems caused by population ageing. Governments and transport planners should consider low-cost, low-risk and easy-to-implement solutions with lower reliance on expensive or unproven technologies. For example, instead of solely promoting costly new technologies such as autonomous vehicles, AI-based ridesharing or on-demand mobility, a low-risk and practical approach would be to adjust laws and regulations to encourage business model innovations using existing resources. These include private vehicles and taxis as well as existing vehicle-fleets and personnel used to shuttle the elderly to local facilities.

Policy Implication to China

China can learn valuable lessons from the findings of the study due to its similar ageing experience. First, China should assess its unique regional mobility issues, focusing on both urban and rural needs. Adopting low-cost, easy-to-implement solutions, as seen in Japan, can provide immediate relief without heavy financial burdens. Leveraging existing resources and fostering partnerships among government, private sectors, and communities is crucial for effective implementation, particularly for increasing the effectiveness of emerging technologies like autonomous vehicles as a means of coping with the consequences of population ageing. Additionally, addressing barriers like low IT literacy among the elderly will enhance technology adoption. By integrating these insights, China can create tailored mobility solutions that genuinely support its ageing population and promote social and economic vitality.

Main Reference

Trencher, Gregory, Masaru Yarime, and Jeongsoo Yu. "Using emerging technologies to tackle mobility challenges caused by population ageing: Experiences from Japan." *Technological Forecasting and Social Change* 208 (2024): 123729.



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