Chapter 1 Cities and transportation

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1.1 The dynamics of urbanization and the role of transportation

Cities change with the passage of time, moving from growth to decline. To make an analogy with human life, cities pass from periods of childhood to adolescence (urbanization), young adulthood to middle age (suburbanization), and into old age (disurbanization). However, cities also expect a fourth phase not comparable to human life, one of reurbanization.[1] The form of urban transportation changes with the growth phase of the city, and the role of urban transportation changes as well according to the life cycle of the city as shown in Figure 1.

The role of transportation demanded in the urbanization phase is the carrying of large numbers of people into the city, for example by railways. During suburbanization, the emphasis is on moving people quickly over long distances. In the latter half of the suburbanization phase, the increasing development of low-density suburbs shifts the predominant modes of transportation toward private automobiles. Later in the disurbanization phase, increased spread of low-density urban areas (urban sprawl) causes a decline in public transportation created on the premise of mass transport, further increasing the dependence on automobiles. Many Japanese cities are still experiencing the effects of disurbanization (urban decline), but some cities are trying to proceed to the reurbanization stage. The role of transportation in this fourth stage is, in contrast to that during the suburbanization stage, connecting areas of agglomeration within the city at short distances and moderate speeds, and promoting interconnectedness between these areas of agglomeration.

The heavily automobile-dependent United States has been often called a “suburban nation.”[2),3)] However, the spread of road infrastructure and automobile use during the 20th century made it the “suburban era” for many countries worldwide. Those looking to escape from problems caused by increased urban density due to increasing populations looked to suburbs as a kind of utopia that would provide a wealthier countryside lifestyle, resulting in the mass production of largely uniform residential and commercial suburban development all over the world. Artificially planned suburbs with decentralized and individualistic lifestyles were supported by freedom of movement for private car owners, and later changed form into widespread sprawl development. This exacerbates the problem of automobile

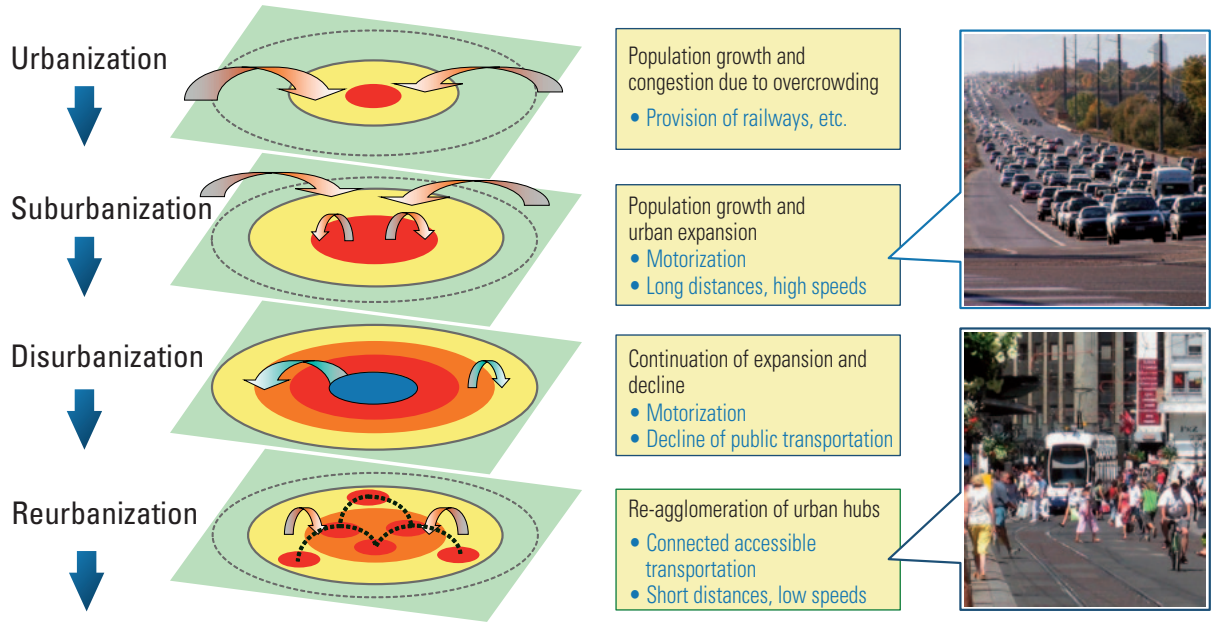


Figure 1. The urbanization process and the changing role of transportation

dependence, creating a negative synergistic effect between motorization and suburban sprawl.[4)]

The root of such urban and transportation problems is, in short, that our thinking regarding the role of transportation has halted at the suburbanization phase, considering that the goal of transportation must be "long distances, high speeds." We must evolve our thinking to the reurbanization phase, where the goal is rather "short distances, low speeds."

1.2 Mobility and accessibility

Mobility is generally defined as the ability to move, and according to Ota[5)] represents "the degree of freedom of general individual movement with no regard to specific destination." In contrast, accessibility refers to "the ability to perform demanding activities through movement to desired destinations." The word "accessibility" is also widely used in fields such as geography and transportation studies. Specifically, the word can also be defined to mean the ease of reaching destinations and opportunities such as workplaces, shopping, and medical services, or the ease with which one can make use of them. In recent years, accessibility and usability have come to be a

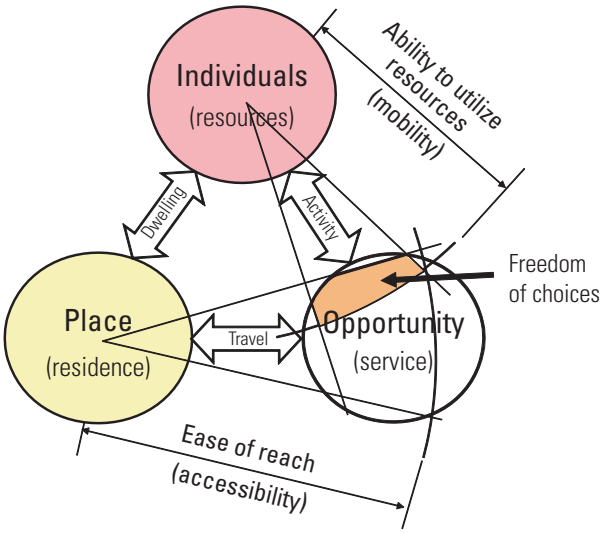


Figure 2. The relation between mobility and accessibility[6)]

central concept in ideas in universal design.[7)]

Figure 2 shows the relationship between mobility and accessibility in a schematic form for a single individual. Here, mobility is considered as the ability of an individual to make use of resources (time, money, external support and assistance, as well as environmental factors, etc.) through movement, and accessibility as ease of reaching essential opportunities and services. The perspective of mobility captures the degree of human-centered freedom of choices, while that of accessibility captures the degree of place-based freedom as relating to the places that attract people. Our overall freedom of choices is determined by both mobility and accessibility.

1.3 Urban travel speed and safety

At the national level, emphasis should be placed on fast mobility to connect cities and hubs at high speed by the latest technologies, including a maglev Shinkansen and a logistics Shinkansen for the country's high-speed rail network. On the other hand, slow mobility for enjoying excursions and interactions at a safe and comfortable speed should be emphasized for personal and social reasons at the local level. Rigid differentiation of travel speed according to location is required for achieving sustainable transportation as well as increasing the attractiveness of cities.

In Japan, which is experiencing the problems of population decline and super-aging of society, large-scale shrinking of cities is required from the perspective of national land and urban management. However, such severe constraints can also serve to foster creativity that can break through the impasse and lead to co-evolution of transportation, urban, and social developments. The development of "shrinking cities" to achieve sustainability and the development of "creative cities" to increase competitiveness are strategies that are two sides of the same coin, and the realization of both will require a reconfiguration of the bonds between the elements of people, knowledge, goods, services, money, and time. Mobility is the key to doing so. As mentioned in Section 1.2, mobility refers both to freedom of movement and ability to make use of resources.

Building a mobility system for cities that are both sustainable and highly competitive will require a multifaceted understanding of the value of mobility, along with the formation of a hierarchical network, consisting of a fast mobility layer that connects cities and hubs at high speed and a slow mobility layer within cities and hubs that promotes excursions and interactions at low to medium speeds. Slow mobility refers to means and forms of transportation at near-human speeds. But why is such distinction between speeds necessary?

A negative aspect of motorization is its standardization of travel speed. Whether in towns, suburbs, or between cities, most automobile drivers pursue speed. The desire for "long distances, high speeds" mentioned in Section 1.1 is ever-present, whether one is inside or outside of urban areas.

The pursuit of speed regardless of places results in uniform expansion that impairs the hierarchy of urban spaces. The result is longer daily trips to work and school, increased energy consumption for transportation, increased production of CO_2 and local environmental load, and even threats to life due

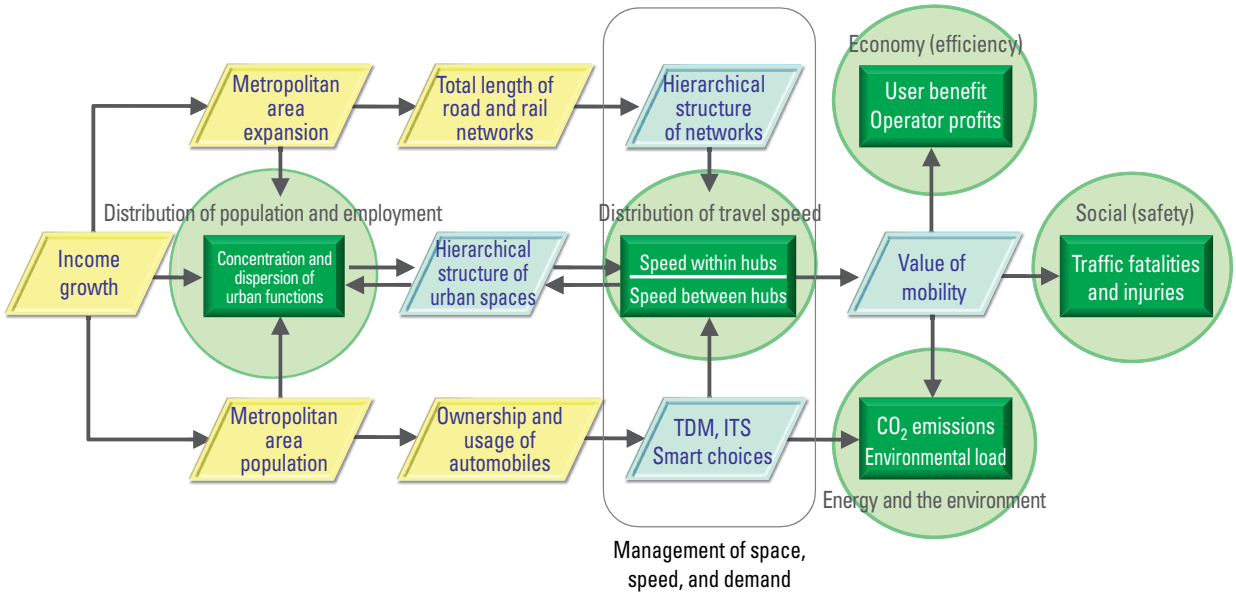
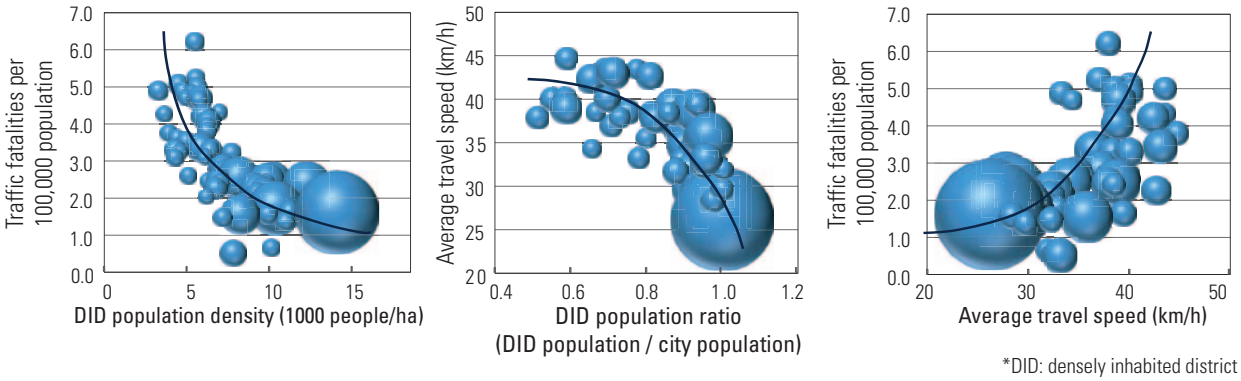


Figure 3. A causal relationship regarding the value of mobility and travel speed as the key factor

to increased risk of injury or death in a traffic accident (Fig. 3).

Figure 4 shows the relationship between urban population density, automobile travel speeds, and rates of road traffic deaths between 2008 and 2010 for 65 regional core cities with a population over 300,000 inhabitants in Japan. Bubble size in the figure represents the population of the city. From Fig. 4 (a), one can clearly see that the rate of traffic fatalities increases with lowered urban density. Considering that this relationship may vary between cities due to differences in the development level and usage rates of urban public transportation, we focused on only automobiles and analyzed the relationship between population distribution and average automobile running speed for intra-city travel, as well as the relationship between average travel speed and traffic death rate. As the results in Figs. 4 (b) and (c) show, we found causal relationships in which the more two-dimensionally dispersed a city was, the higher its average automobile travel speed, and the higher the average travel speed, the higher the traffic death



(a) Population density and road traffic death rate (b) Population distribution and average automobile travel speed (c) Average travel speed and road traffic death rate

Figure 4. Urban population density and distribution versus average automobile travel speeds and rates of road traffic deaths

rate.[8] These results consider only the relationship between density, speed, and safety, so in the future there is a need to analyze the effects of travel speed on society, the economy, and the environment, while keeping in mind the causal relationships indicated by Figure 4.

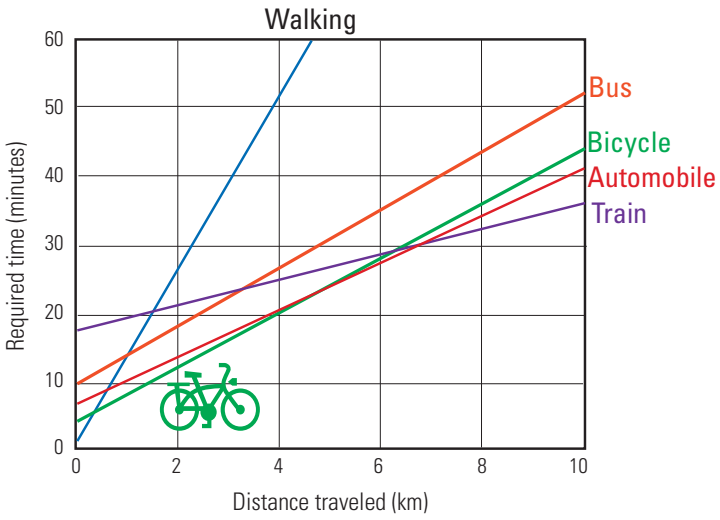


Figure 5. Comparison of travel times by transportation mode for intra-city travel

One result of increasingly slower movement speeds in urban areas and pursuit of the merits of slow mobility is the cycling revolution currently spreading in Europe. As shown in Figure 5, for trips up to around 5 km bicycles have a quicker travel speed than do automobiles and trains, and as is well known in Japan bicycles serve as an excellent, efficient and fast transportation mode within cities. The cycling revolution in London is famous for results such as its cycle superhighways and cycle hire (bike-sharing) scheme, but the social background and events leading up to this realization is rich in lessons. A series of socioeconomic factors such as soaring fuel prices starting around 2002, the introduction of in-town road pricing in 2003, and subway and bus terrorist attacks in 2005 are some of the influences that led people to use bicycles for their travel needs.

1.4 Aging and travel needs

As humans age they experience changes in physiological functions, reduced physical ability, reduced cognitive characteristics, and other changes in psychology and awareness that cause a decline in movement ability (Fig. 6). Figure 7 shows some of these mental changes that accompany increased age and result in changes in travel needs.

In particular, the elderly place less weight on the time and cost aspects of travel, and more weight on travel that is safe, secure, and beneficial to health and the environment. When this is displayed as a ternary plot showing the positioning of various modes of transportation, the travel needs in an aging society show a clear shift up and to the right, representing a shift toward demand for medium- to

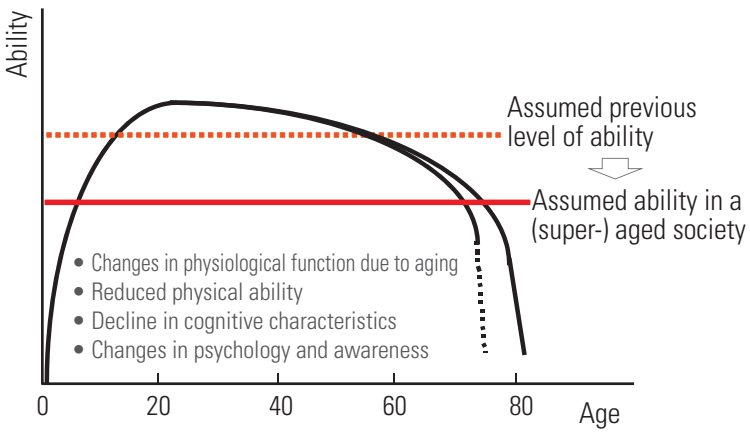


Figure 6. Changes in human ability accompanying age

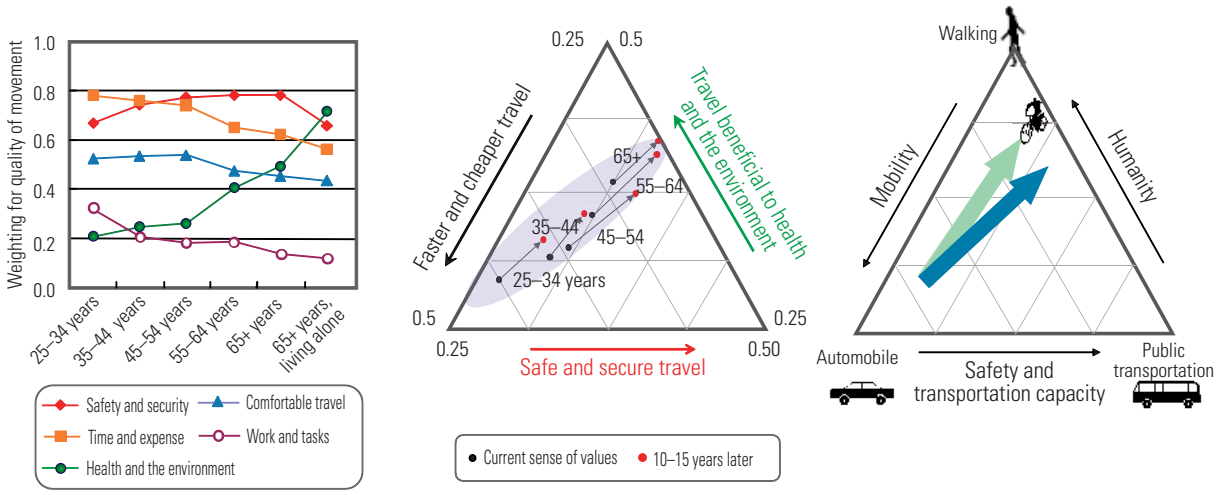


Figure 7. Changes in travel needs accompanying aging[9), 10)]

low-speed "slow mobility" that is located in the position between public transportation and private transportation. This is the position associated with transportation modes such as next-generation LRT systems, low-speed electric community buses, community cycles, and other forms of shared personal mobility.

Building the mobility system for a sustainable city will require a bold outlook on making these changes, and enhanced safety is the starting point of the change process. Doing so will require making decisions on the priorities for and extensive management of speeds of road transportation. Efforts to achieve the harmonious coexistence of humans and automobiles through reducing speeds can be seen in European speed management programs such as the establishment of the "Zone 30" measure, which establishes establish a 30 km/h (20 mph) zone. In recent years there have been increased efforts toward retaining comfortable space via improved road design that attempts to change driver behavior in ways that reduce their running speed. There has also been a worldwide trend toward promoting "walkable cities," which allow residents to walk to places necessary for daily life. These are some examples in which human-centered prioritization has been established as the guiding principle for road and urban space design.

1.5 Integrated design of cities and transportation

The term "integrated transportation" came into common use in the latter half of the 1990s. It goes without saying that a unified perspective is needed when developing transportation policy. The most important point is that one performs not an additive unification, but an integrated approach that combines diverse aspects into a whole. There are four levels in a desirable integrated transportation system:

1) *Operational integration*: integration of public transportation services, fare structures, and operation information
2) *Strategy integration*: integration of policy instruments for the infrastructure, management,

information provision, and pricing between different transportation modes

3) *Policy integration*: integrated policies for transportation and land use; integrated policies between transportation divisions and divisions for other areas such as the environment, health care, social welfare, education, and disaster prevention
4) *Organizational integration*: integration of the various organizations and institutions that are responsible for transportation

Of the above, integrated transportation and urban design largely correspond to item 3), policy integration. In compact cities aiming for sustainability, as well as in transportation systems developed considering the needs of an aging society, addressing each of these in isolation will result in diminished effects. The expansion of cities seen in the twentieth century resulted from increased motorization and road development extended to far-reaching suburbs, in addition to population growth pressures. At a minimum, therefore, it is imperative to perform policy design of integrated transportation and urban development.[11), 12)]

Figure 8 shows some of these integrated design concepts and procedures. The figure illustrates the relation of the four domains of city, infrastructure, mobility, and society; mobility is centrally located and is positioned as a system in which public transportation and personal mobility measures complement each other. "Road diets" refers to a method for creating space for pedestrians, bicycles and other medium- to low-speed personal transportation modes by reducing the number and/or width of roadway

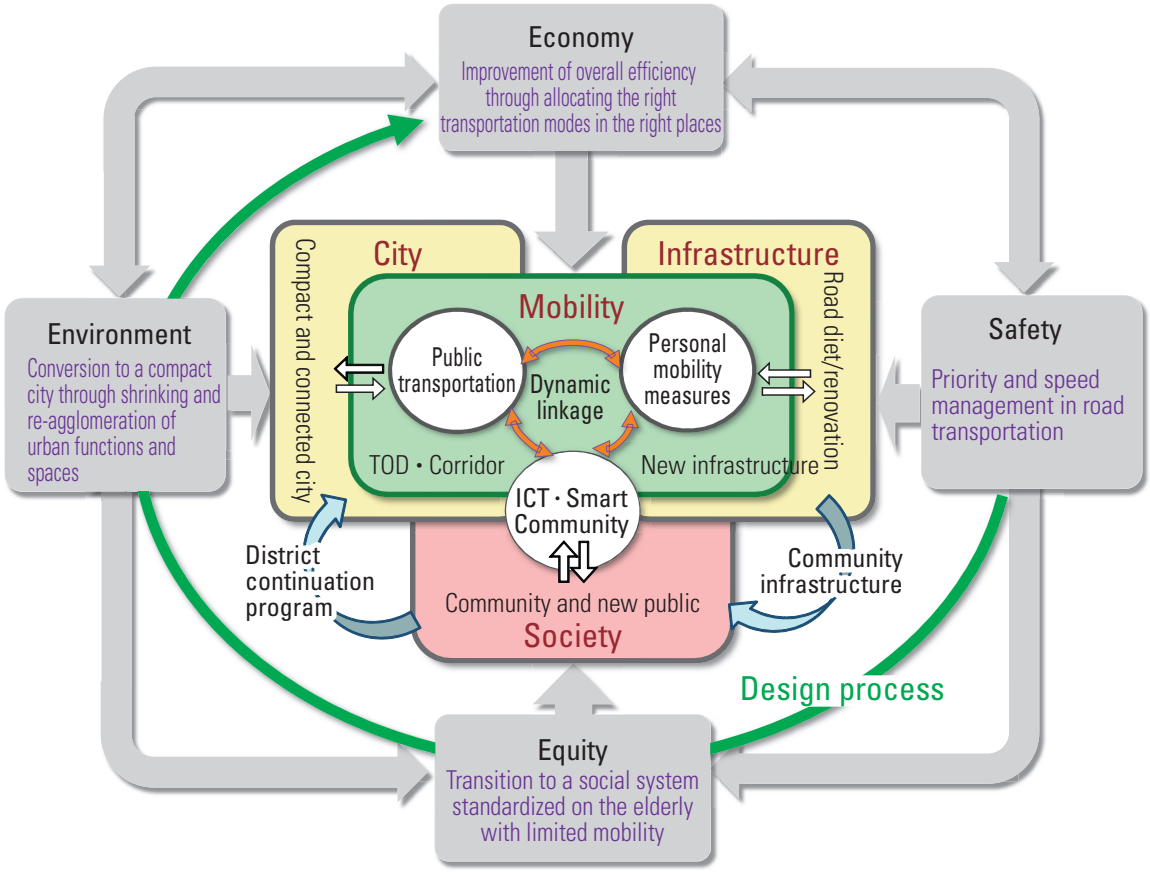


Figure 8. Integrated design of cities and transportation

lanes. This allows existing roads renovated with an emphasis on the usability of road spaces by a broader range of users, and has already been implemented in many countries. In addition, transit-oriented development and corridor development are methods of supporting public and shared transportation from a land use aspect. Detailed discussions of these are presented in chapter 2.

As the design process loop in the figure shows, priority-based road space allocation and strict speed management to secure traffic safety are the primary pursuit, and they result in the ability to render social systems standardized on the elderly in which universal design can assist in providing increased accessibility. Also promoted is a conversion to compact cities in which urban functions and spaces are more aggregated. When these conditions are met, regional public transportation becomes sustainable, and the strategy of "allocating the right transportation modes in the right places" will lead to improved overall efficiency. Implementing a mobility revolution will be impossible without holistic perspectives that clearly prioritize management of speeds (slowness) and spaces (compactness), as well as time management that harnesses the opportunities and threats of external shocks and constraints, converting these to revolutionary force. In Japan, there are continued trends for neglecting the global optimization in transportation policy; public transportation policy is still being discussed in isolation, and slow mobility modes such as bicycles are positioned merely as local solutions without intermodal integration.

In a future of increasingly harsh economic and financial conditions, it will be difficult to improve the quality of mobility in a super-aged society without meeting prerequisites of priority, slowness, and compactness (PSC). Quality of mobility refers to social usability for users with diverse needs. Moving beyond the physical, physiological, and ease-of-use levels of today's "usable" mobility systems to a higher level in which one psychologically wants to use the system will require a revolutionary process that emphasizes PSC.

The view of linear growth that aims at an American- or European-style society has become less effective.[13] Nevertheless, we find it difficult to abandon such concepts of growth in our pursuit of a future mobility society. This is why our thinking on the role of transportation comes to a halt as described at the beginning of this chapter. The development of a mobility society best suited to ourselves will require consideration of not only technologies and systems, but also culture and ethos.

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Practical application projects for reference
A land utilization framework and transportation system for declining population: 132–135
Quality of mobility required for super-aged cities: 136–139