For more efficient use of existing road stock
– Key lies in accumulating and using data–

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1. A historic turning point

Japan's social infrastructure development is undergoing a historic paradigm shift, and the road sector is no exception. The systems and environments involving roads are changing enormously; earmarked funding for roads has been converted to general funding, budgets vastly reduced, the Road Structure Ordinance devolved to regulations, expressway toll measures revised, subsidies converted to grants, and so on. Essentially, the fundamental role of a road is a universal one that transcends time and space. While remaining cognizant of this fact, the issues to be resolved will also of course change, in line with socio-economic conditions and changes in public opinion, the development of science and technology, etc.; policies and the R&D that support them must also adapt to the new era. Amid harsh limiting conditions, creative ideas in various organizations and aspects have become even more important, and it is surely vital that we apply reliable technology to support the efficient implementation of policy issues, in particular.

Amid these recent changes to limiting conditions and policy needs, "effective use and appropriate maintenance of existing stock" could be cited as one major issue. And the key to resolving this issue is "continuously and efficiently accumulating, updating and analyzing data". This paper will introduce some of the initiatives for R&D in the Road Department, in line with this perspective.

2. Integrated analysis of road traffic data

When carrying out measures to reduce traffic congestion or manage traffic demand as means of making effective use of existing stock, it is difficult to achieve this with road traffic censuses held only once every five years, and even then only on one typical day. Locations need to be selected and countermeasures proposed after comprehensively ascertaining, accumulating and analyzing hourly fluctuating traffic volumes and traveling speeds for the whole country's trunk roads. To this end, we are pursuing the following research with a view to obtaining, accumulating, calibrating, supplementing, and finally using various traffic data such as OD traffic volume, cross-sectional traffic volume and traveling speeds.

1) Efficient methods of obtaining traffic data
- Techniques for estimating traffic fluctuation over a wide area using a traffic volume constant observation system
- Techniques for using probe data and other ITS data to obtain traveling speed data, etc.

2) Methods of standardizing and accumulating traffic data
- Methods of standardizing positional data, data headings, etc., and methods of electronic delivery

3) Techniques for calibrating and supplementing traffic data
- Methods of supplementing data in unobserved sections and time zones
- Techniques of reverse-estimating OD traffic volume using traffic volume data

4) Methods of computing evaluation indices, etc., using traffic data
- Congestion-related indices (aggregation of lost hours, etc.)
- Indices related to time constancy (time reliability, etc.)
- Indices related to traffic demand (vehicle kilometers traveled by type of vehicle, etc.)

Our aim is to be able to evaluate the effects and priority levels of individual locations subject to congestion measures by using detailed and highly reliable congestion-related indices, achieve qualitative evaluation from the user's viewpoint by using time constancy indices, and ascertain traffic demand fluctuation on national trunk roads in real time by using traffic demand-related indices.

3. Improving traffic safety

In 2009, traffic accidents resulted in 4,914 deaths, the number falling below 5,000 for the first time in 57 years. However, this is still an unacceptable figure, and the new administration has set the target of halving road deaths by 2018 and achieving the safest road traffic environment in the world. Improving traffic safety is synonymous with improving the quality of existing stock, and is one of the most important policies.

On trunk roads, priority measures are effective in sectors with a high rate of accident occurrence. As with congestion countermeasures, we will need to select locations for implementing measures, propose measures, evaluate their effects, etc., while continuously accumulating data on traffic accidents and the implementation of safety measures. To this end, we are pursuing the following research aimed at upgrading techniques for analyzing the current status of accidents, efficiently obtaining data on accidents and hazards, and analyzing the effects of countermeasures, among others.

1) Expanding techniques for ascertaining the current status of hazards and upgrading analytical techniques
- Techniques for analyzing and ascertaining the current status by driving experiments involving eye-mark recorders and video data analyses
- Methods of using private-sector drive recorder information to glean the present status of hazards

2) Upgrading techniques for selecting safety measures
- Techniques for building a safety measure database, improving accuracy when evaluating the effects of safety measures, and evaluating composite measures
- Establishing techniques for factor analysis based on driving experiments, etc., in locations where the cause of accidents is difficult to ascertain

We aim to tackle research that will not only enhance the effects of traffic safety policies amid severe budgetary constraints, but will also promote understanding and trust in various regions and in public opinion. This will be done by making it possible to select effective countermeasure locations based on the present status of each location, as well as increasing the reliability of countermeasure effects and making it possible to ascertain and express these quantitatively.

4. Towards "preventive conservation" and "total optimum"

Japan, as a mountainous archipelago, has a road network supported by a vast complex of road structures, including more than 150,000 bridges and 9,000 tunnels. There have been repeated reports of serious deterioration and damage to these structures in recent years. This is the result of aging, compounded by harsh natural conditions not often found in other developed nations (earthquakes, typhoons, torrential rains, heavy snow, tidal waves, etc.). Establishing conservation measures for these structures is therefore an important task.

To prevent accidents and terminal damage due to the deterioration of structures, we need to carry out accurate inspections, diagnosis, etc., and accumulate data, correctly analyze and ascertain the nature of the deterioration or damage based on the accumulated data, and carry out appropriate repair, reinforcement or preventive conservation measures based on the results of highly reliable prognosis. Roads also have to function as networks, and when assessing structures or implementing countermeasures, we need not only to optimize in units of individual structures, but also to optimize the content of countermeasures, their timing and sequences, etc., for whole groups of structures. This could also be seen as an important perspective in terms of achieving the maximum investment effect amid budgetary and other constraints.

To this end, we are pursuing the following research aimed at gaining an accurate grasp of the status of individual structures, more correctly evaluating their performance, and evaluating whole groups of structures with a view to the total optimum.

1) Techniques for accurately ascertaining the status of structures
- Techniques for optimizing the system of inspections
- Techniques for prognosis on the status of deterioration, etc., of structures

2) Techniques for more correctly evaluating the performance of structures
- Techniques for estimating the load resistance performance of structures subject to deterioration and damage
- Techniques for estimating the effects of repair and reinforcement

3) Techniques for evaluating whole groups of road structures
- Techniques for quantitatively evaluating the maintenance status of groups of road structures

Our aim is to achieve a balance between reducing lifecycle cost and improving the reliability of road services. We will do so by supporting a shift from post facto conservation after carrying out remedial countermeasures for individual structures, to strategic preventive conservation based on the latest data and high-precision prognosis.

5. The role of "roads" as universal entities transcending time and space

As it happens, the city of Nara is now celebrating the 1,300th anniversary of the establishment of the Heijo capital there. Roads were part of the core infrastructure supporting the birth of the nation at Nara and its subsequent glory. The "Takeuchi Kaido" was a regional trunk road that could be called the very first National Route in Japan. "Taishi Michi" was an access road that supported the project to build the Ikaruga Palace. "Kami-tsu-Michi, Naka-tsu-Michi and Shimo-tsu-Michi" (Upper, Middle and Lower Roads) were urban planning roads to assist area demarcation, and "Yamanobe-no-Michi" (Mountainside Road) was a domestic road that linked settlements on the shores of Lake Yamato. These ancient Nara roads provide conclusive evidence that the fundamental roles and valuable nature fulfilled by "roads" are universal ones that will always transcend time and space. Encouraged by this irrefutable evidence, we would like to tackle research and development with a view to providing a robust response to all kinds of change.