

# **MANAGEMENT OF OVERSIZED/OVERWEIGHT VEHICLE OPERATIONS USING INFORMATION TECHNOLOGY**

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## **ABSTRACT**

Oversized/overweight vehicles sustain the distributing system in Japan, despite imposing some serious problems. The operation of these oversized/overweight vehicles, due to their weight and size, generally needs clearance from road administrators, although 70% of them are in violation (non-permission or illegal operation). Of these, overweight vehicles inflict a significant impact in terms of road maintenance. In view of the fact, the appropriate control and the management of oversized/overweight vehicles needs to be addressed. One of the potential solutions to this problem is advancing information technologies. This paper outlines an oversized/overweight vehicle monitoring system and discusses the impact on the control and management of these oversized/overweight vehicles.

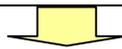
## TECHNICAL PAPERS

### CURRENT STATUS IN THE ASPECT OF THE LAW ON OVERSIZE/OVERWEIGHT VEHICLES

Vehicle transport sustains today's economic activities in Japan. About 90% of freight tonnage is transported by vehicles, which represents 50% in tonnage-kilometer. However, the majority of this vehicle freight in tonnage –about 76%– is carried by oversize/overweight vehicles, which is equivalent to 82% in tonnage-kilometer. The ownership of oversized/overweight vehicles of more than 20t exceeds 300,000 units and the size of vehicles is increasing. Thus the use of large-sized vehicles is being promoted.

Any roads being designed should be intended to serve a certain level of vehicle (a designed vehicle) in order to secure safe and smooth operations

[Road Structure Ordinance]



The limits in the features of vehicles are stipulated to regulate vehicle operations.

[Vehicle Limitation  
Ordinance[0]]

Example of stipulated limits

• Tonnage :

A single unit (a vehicle other than trailer[0])

25 t (expressway and specified road[0])

20 t (road other than the above mentioned)

Trailer

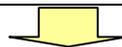
36 t (expressway)

27t (other than expressway)

• Axle load (load on an axle) : 10 t

• Vehicle height : 3.8 m

• Vehicle width : 2.5 m



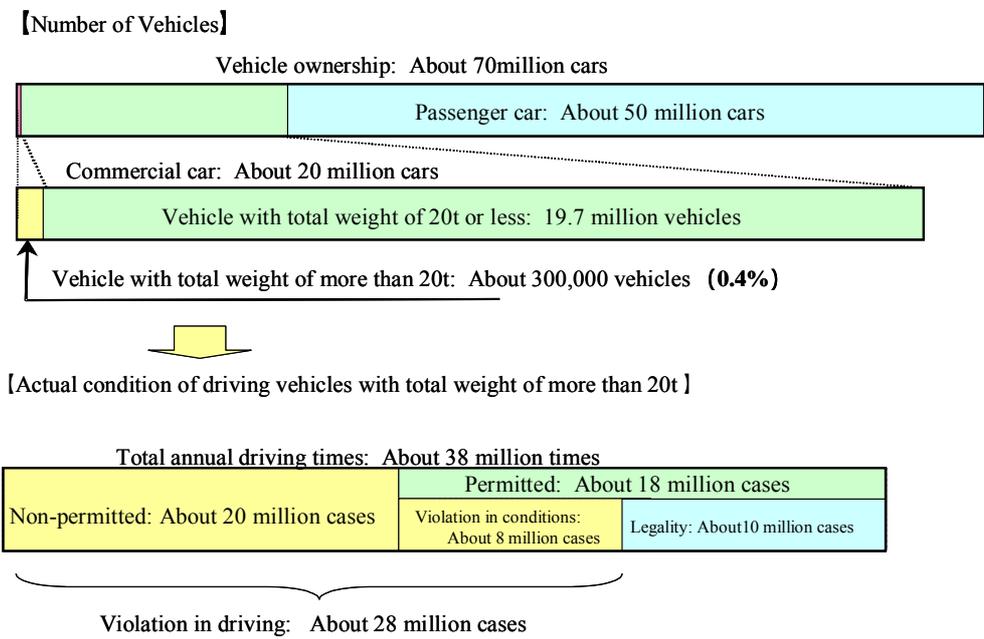
Note that if a vehicle exceeds any of these limits for inevitable reasons due to the vehicle structure or the freight (separate loading is impossible), the mandate operation conditions (operation routes, operation methods, etc.) can be overridden.

[Oversized/overweight operation permission]

**Fig 1: Overview of the oversized/overweight operation permission**

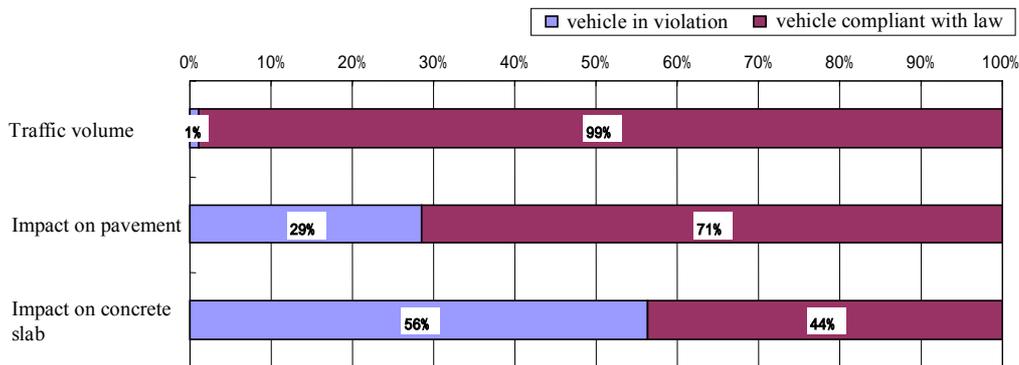
Japanese road transport regulations specify the limits of vehicle features as listed in Fig 1, and requires permissions to oversized/overweight vehicle operations when any of the conditions is exceeded.

Japanese bridges are designed to bear vehicles with the tonnage of 20t (25t in specified roads). Vehicles with a potential load capacity exceeding the designed target account for less than 1 % of total traffic volume. Actually, vehicles exceeding 20t are operated 38,000,000 times annually in average. About 28,000,000 times, that is counterpart of about 70% of the total, were considered to have no license or in illegal operations (Fig 2).



**Fig. 2 Actual condition of driving vehicles with total weight of more than 20t**

About 60 % of the total damage on concrete slab is inflicted by vehicles with excessive axle weights, which account for less than 1% of the total ownership. Further, it is proved through a trial calculation that about 30% of the total damage on road pavement is inflicted by them. It was pointed out that it potentially causes cracks in bridge pier or to lead to a bridge collapse. Thus, the impact of the above is regarded as a serious problem. (Fig 3)



**Fig 3. Impact on road structure by a vehicle in violation.**

The enforcement of oversize/overweight vehicle is periodically carried out at specific locations. However only about 1% of vehicles in violation was rounded up due to the limitation on location and labor. On this score, the enforcement of the oversized/overweight monitoring system is desired, and the adoption of an effective monitoring system for oversized/overweight vehicles should be planned.

## **OVERVIEW OF OVERSIZED/OVERWEIGHT VEHICLE MONITORING SYSTEM**

### **Operational requirement for automatic vehicle enforcement system**

The oversized/overweight vehicle monitoring system is composed of an automatic enforcement device to measure vehicle features and a central device to process collected data.

Capacities required to manage and control (obtaining their operation status and giving strong instructions for violators) oversized/overweight vehicles, are listed in Table 1.

Capacity	Operation requirement	Objective
1.Weight measuring capacity	○Collection of vehicle features data	○Conform to conditions specified in Road Law Section 47, Article 1, and Vehicle Restriction Regulation Section 3 ○Judge oversized/overweight vehicle in violation
2.Dimensions-measuring capacity		
Vehicle height measuring capacity		
Vehicle width measuring capacity		
Vehicle length measuring capacity		
3. Capacity to collect the vehicle data	○Data acquisition to identify an oversized/overweight vehicle in operation	○Judging whether operation permission obtained or not. ○Identify an owner who uses a vehicle without permission.
4.Roadside processing capacity	○Entire data on a vehicle in operation is integrated from each sensor.	○Checking whether operational permission obtained or not, identify a vehicle without permission.
	○Transmitting data on a vehicle in operation to a central system.	○Judging the violation of the oversized/overweight vehicle.

**Table1. Capacities of the automatic enforcement device**

Further details in each capacity in Table 1 are described as follows:

●Weight measuring capacity

- The capacity to measure the following items regarding a vehicle passing through the location where an automatic enforcement device is placed
  1. Objectives: all vehicles
  2. Weight measuring items: (measuring range) total tonnage (20 tons or more), axle load (10 tons or more), the distance between outer axles (5.5 m or less, 5.5 m or more), and number of axles (2 axles or more)
- The capacity to transmit the measured data to a roadside processor

●Dimensions-measuring capacity

- The capacity to measure the following items regarding a vehicle passing through the location where an automatic enforcement device is placed
  1. Objectives: all vehicles
  2. Measuring items: (measuring range)
    - Width of vehicle (2.5 m or more), height of vehicle (3.8 m or more) and

length of vehicle (9 m or less, 9 m or more)

- The capacity to transmit the measured data to a roadside processor

- Capacity to collect the vehicle data

- The data shall be collected to select a vehicle (oversized/overweight vehicle) which exceeds the conditions specified in Road Law Section 47, Article 1, and Vehicle Restriction Regulation Section 3
- The capacity to transmit the data to a roadside processor

- Roadside processing capacity

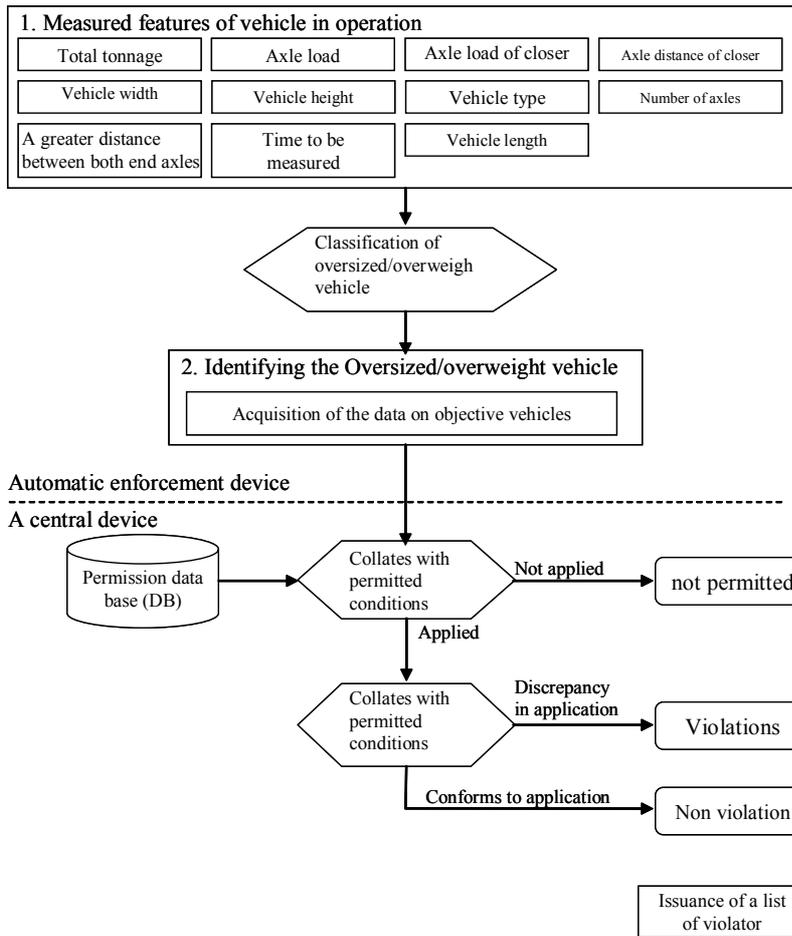
- The entire data on a vehicle in operation shall be integrated from each sensor of weight measuring capacity, dimension-measuring capacity, and data acquisition capacity
- A time stamp shall be created for the objective vehicle that shows the time, day, and year of the vehicle passing through the weight-measuring location
- the integrated data shall be able to be transmitted to a central system when required (vehicle for data transmission: oversized/overweight vehicle)
- Data shall be able to be tentatively stored until the data is transmitted to a central system

### **Oversized/overweight vehicle monitoring system**

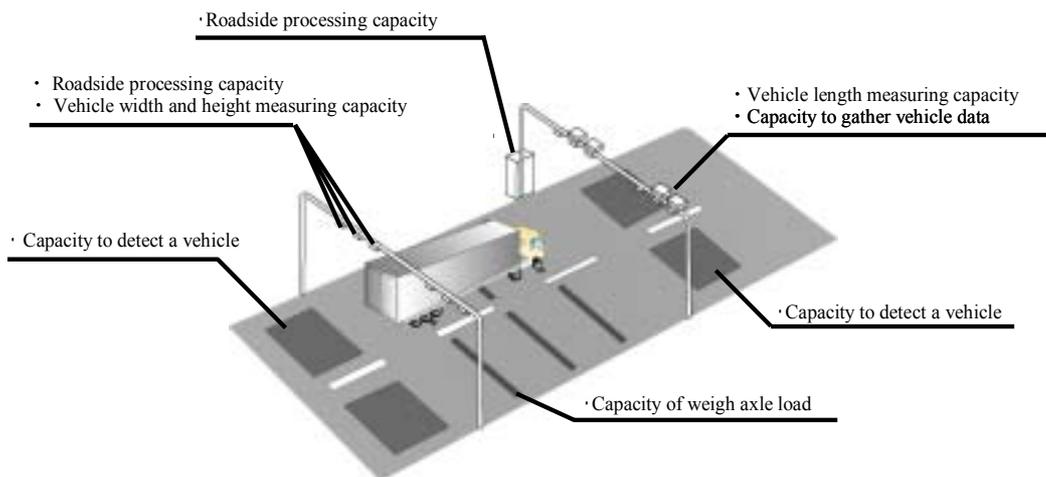
The data flow in an oversized/overweight monitoring system that has the above capacities is discussed in the following section. To begin with, deploy an automatic enforcement device along major trunk roads where oversized/overweight vehicles converge, and each vehicle features such as total tonnage, axle load and vehicle height and other items are measured. In this occasion, vehicles are classified through the measured values to find out the oversized/overweigh vehicles and identify them.

Next, the measured data from the automated enforcement device and the data of each vehicle is transmitted through optical fibers to a central device and collated with the relevant stored data in the permission database. The result is used for facilitating automated list issuance, which describes the owner's name of the vehicle in violation, after identifying a vehicle with/without permission, and operation in violation or not, if they have received permission,(Fig 5).

Fig 6 charts the conceptual image of the deployment of automated enforcement device.



**Fig 5. Processing flow of measured data**



**Fig 6. A conceptual image of automated enforcement device**

## **BENEFIT OF ADOPTING THE SYSTEM**

The enforcement that is strengthened by the oversized/overweight vehicle monitoring system is intended to decrease the operations of oversized/overweight vehicles in violation. The reduction of violations reduces damage on pavements and bridges, resulting in saving of maintenance cost. At present, 5.7 trillion yen is annually spent for pavement and bridge maintenance, and 2.1 trillion yen of those is inflicted by vehicles in violation. Based on the result of these calculations, 20% reduction of vehicles in violation would reduce about 5% of the total annual maintenance costs.

## **CONCLUSION**

Further utilization of information technology is expected as a solution for various issues raised by oversized/overweight vehicle operations. A case has been introduced in this paper to effectively and efficiently enforce these oversized/overweight vehicles through monitoring. The effective elimination of these oversized/overweight vehicles in operation leads to reduced maintenance cost at of roads and bridges in the future.

As a part of integrated enforcement measures aiming at watertight enforcement of oversized/overweight vehicle operation permission systems in the future, this vehicle monitoring system using an automatic enforcement device will be deployed along the ministry's direct jurisdictional road sections throughout the country in the fiscal year 2004.