PDCA Cycle Based Traffic Accident Countermeasure Management

Shinsuke SETOSHITA, Hiroki HASHIMOTO
National Institute for Land and Infrastructure Management

***ABSTRACT*:** In order to implement traffic accident countermeasures more effectively and to carry out traffic accident countermeasure projects with improved efficiency, it is essential to propose countermeasures based on the appropriate analysis of the causes of accidents, and to accurately evaluate the effectiveness of countermeasures that have been taken to study supplementary countermeasures. And we must also accumulate data and knowledge through these processes in order to feed back the knowledge gained from these evaluations to propose future countermeasures. Therefore efforts are undertaken based on the Traffic Accident Countermeasure and Evaluation Manual that has been prepared to systematize the procedure—proposal, implementation, and evaluation of countermeasures—as applied to traffic accident countermeasures on trunk roads. And all data concerning locations of countermeasures, accident data, contents of countermeasures, and results of evaluations are being accumulated in the Accident Countermeasure Database that can be searched for reference data in order construct a procedure that can be applied to feed these data back to the process of proposing future countermeasures. This report introduces the application of this PDCA cycle to the management of traffic accident countermeasures.

KEYWORDS: traffic accident measurement management, hazardous spot project, PDCA cycle

1. INTRODUCTION

1.1 Problems with traffic accident countermeasures

A characteristic of traffic accidents on trunk roads in Japan is that they are concentrated at specific locations: as shown by Figure1.1, 56% of all traffic accidents are concentrated on 9% of total road length. This means that it is effective to take countermeasures at locations where accidents are concentrated, so from 1996 until 2002, countermeasures were taken concentrated at a total of 3,196 locations that had been selected as locations where accidents occur frequently (below, “hazardous spots”).

It has been confirmed that this policy has reduced the number of fatal accidents and accidents causing injuries by about 30% at these locations.

But as shown by Figure1.2, although both the number of fatalities and the number of fatalities and injuries caused by traffic accidents in Japan are now tending to fall, the number of fatalities and serious injuries tended to rise almost consistently until 2004 that is only four years ago regardless of the implementation of various countermeasures including concentrated countermeasures.

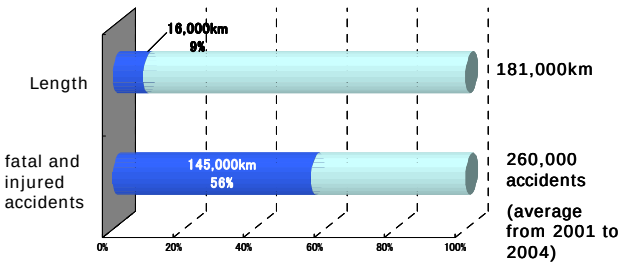

Figure1.1 Locations of Traffic Accidents on Trunk Roads

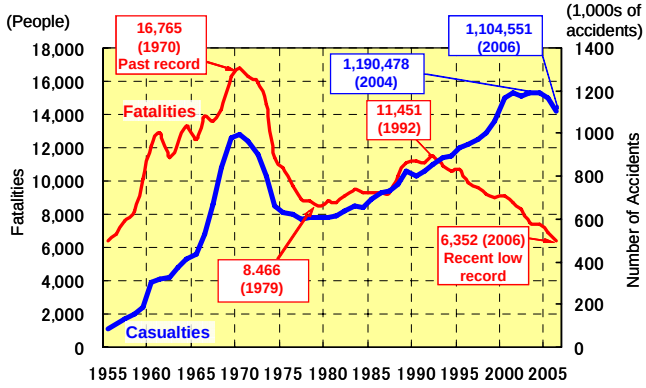

Figure1.2 Changing Number of Fatalities and Number of Fatalities and Injuries Caused by Traffic Accidents

The number of fatalities and the number of fatalities and injuries caused by traffic accidents are greatly influenced by traffic volume. And traffic accident countermeasures include the strengthening of regulations that mandate the use of seat belts, improvement of the safety of automobiles, and improvement of emergency medical treatment systems and other countermeasures, so it is difficult to explain the factors influencing traffic accident fatalities and serious injuries in terms of a single factor.

However, past traffic accident countermeasures have been hampered by the problems discussed in parts 1.1.1 to 1.1.3 below, so the fact that places where countermeasures have been taken but have not been sufficiently effective have been identified is one cause of the failure of the numbers of fatalities and injuries to decline.

1.1.1 The incomplete state of a system for the specification of causes of traffic accidents

To select appropriate countermeasures, it is essential to clarify the state of occurrence and the contents of accidents to gain a detailed view of the processes resulting in accidents, and thereby, learn their actual causes. But because a system to specify the causes of accidents has not been established, the specification of the causes of accidents is left up to hypotheses made by responsible officials in the field.

1.1.2 Increasing complexity of the causes of the occurrence of accidents

The causes of the occurrence of accidents have become increasingly complex under the impact of the diversification of road users. Advanced specialized knowledge is necessary to propose appropriate countermeasures in the face of the diversification and increasing complexity of methods of taking countermeasures.

1.1.3 Inadequate evaluations of countermeasures

In order to study the effectiveness of countermeasures that have been taken and the need for supplementary countermeasures, the implementation of countermeasures must be followed by qualitative and quantitative evaluations of the effectiveness of these countermeasures. To be able to effectively conduct future countermeasure proposal and evaluation processes, it is vital to collect knowledge gained through the implementation of past traffic safety countermeasures so that it can be referred to when implementing future traffic safety countermeasures. Additionally, when planning a future countermeasure, it must be possible to select the most effective countermeasure from among many proposed countermeasures that have been taken in the past based on the organization of accident reduction effectiveness of traffic safety countermeasures that have been taken at each location.

But the evaluation of countermeasures after they have been taken has not been performed adequately, so that knowledge and expertise regarding traffic safety countermeasures have not been accumulated systematically.

1.2 New initiatives at hazardous spots

In 2003, 3,956 intersections and uninterrupted flow sections of roads where the rate of accidents causing fatalities and injuries is high were newly designated and hazardous spot countermeasures devised to prevent concentrated accidents were begun under a five year plan spanning the period from 2003 to 2007. Based on past considerations of traffic accident countermeasures, these traffic accident countermeasures were carried out by constructing a PDCA cycle system to implement countermeasures more effectively and more efficiently. This report introduces the Traffic Accident Countermeasure and Evaluation Manual and the Traffic Accident Countermeasure Database that have been prepared in order to build the PDCA cycle system and a procedure for using these to take traffic accident countermeasures.

2. TRAFFIC ACCIDENT COUNTERMEASURE AND EVALUATION MANUAL

2.1 Outline

The Traffic Accident Countermeasure and Evaluation Manual systematically organizes traffic safety countermeasure study methods to present an overall procedure based on the PDCA cycle from countermeasure proposal to evaluation. The following is a detailed description of this manual.

2.2 Systematization of the countermeasure procedure

In order to implement traffic accident countermeasures more effectively and to carry out traffic accident countermeasure projects more efficiently, it is essential to propose countermeasures based on the appropriate analysis of the causes of accidents, and accurately evaluate the effectiveness of countermeasures that have been taken to study supplementary countermeasures. And we must also accumulate data and knowledge obtained through this process in order to feed back the knowledge gained from these evaluations to propose future countermeasures.

Consequently, the manual systematizes the countermeasure procedure in the sequence of steps: proposing a countermeasure, evaluating the countermeasure, and placing the results in the data base, to establish the procedure shown in Figure2.1. This permits users of the manual to take countermeasures efficiently without the wasteful repetition of steps.

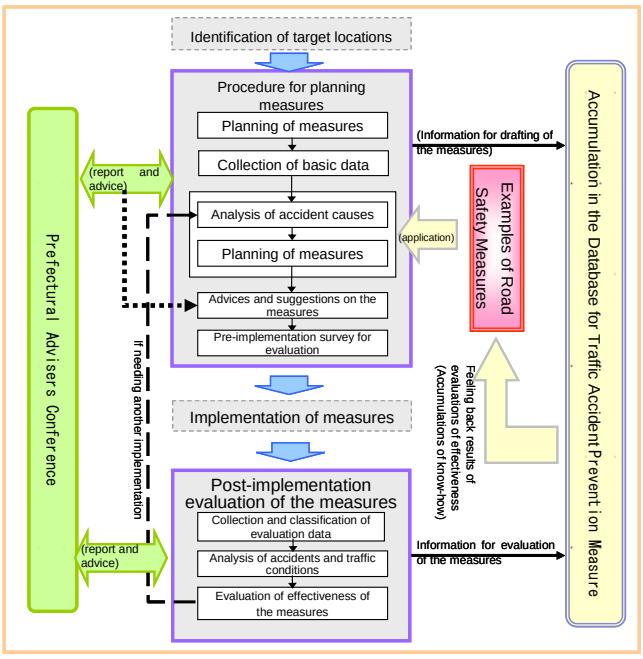

Figure2.1 Accident Countermeasure Procedure

2.3 Clarification of information that should be known to propose countermeasures

To propose an effective plan, it is vital to accurately clarify the road structure and state of traffic at locations of countermeasures and the ways that accidents occur to perform a correct analysis of the causes of the accidents.

So for use when proposing a planned countermeasure, the manual organizes outlines of locations—road structure and state of traffic etc.—in order to gain an understanding of conditions before

the countermeasure, plus the way that accidents occur based on accident data and drawings of accident occurrence processes.

By entering information according to the format, users can provide all items of information necessary to propose a countermeasure.

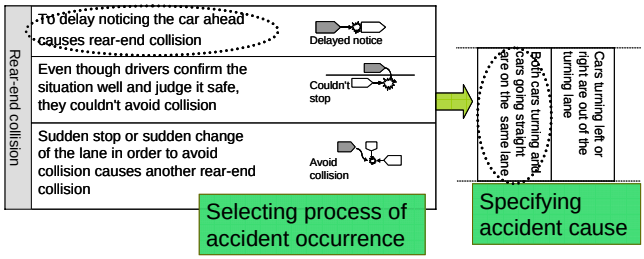

Figure2.2 Example of an Accident Cause Table

2.4 Use of the Collected Traffic Accident Countermeasure Cases

Planners can propose more effective countermeasures more efficiently by accumulating and applying information such as methods of taking countermeasures applied in the past, precautions followed to apply these methods, and so on.

The Collected Traffic Accident Countermeasure Cases that presents knowledge concerning cases of the analysis of past accidents at 557 locations can used by accident countermeasure planners. This consists of the Accident Cause Table that is used to abstract the causes of accidents based on the types of accidents that occur often at the study locations (head-on collisions, collisions between automobiles entering intersections, etc.) and the Accident Countermeasure Table that is used to select an appropriate countermeasure menu based on the cause of accidents.

2.4.1 Accident Cause Table

This table organizes accident occurrence processes hypothesized based on each type of accident and road environment factors that encourage accidents, and is used to support the task of specifying the factors that contribute to the occurrence of accidents.

Even for accidents in the same accident category, their causes vary according to characteristics of the road at each accident location. Therefore, Accident Cause Tables are prepared separately for 14 kinds of roads categorized based on intersection/uninterrupted flow, absence/presence of signals, number of lanes, and other road features.

2.4.2 Accident Countermeasure Table

This table summarizes countermeasure guidelines and specific types of countermeasures plus precautions for each accident causal factor that is a result of the road environment, and is used to support the proposal of specific accident countermeasures.

Even when accidents are caused by the same factor, the countermeasure taken varies according to the characteristics of the road at the accident occurrence location. Therefore an Accident Countermeasure Table is prepared for each of 4 road types categorized based on intersection/uninterrupted flow, absence/presence of signals, number of lanes, and other road features.

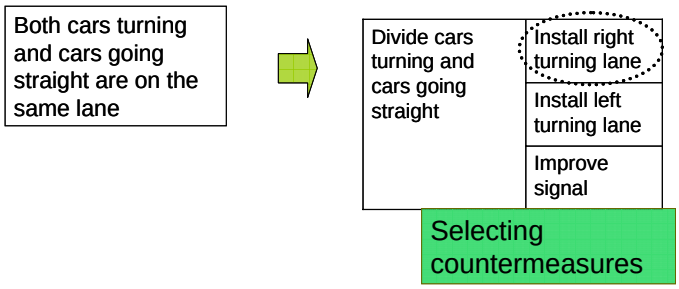

Figure2.3 Example of an Accident Countermeasure Table

2.5 Incorporation of countermeasure evaluations in the countermeasure procedure

Countermeasure evaluations can be used not only to confirm whether or not a measure that has been taken has achieved its intended effects, but can also be used as reference information to perform studies necessary to plan supplementary measures at its

location and measures for other locations, making these extremely important procedures.

So the manual stipulates that an advance survey be carried out to permit a two step evaluation—setting evaluation indices and collecting data needed for the evaluation—before actually planning a proposed countermeasure. And the evaluation of a countermeasure performed after the countermeasure has been taken is a three step procedure: a post-measure organization of conditions after the measure, post-measure survey to evaluate the measure, and performance of the evaluation. All the needed data can be organized by recording it according to the format stipulated in the manual.

2.6 Role of Advisory Committee

There are some causal factors that are clear and can be dealt with by easily planned countermeasures, pedestrian accidents on roads without sidewalks for example, but there are also factors that are unclear, complex, and are difficult to deal with by planning suitable measures: those that cause accidents at locations equipped with traffic safety facilities for example.

An effective way to handle these cases is to establish a system that reflects the knowledge of academic experts who possess specialized knowledge.

So the manual stipulates that, as necessary, the advice of a Prefectural Advisory Committee concerning the analysis of causes of accidents, planning of measures, the advance survey performed to prepare for evaluation, etc. be sought before implementing a measure in order to obtain technical guidance and objective opinions to implement the project.

2.7 Accumulating information in the Accident Countermeasure Database

Information extending from the planning to the evaluation of measures at hazardous spots is extremely valuable information when planning measures for other locations.

Therefore, all information including outlines of locations of measures, accident data, countermeasures, evaluation results etc. that are recorded as stipulated by the manual are stored in the Accident Countermeasure Database.

The Collected Traffic Accident Countermeasure Cases that organizes and summarizes knowledge about the analysis of past accidents as described in part 2.4 above was prepared based on data for 557 locations. Building this Database will permit the completion of the Collected Cases in the future. And it will allow countermeasure planners to set conditions to directly search for cases for reference use from among nationwide countermeasure cases. The Accident Countermeasure Database is described in greater detail in Part 3 below.

3. ACCIDENT COUNTERMEASURE DATABASE

3.1 Outline

The Traffic Accident Countermeasure and Evaluation Manual, that is a collection of countermeasures, results of evaluations of these countermeasures before and after they have been taken, and other knowledge obtained through every step from the planning of countermeasures to their evaluation, is used to propose future countermeasures and to evaluate their effectiveness. The Accident Countermeasure Database that was constructed based on the manual consists of the Accident Countermeasure Database Entry System that is used to enter data about countermeasure locations and the Accident Countermeasure Database Web System that can be used to refer to and search for data and to abstract data on the Web.

As explained in part 1.2, a total of 3,956 locations where accidents causing death or injuries have

occurred frequently were designated as accident hazardous spots in 2003 and concentrated countermeasures have been taken at these locations. The Database stores data concerning the road structure and traffic environments at these locations, plus the countermeasure study procedure and the effectiveness of measures.

The data is updated once a year by using the Entry System to recover data prepared by road managers.

The system used to reference, search for, and abstract data is constructed as a Web system so that it can be operated from any personal computer linked to the internet in every part of Japan.

Figure3.1 is an example of a Database screen. It is a screen that is visually easy to understand and that can be operated completely using only a mouse. It is possible to use the Database to easily search for and refer to data about locations with similar road characteristics, locations where similar accidents occur, and other locations a planner wishes to refer to.

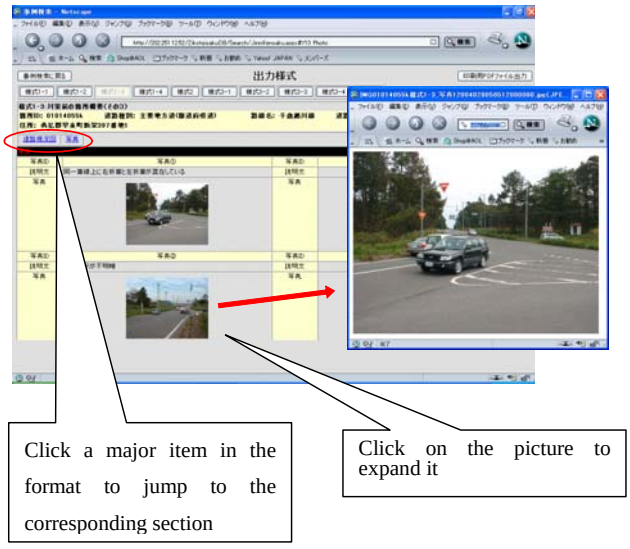

Figure3.1 Example of an Accident Countermeasure Database screen

3.2 Data items

Items of data entered to the Database are, under the procedure prescribed by the Traffic Accident Countermeasure and Evaluation Manual, categorized as items necessary to propose plans before taking a traffic accident countermeasure and items necessary to evaluate the effectiveness of a countermeasure that has been taken. Figure3.2 shows the relationships with items entered at the countermeasure and evaluation stages of the process.

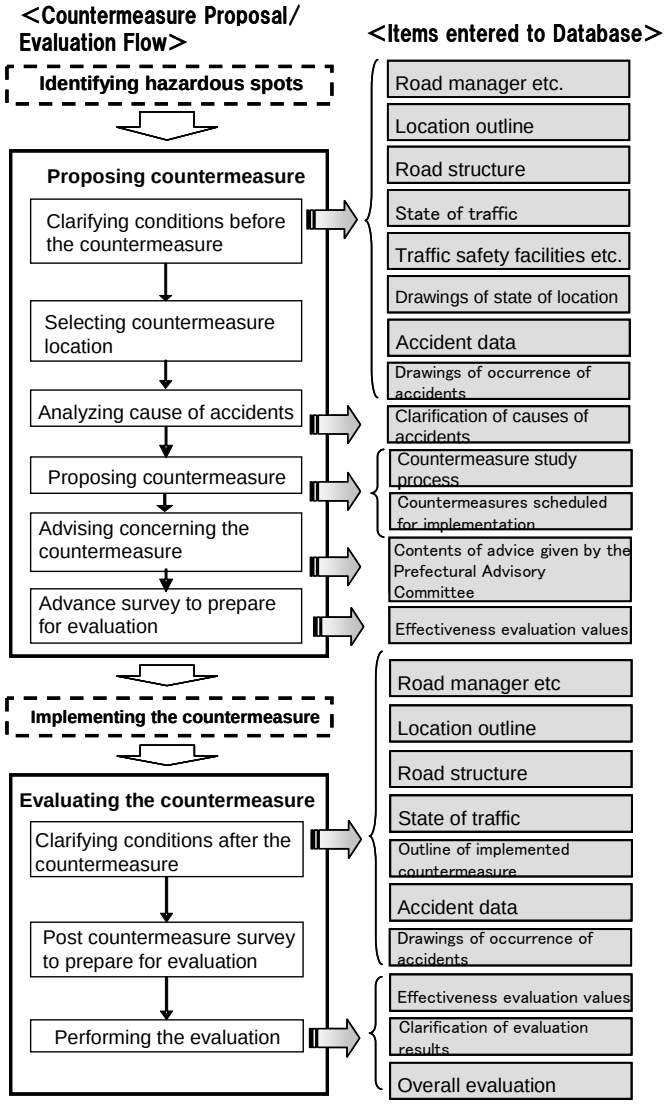

Figure3.2 Relationship of the Traffic Accident Countermeasure Proposal and Evaluation Flow with Entered Items

3.3 Functions of the Database

3.3.1 Data entry and proposal support functions

This function is used by road managers to enter data concerning countermeasure locations. The screen structure conforms to an entry format stipulated by

the Traffic Accident Countermeasure and Evaluation Manual, so it can be used to read in image data such as photos of the site and drawings showing how accidents occur. Selecting the entry format is done not only by clicking tabs. It is designed so it is easy to enter the road category and other items by using pull down menus.

And the countermeasure study process from the analysis of the causes of occurrence of accidents to deciding on the specific countermeasure work category has been designed so entry can be done in sequence. By automatically displaying a menu of candidate countermeasures based on types of accidents that occur frequently at a countermeasure location, it supports the systematic study of countermeasures.

3.3.2 Case search and reference functions

The case search function can be used to search for and display locations that conform with preset search conditions. Figure3.3 is an example of a case search display screen.

It can be used when planning a traffic safety countermeasure to propose and evaluate traffic safety measures according to a variety of purposes; to find out what kinds of countermeasures have been taken at locations where the same types of accidents occur or to find out the cost of particular countermeasures.

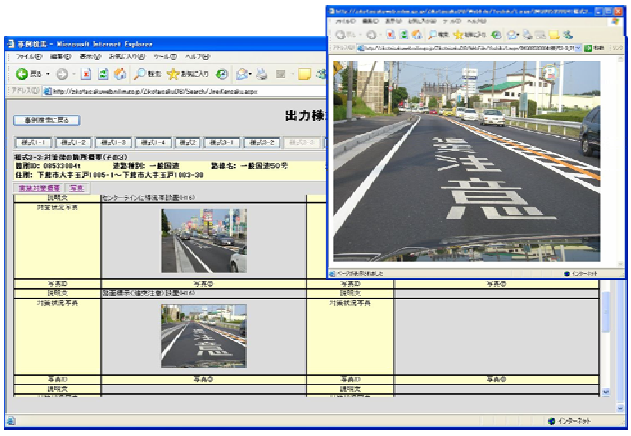

Figure3.3 Example of a Case Search and Display Screen

3.3.3 Project progress management function

The project progress management function can be used to confirm the state of progress of a countermeasure for hazardous spots by road manager, by uninterrupted flow/intersection, and by body implementing the project. Figure3.4 shows an example of a project progress management screen. The state of progress is displayed on a bar graph color coded according to the degree of progress, permitting the user to visually confirm the progress of the project.

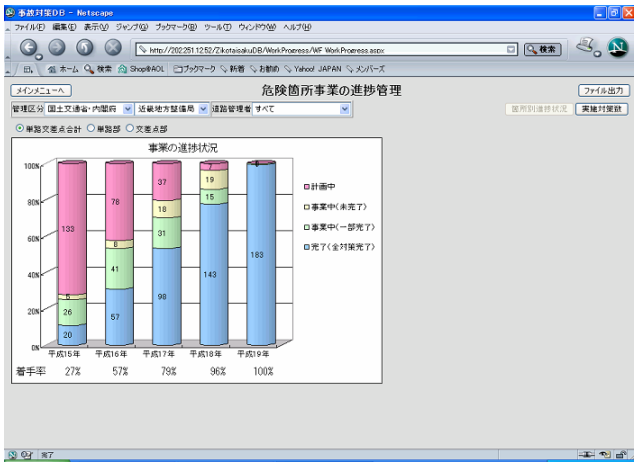

Figure3.4 Example of a Project Progress Management Screen

3.3.4 Data abstraction function

The data abstraction function can be used to output data for optional items regarding hazardous spots searched for based on search conditions to an Excel file. It can, for example, be used to find out which type of countermeasure has been taken most frequently to deal with a certain type of accident, or how a certain countermeasure work is evaluated. It can be used to obtain information for use as reference information when selecting countermeasures or studying evaluation indices by analyzing the data that is output.

4. CONCLUSION

Although the number of fatalities and the number of fatalities and injuries caused by traffic accidents have been tending to fall since 2004, they remain at high levels: 6,352 fatalities and 1,104,551 people injured or killed in 2006. To achieve the numerical goals of 5,500 or fewer fatalities and 1,000,000 or fewer fatalities and injuries by 2010 set in the Eighth Basic Plan for Traffic Safety and the ultimate goal of a traffic accident free society, we must continue to strive to implement traffic accident countermeasures in the future.

New concentrated countermeasures are scheduled to begin in 2008. We will continue efforts to improve the Traffic Accident Countermeasure and Evaluation Manual and the Accident Countermeasure Database by means such as having managers in the field complete questionnaires to identify shortcomings with the Database and the Manual. We also plan to continue to carry out improvements to further strengthen the traffic accident countermeasure system based on the PDCA cycle.