Research on Assessment Index and Model of Road Safety Measures and Technical Means Effect Based on Trans-Departmental Information

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Abstract—This article on trans-departmental information, combines with specific field survey data, based on the principle of establishment of evaluation index, determines the specific indicators of comprehensive evaluation of road safety measures and technical means effect based on trans-departmental information, establishes the assessment model through the processing of indicators, and makes the foundation to the post safety assessment.

Index Terms—Trans-department, safety measures, technical means, assessment index, assessment model

I. INTRODUCTION

Road traffic safety measures are any technical equipments, means, procedures and so on, take improving road safety as the sole purpose or at least as one of the objectives of the unit. It is for the elements of road transport system, such as the use of the land, roads, and road equipment itself, and traffic control facilities, motor vehicles, policemen, road traffic participants and their traffic behavior, and main purpose is to reduce the number of traffic accidents, reduce the damage due to traffic accidents.

At present, not only our research results on road traffic safety measures of the quantitative evaluation are fewer, but also we do not have a systematic evaluation study on a variety of safety measures. Therefore, this paper through the classification research of road safety and technical instruments and their related traffic safety events, builds the assessment index system of road safety measures and technical means effect, and on this basis, establishes the comprehensive evaluation model of road safety measures and technical means effect combining with actual data.

II. THE CREATION OF EVALUATION INDEX

Establishment of the comprehensive assessment indicators of road safety measures and technical means effect: extract the relevant data of the transport sector on road safety facilities and the corresponding accident statistical data of public security department, and finish the comprehensive assessment of road safety measures and technical means effect. It is a very abstract issue to measure road safety measures and technical means effect. Therefore this paper has the research from three aspects. On the one hand, through obtaining the relevant data of the transport sector on road safety facilities, it evaluates the self-generated effects value of road safety measures; on the other hand, by analyzing and comparing the accident statistical data and violation data of the public security departments that corresponding to safety measures, it measures the effects produced by improving and setting safety facilities; finally, considering the above two aspects of the evaluation value, it gives the final safety facilities effective value[1].

Assessment index system of road safety measures and technical means effect as shown below:

III. THE CREATION OF EVALUATION MODEL

A. Study On Dimensionless Indicators

1) Method selection[2]

Observe the defined index system and analyze their possible range, obtain that most of the indicators are showing the approximate linear transformation, so here it chooses linear undimensionalization.

2) Generalized linear efficacy coefficient method

The basic form of generalized linear efficacy coefficient method:

Dimensionless value of individual evaluation index:
\[ d = \frac{X_i - X_{i0}}{X_{ii} - X_{i0}} \]  

(1)

Or linear transformation:

\[ Fd = d * a + b \]

(2)

\[
\begin{align*}
N & \quad x < a \\
\ln x - \ln a & \quad 40 + 60 \quad a \leq x \leq b \\
d & \quad M \quad b < x < c \\
\ln 1/x - \ln 1/d & \quad 40 + 60 \quad c \leq x \leq d \\
N & \quad x > d
\end{align*}
\]

(3)

Usually take \( a = 40, b = 60 \). \( X_i \) is the actual value of index \( i \), \( X_{i0} \) and \( X_{ii} \) are two key points of index \( i \). For the positive index, \( X_{i0} < X_{ii} \), for the inverse index, \( X_{i0} > X_{ii} \).

3) Dimensionless function

Fig. 2. Dimensionless function

It can be seen that defects of safety facilities belongs the first class graphic, identification and inducibility of safety facilities belong the second class graphic, here we define defects of safety facilities as the inverse index. In order to construct function better, we can integrate the two classes of graphics above to a graphic as shown below:

Dimensionless function constructed:

When \( a \leq x \leq b \), a is “not allowed value”, b is “satisfied value”; and when \( c \leq x \leq d \), d is “not allowed value”, c is “satisfied value”.

B. Dimensionless Indicators

After dimensionless method and function are determined, we make the index dimensionless.

1) Defects of safety facilities dimensionless

The index of defects of safety facilities is an inverse. Here define its satisfied value as 0.1, its not allowed value as 3, that is when the value of defects is less than 0.1, the dimensionless values are the maximum, and when the value of defects is larger than 3, the dimensionless values are the minimum. As the following Table I.

2) Identification and inducibility of safety facilities dimensionless

The indexes of identification and inducibility of safety facilities are the positive. Here define satisfied value of identification and inducibility as 100, their not allowed value as 40, that is when the value of identification and inducibility is less than 40, the dimensionless values are the minimum of 60, and the value of identification and inducibility can be as large as 100. As the following table II.

C. Index Weighting Method

1) Determine order relation[3]

If the important degree of index \( X_i \) is greater (or not less) than \( X_j \) to an evaluation criteria (target), then denote \( X_i > X_j \).

And if the indexes of \( X_1, X_2, \ldots, X_n \) have the relation of \( X_1 > X_2 > \ldots > X_n \) to an evaluation criteria (target), then we say \( X_1, X_2, \ldots, X_n \) determine the order relationship according to “>”. Here \( X_i \) represent the scheduled order index \( i \) according to “>”. (i=1 , 2 , \ldots , m).

2) Compare the relative importance of \( X_{k-1} \) and \( X_k \)

Assume the rational judgment of \( w_{k-1}/w_k \) about the importance of the evaluation index \( X_{k-1} \) and \( X_k \) that experts give is:

\[ w_{k-1}/w_k = r_{k}(k = m, m-1, m-2, \ldots, 3, 2) \]

(4)

When m is larger, then take \( r_{k} = 1 \) according to order relation above.

Values of a as the following table III:

<table>
<thead>
<tr>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>
If \( x_1 > x_2 > \ldots > x_\alpha \) then \( r_{k-1} > \frac{1}{r_k} \), \((k = m, m-1, m-2, \ldots, 3, 2)\)

D. The Calculation of the Weight Coefficients \( w_k \)

If the rational values of \( r_k \) that experts give have the relation of \( r_{k-1} > \frac{1}{r_k} \), then

\[
w_k = \left(1 + \sum_{i=2}^{a} \prod_{j=i}^{k} r_j\right)^{-1}
\]

E. Calculation and Classification of Evaluation Value

After having the dimensionless index and determining the weights of them, we can get the comprehensive assessment value by the multiplied product of them[4].

In evaluation of road traffic safety, considering experts’ opinion and the distribution of evaluation results, the results of the micro-evaluation and macro-evaluation are divided into five levels, which called the traffic safety state level, and we give each level a corresponding value range. As the following table IV :

IV. Conclusion

Relying on the national road traffic safety science and technology action plan, through specific field survey data of trans-department, this paper has put forward the assessment index system of road safety measures and technical means effect based on trans-departmental information, and finishes the process of dimensionless indicators and weighting indexes, and then gets the classification of the evaluation level, finally build the assessment model of road safety measures and technical means effect based on trans-departmental information, which provides a theoretical support for the next comprehensive assessment.

REFERENCES