

Research on Establishment of a Standard of Traffic Impact Assessment with Integrated Database System

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Summary

Planning support systems, such as geographical information system (GIS) and traffic flow simulation models, are widely in use in recent urban planning research. In this paper we propose a method to apply traffic impact assessment (TIA) to large-scale, commercial developments. In TIA research we often encounter the problem of increasing amount of data that is necessary for detailed investigation and analysis, as the scale of commercial developments become larger and more complex. As a result, TIA presents two problems. The first problem is the difficulty of data acquisition. The second problem is the reliability of data. As a solution, we developed an integrated database system.

1 Introduction

1.1 Background and Purpose of Study

Construction of transportation facilities such as roads and parking facilities have been vigorously promoted in cities along the progress of motorization. However, the reality of the current state is that the demand for automobile far exceeds supply. This is especially true in urban area where various kinds of development spurs the demand for automobile usage. Traffic Impact Assessment (TIA) is an attempt to measure the effects quantitatively and to take appropriate measures to alleviate the adverse effects of increased traffic to urban environment. In Japan, government enacted the Large-Scale Retail Stores Location Law to control large scale commercial developments. However, it has problems because it applies a single standard throughout the whole country. In general, commercial establishments tend to show different tendencies even for the same types of businesses based on location area and consumer demand. Therefore, there is a danger to apply a single indicator of traffic assessment value to the whole country, which results in either underestimating or overestimating the impact of heavy traffic. In this research, we tried to develop an integrated database system that can accumulate and manage the up-to-date field data. This system takes the above-mentioned problem into account and enables proper assessment of the traffic impacts in local citine in Japan, which varies by location area and consumer demand. This paper also proposes the more reliable assessment methodology and procedure using traffic flow simulation models.

1.2 Review of Existing research

There are a lot of studies about the traffic impact assessment. Seki et al. (2002) did some case studies in Utsunomiya City. This study shows that impact from traffic appears not only during peak hours but also for longer time period. Kurokawa et al. (1997) shows the issue of traffic impact assessment in a series of commercial developments. It is difficult to capture the impact adequately with individual cases of traffic impact assessment. It shows the impact of consecutive commercial developments expanding in larger areas. Additionally, this study specifies four aspects of consecutive commercial developments. They are 1) strength of consecutive commercial development, 2) content of traffic load, 3) range of catchments area of

development influence, and 4) accuracy of trip generation unit. Nishimiya et al. (2002) compared the basic trip generation unit for TIA with ITE's (Institute of Transport Engineers) guidelines. In addition, this paper discusses how to deal with commercial complex. Takayama et al. (1993) developed a system that enables planning and evaluation of large scale development. Osada et al. (2001) constructed an online database system for city planning. Finally, Sakamoto et al. (2002) introduced the effectiveness of the traffic flow simulation model for TIA. From reviewing these exiting papers, the following three issues came to light. First is the necessity to consider the data fluctuation over time. The second issue is the basic unit used. The third is about the method of collecting data. Based on these observations, we developed an integrated database system which allows the continuous update of input data collection, and proposes a method of assessment procedure.

1.3 The Characteristics of this Study

This study has two major focuses. First is the development of a database system which enables frequent updates of data. The other focus is preparing a traffic impact assessment manual for local cities in Japan. With the use of this study, it is possible to set a practical criterion value that is based on the data that varies over time. The latter part of this paper supports public involvement by releasing the result of the analysis to the citizens and collecting the information and feedback from them.

2 Outline of integrated database system

2.1 System Concept

This system stores data necessary for the assessment and provides results from the analyses. In addition, it can collect the feedback from the public using the Internet. The system can reflect the public opinions for future use (The system outline is shown in the Figure-1). The system interconnects local governments, private enterprises, research institutes and universities, and residents in the region.

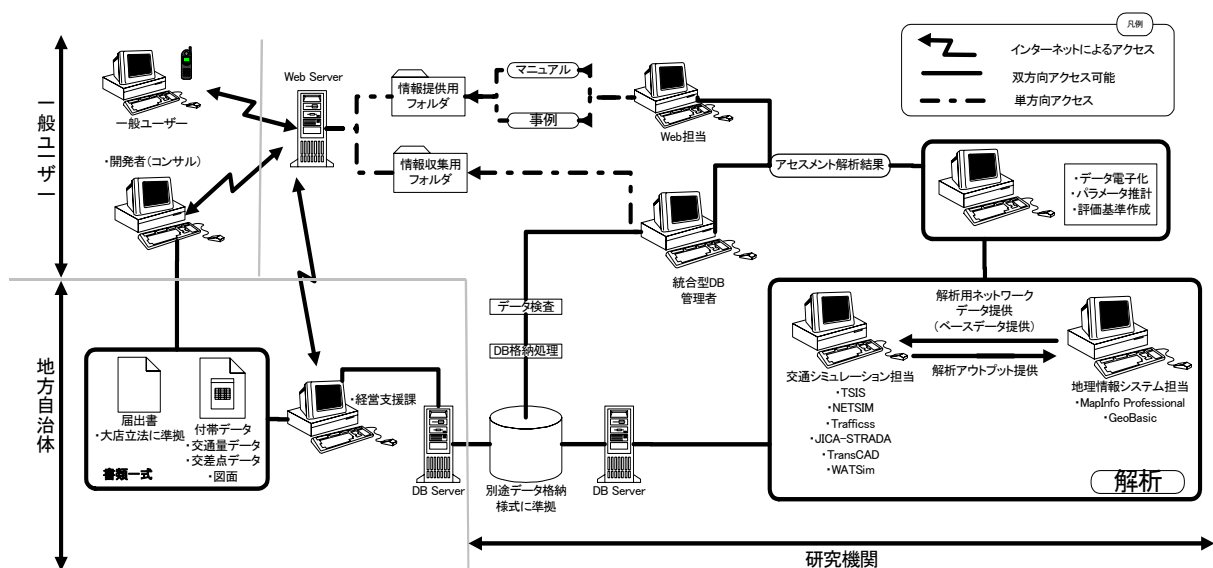


Figure-1. System Configuration

2.2 System Characteristics

When we developed this system, we considered two main characteristics for the system. The first was to develop an operating environment using graphical user interface (GUI) which does not require advanced system knowledge. Secondly, ease of use, in terms of system maintenance data updating was important. The system adopted the hypertext markup language (HTML) and common gateway interface (CGI) as the programming environment. This technique coordinates two subsystems, namely, analysis system and online database system. In this study, we utilize the Microsoft Access 2000 for database engine. Included data are traffic flow count value for analysis, data from opinion of citizens and results of the analyses. These data are checked by database administrators before they are put into storage to ensure security. In addition, the system adopted the standardized data structure like CALS/EC authorized by the Ministry of Land, Infrastructure and Transport in Japan.

2.3 Storage of Data Sets

These data sets stored in the system are of information on large-scale retail store. There are two kinds of databases in this study. They are text based and GIS based database. Text based datasets enables context search, and the other is to find locations from maps displayed in GIS. From each database, one can find assessment measures or location environments for new stores. When we assess the traffic impact using traffic flow simulation models, reference can be made using existing commercial development in the database.

2.4 Method of Utilizing the System

In the conventional traffic impact assessment procedures, many parties are involved as shown in Figure-2. Various sections in organizations exchange information. Two problems arise in this process. One is the time lag during communications between parties, and the other is the information intercross and conflicts amongst each other. Both issues are derived from the fact that so many organizations are involved in TIA. Therefore, we propose a new procedure to avoid these problems using this system. The revised relationship will look like Figure-3 by applying the system developed in this paper. Online sharing of information across-the-board by centering around the system enables the solution of the above-mentioned problems.



Figure-2. Conventional traffic impact assessment procedures

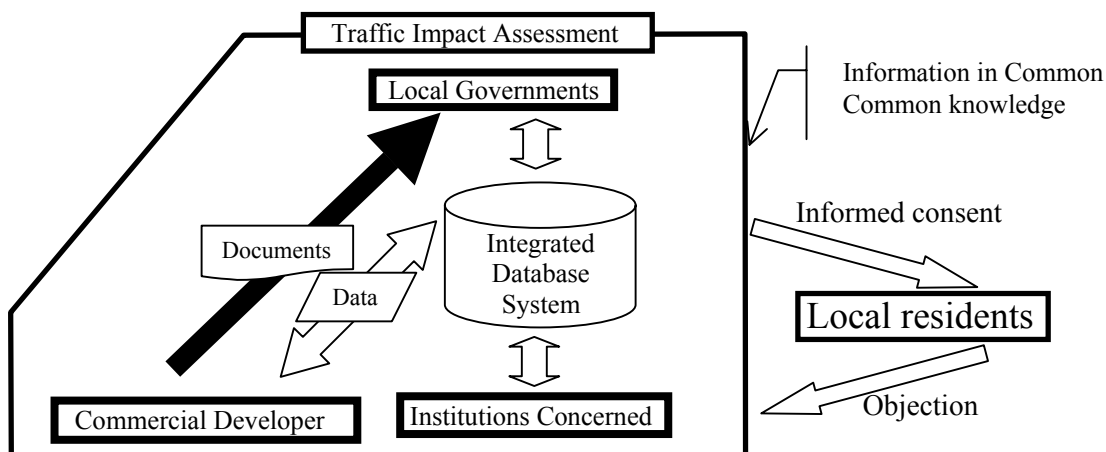


Figure-3. Revised Relationship

3 Subsystems

3.1 Analysis System

In the existing research, a traffic impact assessment is done using a traffic flow simulator whose result of analysis is then on display using a geographical information system. It is usually very difficult to consolidate these two processes. In this study, we consolidated them in an integrated system around the database machine. As the result, analytical work can be done much easier. The transportation network for the traffic flow simulation model is constructed using GIS, which is coordinated with the database, and returned to the simulator.

3.2 Public System for External Users

The external system for public is divided into two streams. One is a system to collect information, and the other a system to disseminate information. Information open to the public is released in map form as a result of the assessment process. This makes it possible for the residents to better understand the congestion situation. The information collecting system is used to collect feedback from citizen who live near the facility or those who receive service from it. The information exchange function is done by e-mail and by bulletin board system (BBS). In addition, the -mail function supports the GPS cellular phone with digital camera. The digital photos and the location information generated by GPS are sent by e-mail. Received e-mail is converted to the format suitable for GIS.



Figure-4. System Image

4 Setting of Standard for Traffic Impact Assessment

This chapter explains setting criterion values in Tochigi prefecture for traffic impact assessment as an application of the integrated database system discussed in the previous chapters.

4.1 Details of the Utilized Data Sets

The data used to set the criterion value is obtained from the survey of actual sales volume by large-scale retail stores done in March, 2002. Two kinds of surveys were conducted. One is the

questionnaire survey, and the other is the traffic count surveys for 30 sampled stores in the prefecture.

4.2 Analysis Comparison

From the detailed analysis of the survey result, a remarkable tendency appeared in the automobile usage rate. Under the Large-Scale Retail Stores Location Law, the automobile share rate is set at 70 % for the city with less than 400 thousand people, and 75 % for cities with populations between 400 thousand and one million. However, the result of the analysis shows the automobile share rate to be between 80 % and 90 % in Tochigi Prefecture, which is higher than the standard indicator value discussed above. This means the recommended value based on the law has a possibility of overestimation or underestimation. This is true with other values, as well.

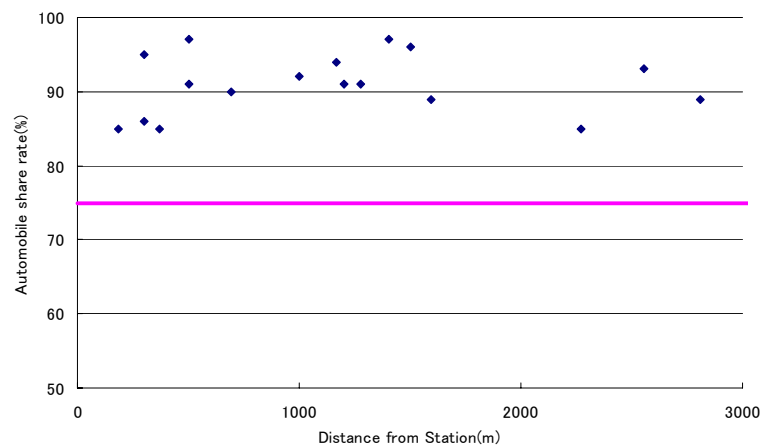


Figure-5.Result of Analysis

5 Application of Integrated Database System

5.1 Case Study

Using the assessment manual developed with the integrated database, a case study is reported here. This case study is the development of a large scale outlet mall and a shopping center. Such large scale suburban malls are increasing in Japan in recent years. The development area is located in a very convenient site, which is along the major national highway near an interchange of the expressway. The network for the analysis is in two square kilometers (see Figure-6).

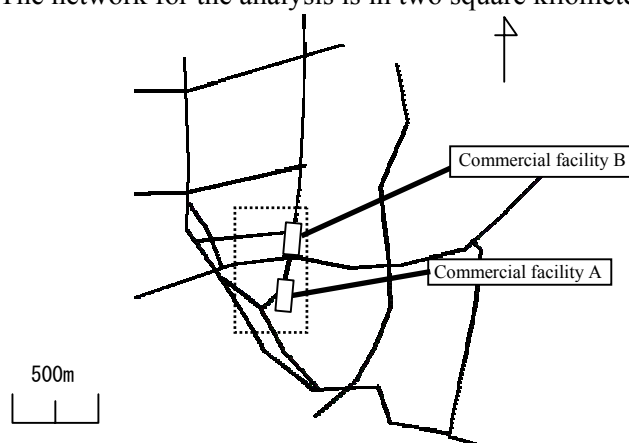


Figure-6. Network for the Analysis

5.2 Countermeasure of Application

As a result of the traffic impact assessment, efficiently done by using the integrated database, significant problems are found. Due to the high accessibility, serious traffic jam were suspected to take place around the development area. Furthermore, it was found that in some intersections, traffic congestion cannot be reduced by the existing traffic signals. The reason for this phenomenon is that the increase in traffic volume due to developments has added to the already existing traffic volume of an certain road. These intersections become bottlenecks, which lead to the congestions. In order to deal with these problems, maximum waiting queue length is secured in the simulation, and the signal timing was readjusted. When these results were shown to those parties involved, effective countermeasures were implemented to minimize the congestion.

6 Conclusion

This paper discussed the issues of traffic impact assessment. By analysing the existing indicators of traffic impact assessment criterion values, it was confirmed that there was a potential danger to overestimate or underestimate the traffic impact from new developments. This is due to the change of data over time such as economic data, traffic data, location condition, customer preference, and so on. Through this study, the shortcoming of the existing law was confirmed. Therefore, the need for a more appropriate method for local cities in Japan was confirmed. As far as the integrated database system is concerned, the usefulness of traffic flow simulator for advanced traffic impact assessment was proved. As for the public subsystem for external users, this paper proposed a new data collecting method and systematic analysis procedure. However, in order to conduct traffic impact assessment with high accuracy, it is necessary to update the criterion value regularly. The issues to be solved in the future are to accumulate more data to improve system performance, and adopt XML language for more efficient search capabilities.

7 References

- Tatsuya Seki, Akinori Morimoto and Hirotaka Koike (2002); A Study of Spatial and Temporal Changes of Traffic Impact Assessment Associated with Large Scale Development, Proceeding of Infrastructure Planning, Japan Society of Civil Engineers
- Takeshi Kurokawa, Haruo Ishida, Mamoru Tanigushi and Mikio Togawa (1997); A Study on Transportation Impact Assessment Focusing on Accumulation Effects of Development Projects, City Planning Review, The City Planning Institute of Japan
- Ryoichi Nishimiya and Tetsuo Komeiji (2002); A Comparison of Traffic Generation and Concentration Rate in Traffic Impact Assessment, Proceeding of Infrastructure Planning, Japan Society of Civil Engineers
- Jun-ichi Takayama and Masashi Takeno (1993); A Study on Traffic Access and Impact Studies for A Large Site Development in Urban Residential Area, Proceeding of Infrastructure Planning, Japan Society of Civil Engineers
- Tepei Osada, Akinori Morimoto and Hirotaka Koike (2001); Development of Online Database System for Urban Planning Research Using Java, Proceeding of Infrastructure Planning, Japan Society of Civil Engineers
- Kunihiro Sakamoto, Hisashi Kubota and Kazuki Hirose (2002); Micro Simulation Analysis of Traffic Assessment about Department store, Proceeding of Infrastructure Planning, Japan Society of Civil Engineers