CASPER: The Friendly, Efficient Snow Routes Planner

Snow and ice control is a major operation on highways during the winter months in Indiana. The Indiana Department of Transportation (INDOT) is responsible for the snow and ice control on 46 400 lane-kilometers (29,000 lane-miles) of roadway. The duration of the interval between snowfall and snow clearance from roadways is a good measure of the quality of service. INDOT's focus in this respect is to minimize the duration of that interval to enhance the quality of its service.

PROBLEM

INDOT's goals for winter snow removal operations are to provide safe driving surfaces for the public, to design efficient snow routes that make cost-effective use of maintenance equipment and personnel, and to use deicing materials efficiently. In Indiana these operations require almost 1,500 trained personnel and some 1,200 maintenance vehicles. Each year INDOT allocates more than $9 million in materials to support these operations. Approximately $22 million is spent annually on winter activities.

Each road segment in the INDOT network is rated on the basis of its average daily traffic count (ADT). Class I roads have an ADT greater than 5,000 and receive service every two hours during snow events, whereas routes with ADT less than 5,000 receive service every three hours.

The goal of the Computer Aided System for Planning Efficient Routes (CASPER) is to find routes on which deviation from the target service times is as small as possible and deadhead travel (travel over a given route with no service performed) is minimal. To a lesser extent, road class uniformity is also important. Routes designed by CASPER tend to result in better service to the network using fewer routes.

SOLUTION

The design of snow routes is a major factor in the overall quality of service. Minimizing deadhead travel is an important objective. Efficient snow routes increase the homogeneity of road classes and service quality within a route while minimizing deadhead travel and the number of trucks and personnel necessary.

INDOT maintenance engineers have worked with researchers at Purdue University in West Lafayette, Indiana, for nearly a decade to improve how winter maintenance operations are designed and conducted. Most recently the team has developed CASPER, which is being implemented throughout the state with significant improvement in operations and greatly reduced costs.

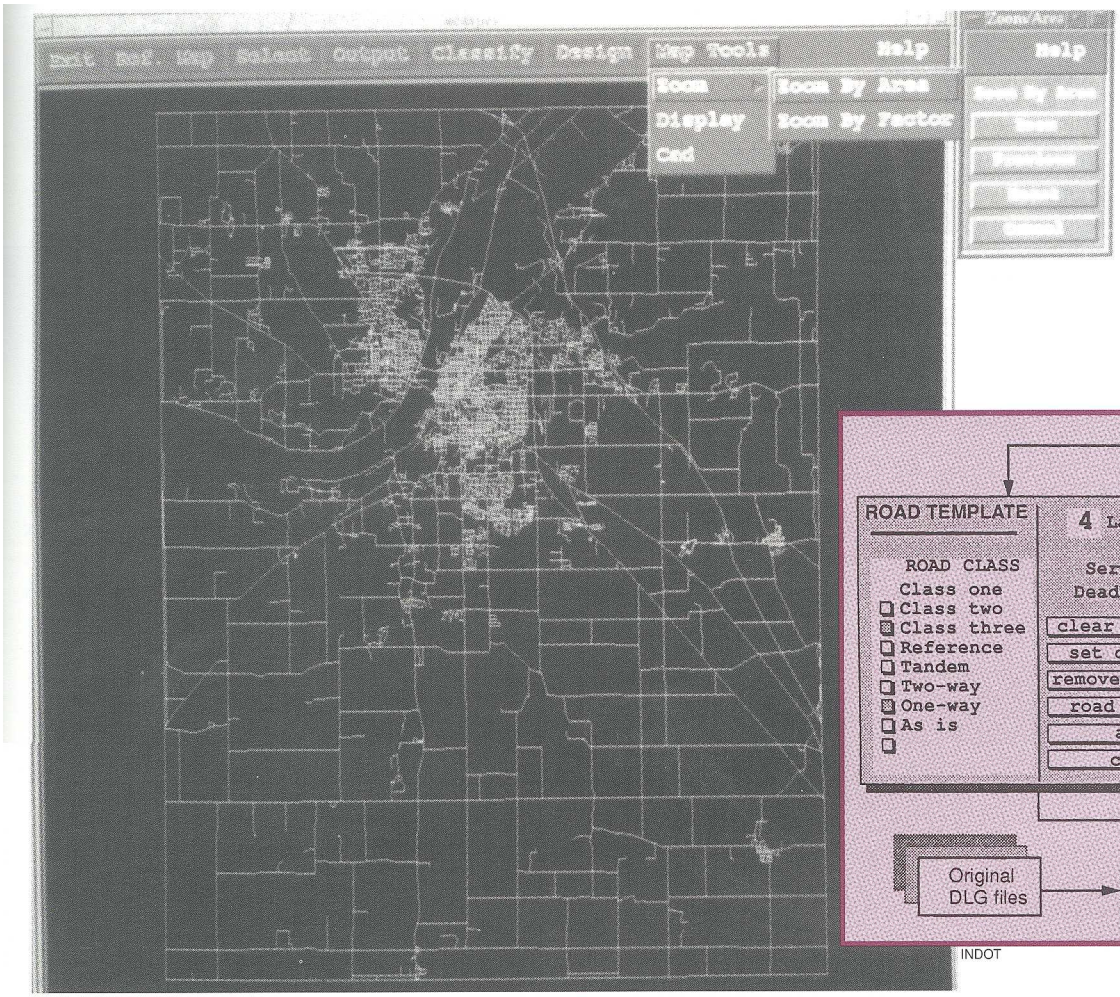
The CASPER decision support system consists of three main components: a spatial Global Information Systems data base containing detailed information about physical aspects of the transportation network, a set of models for optimizing route design, and a user interface that allows INDOT maintenance engineers to interact with the data and models efficiently. Users establish design parameters and route specifications through this interface, which are then used by the system models in finding optimal route configurations. Users need not understand the complex internal workings of the models. Instead they are presented with a clear profile of model results so they can judge immediately whether the routes designed by the system are feasible and practical for implementation. Changes and manual modifications to route designs can be made throughout this process.

APPLICATION

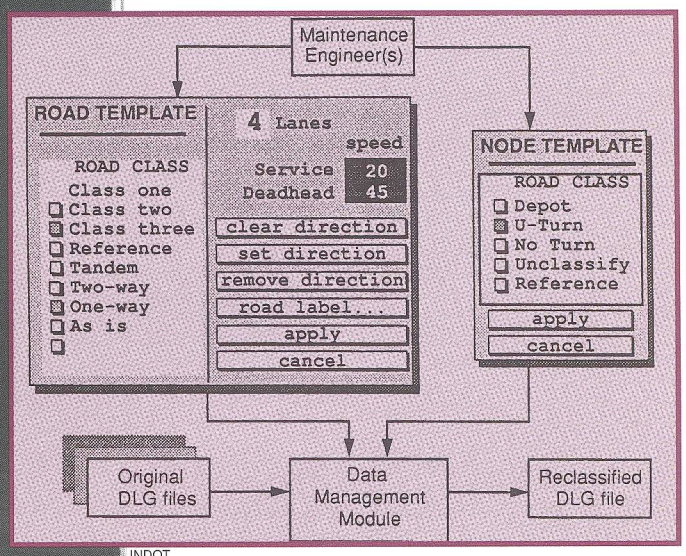
CASPER was implemented during winter 1992-1993 in three INDOT districts, including the Fort Wayne District, which is responsible for snow and ice control on almost 8000 lane-kilometers (5,000 lane-miles). This road network was divided into 163 routes, requiring 181 trucks to service. INDOT maintenance engineers used CASPER to redesign winter service routes, with the goal of minimizing deadhead travel from maintenance depots while making surface treatment time more efficient. The result was 155 routes that required only 173 trucks. Each route reduction eliminated 24 kilometers (15 miles) of deadhead travel.

Application of CASPER in the Fort Wayne District has also eliminated the need for eight new trucks. According to INDOT the cost of purchasing a new truck, with an estimated service life of 10 years, is $65,000. Consequently, savings of about $520,000 were realized. Operational costs, including equipment

Suggestions for "Research Pays Off" topics are welcome, Contact G.P. Jayaprakash, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, D.C. 20418 (telephone 202-334-2952).



CASPER user's interface with pull-down menu for locating and assigning road segments by service areas.



Example CASPER interactive screen.

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repair, maintenance, and materials, average up to $8,200 each year over a 10-year period. Despite the reductions in snow routes, complaints from the public have decreased.

CASPER is now being used in INDOT's Fort Wayne, LaPorte, and Crawfordsville districts. Additional CASPER routes were designed in 1995 using INDOT's new GIS basemap. By the end of 1996 statewide implementation of CASPER will be complete.

BENEFITS

Maintenance engineers in three INDOT districts have used CASPER to redesign snow routes for winter maintenance vehicles, realizing significant savings. CASPER has reduced the number of snow routes by 17 in these districts, thus eliminating the need to purchase 17 new trucks; it has also reduced deadhead travel by 400 lane-kilometers (250 lane-miles). Savings on the purchase of new trucks is $1,105,000, with potential savings of up to $139,400 each year on operational costs. These savings will accrue without compromising service to the traveling public.

INDOT expects about 50 routes to be eliminated by CASPER statewide. The potential for savings is $3.25 million on new-truck purchases and up to $4.1 million on operational costs over a 10-year period. CASPER is also being considered to assist in other maintenance routing uses such as road painting, sign maintenance, and roadside mowing.

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