Detour or No Detour? A New Decision Support Tool for Urban Freeway Incident Management

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Abstract

Traffic delays on freeway corridors due to congestion have significantly undermined the mobility and reliability of the highway systems in the United States. Most of those delays are due to non-recurrent traffic congestion caused by the reduced capacity and overwhelming demand on critical metropolitan corridors coupled with long incident durations. In such conditions, if proper routing and detour strategies could be implemented in time, motorists could circumvent the congested segments by detouring through parallel arterials, which will significantly enhance the reliability of travel in the corridor system. Nevertheless, prior to implementation of any detour strategy, traffic managers need to ensure the resulting benefits, as implementing those advanced control strategies usually demand substantial amount of resources and manpower.

This paper presents a new decision support tool to warrant detour operations during incident management. Such as tool offers the capability for responsible traffic operators to make consistent detour decisions in response to a detected incident from the system benefit perspective and with multiple affecting factors taken into account. The proposed tool is developed based on the dataset obtained from extensive simulation experiments and operational guidelines for highway agencies. The tool also features its computational convenience and operational flexibility, allowing potential users to make necessary revision and extension if more field data are available. Numerical results clearly indicate that a timely and well-justified detour decision made by the proposed tool can yield substantial benefits to both the driving populations and the entire community.

Keywords: Detour operations; Incident management; Decision support; Logistic regression;

1. INTRODUCTION

Non-recurrent traffic congestion due to incidents, highway construction zones, and special events has contributed up to 60 percent of the total freeway corridor delay in the United States. Under most scenarios, if proper diversion plans can be implemented in time, motorists can circumvent the congested segments and best use the available corridor capacity. To contend with this vital operational issue, transportation professionals have proposed a variety of advanced diversion control and route guidance strategies [1]-[9] to optimally balance the load between the freeway and the arterial systems over dynamically computed time intervals. Certainly, those advanced diversion control strategies have made an invaluable contribution to incident management for freeway commuting corridors. Nevertheless, prior to implementation of any detour strategy, traffic operators need to ensure the resulting benefits, as implementing those advanced control strategies usually demand substantial amount of resources and manpower.

In this regard, very limited information is available in the literature to assist decision makers in assessing the roads and the benefits of implementing detour operations, although numerous traffic safety and operation manuals [10]-[14] have addressed the need of properly diverting traffic flows during major incidents or emergencies.

One of the notable sources for guiding the detour plan development is the Alternate Route Handbook (2006) [15]. This report provides comprehensive and general guidelines for how to plan and execute the alternate route plan with various stakeholder agencies. According to this document, key factors to be considered in establishing criteria for detour plan implementation include incident duration, number of lane blockage, observed traffic condition, time of day, and day of week. The capacity of the proposed alternative route and its background traffic are also critical factors.

Table 1 summarizes the criteria used to decide whether to execute the pre-developed alternate route plan or not in a variety of states. Manual on Uniform Traffic Control Devices (MUTCD) [16] states that major and intermediate incidents lasting more than 30 minutes usually require traffic diversion or detouring for road users due to partial or full roadway closures, while traffic diversion even into other lanes may not be necessary, or needed only briefly for minor incidents usually cleared within 30 minutes.

In review of the literature, it is evident that a reliable tool for traffic control operators to decide when and how to implement detour operations, based on well-justified resulting benefits is one of essential tasks for contending with non-recurrent congestion. Figure 1 illustrates how the detour decision model and consequent benefit analysis are utilized in the incident management system. This study, proposed in response to such need, will present an effective decision function for use by traffic operators to make appropriate detour operations. The process for estimating the resulting benefits will also be provided along with an example study.

TABLE 1 Criteria for Deciding the Implementation of Detour Plans in Various States

AGENCY	CRITERIA
North Carolina DOT – main office	• A complete closure of the highway in either direction is anticipated for 15 minutes or longer.
North Carolina DOT – Charlotte regional office	• No action or discussion occurs until 15 minutes after the incident. After 15 minutes, an alternate route plan is deployed only if the highway is completely closed (all lanes closed, including the shoulder) and expected to last longer than an additional 15 minutes (30 minutes total).
New Jersey DOT	• Level 1: Lane closures on a State highway, expected to have prolonged duration and impact on traffic. • Level 2: Complete closure of highway, anticipated to last more than 90 minutes.
Oregon DOT	• Incident with two or more lanes blocked, or • Incident with one lane blocked and expected to last more than 20 minutes.
New York State DOT Region 1	• Implemented only when the highway is completely closed. • Will not be implemented if at least one lane (or even the shoulder) is open.
Florida DOT District IV	• Two or more lanes blocked for at least 2 hours.
ARTIMIS (Ohio/Kentucky)	• This plan has a detailed table with four different levels, based on criteria. The following represents a summary: - During the morning and afternoon peak hours, an advisory alternate route is deployed in the event of a two-lane closure for more than 2 hours, or a closure of more than two lanes for less than 30 minutes. - Mandatory alternate routes are deployed during the peak hours when more than two lanes are closed for at least 30 minutes.
Ada County, Idaho	• This plan specifies different levels of severity, including: - Levels C and D require implementation of a diversion route. - Level C is an incident taking 30-120 minutes from detection to fully restored traffic flow. - Level D is an incident taking over 2 hours from detection to fully restored traffic flow (including full freeway closure in one or both directions).
Wisconsin DOT (Blue Route)	• Incident causes delays that will exceed 30 minutes.

Source: *Alternate Route Handbook (2006)[16]*

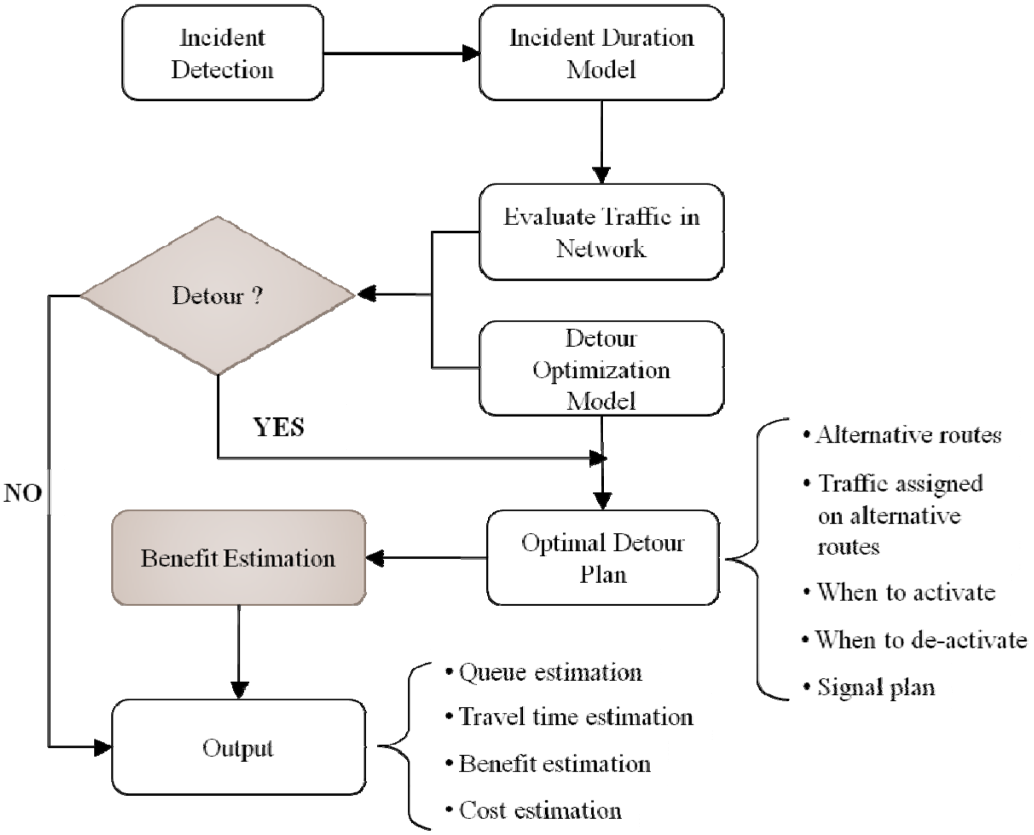


FIGURE 1 The Incident Management System Flowchart

2. METHODOLOGY

Study Network and Experimental Design

To ensure that the developed detour decision model is tractable and also realistically reflect the real-world constraints, the network for an experimental design includes a segment of the freeway mainline experiencing an incident, an on-ramp, and an off-ramp right upstream and downstream of the incident location, and the connecting parallel detour route (see Figure 2).

During an incident, there are many factors that may affect the traffic operator's final decision on whether or not to implement detour operations, such as traffic volumes on the freeway and the detour route, the incident duration and number of lanes blocked, and the number of signals on the detour route, and etc. To accurately reflect the real-world operational characteristics in the study network (e.g. turning-bay, delay on ramps, and driving behavior), we have modeled each experimental scenario with the widely used micro-simulation package, CORSIM. Key variables associated with each experimental scenario are organized into the following groups and the range of values is summarized in Table 2:

- ***Freeway related variables***: *flow rate on the freeway mainline and the number of lanes on the freeway mainline;*
- ***Incident related variables***: *incident duration and the number of lanes blocked; and*

- ***Detour route related variables****: flow rate on the road connecting from freeway to detour route, flow rate on the parallel route, flow rate on the road connecting from detour route to freeway, the number of lanes on the detour route, and the number of signals on the detour route.*

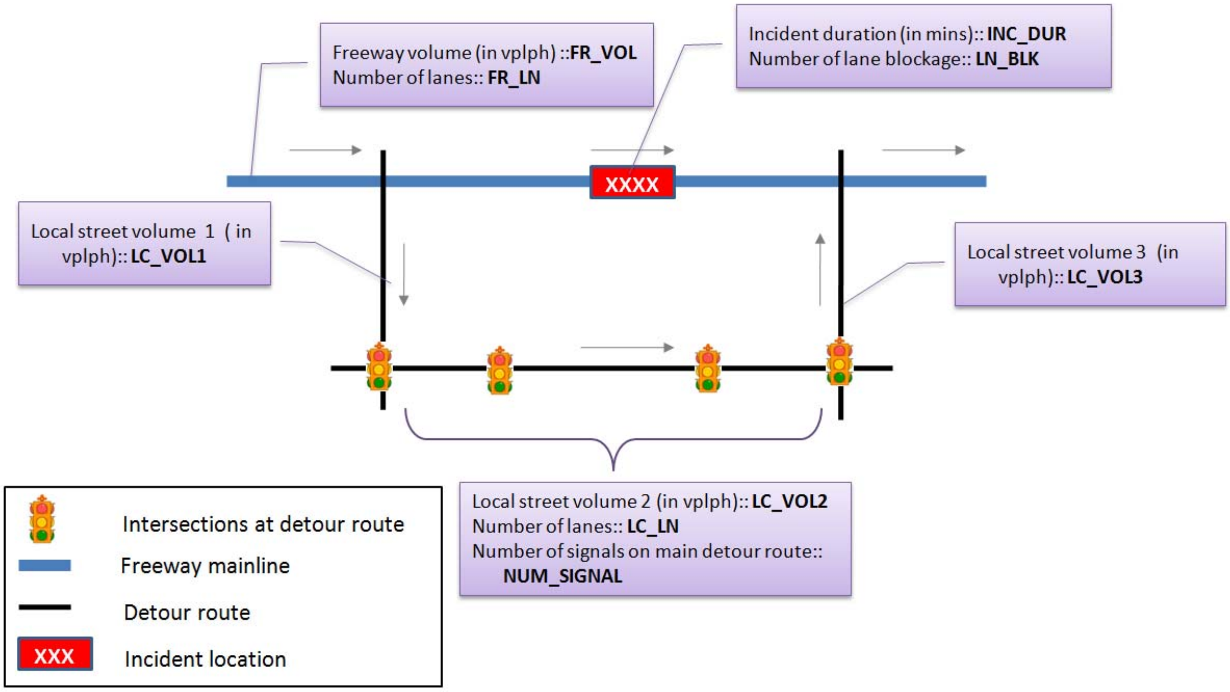


FIGURE 2 The Study Network and Key Variables in the Experimental Design.

TABLE 2 Key Variables and Range of Values for the Experimental Design

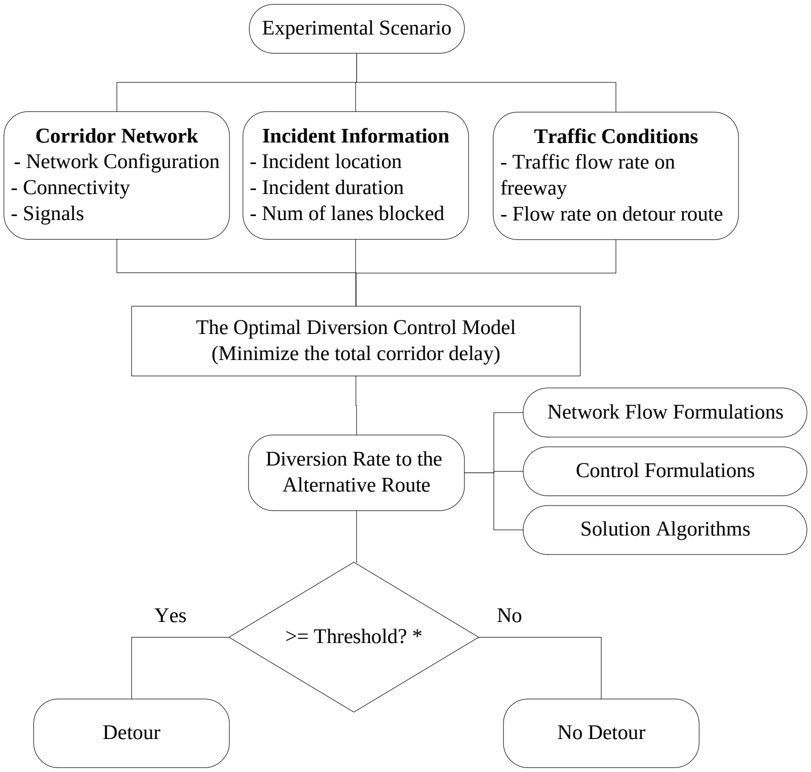
VARIABLES	DESCIRPTION	RANGE OF VALUES
FR_VOL	Flow rate on the freeway mainline (in vphpl)	250, 750, 1250, 1750, 2200
FR_LN	Number of lanes on the freeway mainline	2, 3, 4
INC_DUR	Incident duration (in mins)	15, 30, 45, 60, 75, 90, 105, 120
LN_BLK	Number of lanes blocked due to incident	1, 2, 3, 4
LC_VOL1	Flow rate on the road connecting from freeway to detour route (in vphpl)	200, 300, 400, 500, 600, 700, 800
LC_VOL2	Flow rate on the parallel route (in vphpl)	200, 300, 400, 500, 600, 700, 800
LC_VOL3	Flow rate on the road connecting from detour route to freeway (in vphpl)	200, 300, 400, 500, 600, 700, 800

LC_LN	Number of lanes on the detour route	1, 2, 3
NUM_SIGNAL	Number of signals on the detour route	2, 3, 4, 5, 6, 7

Based on Table 2, the total number of experimental scenarios that can be generated from all possible combination of key variables is: 5×3×8×4×7×7×7×3×6 = 2963520, which will be quite time-consuming or even impossible to evaluate. To contend with this problem, this study has employed a probability sampling approach to randomly select scenarios from the sample space and assure that all scenarios have equal probabilities of being chosen. Using this procedure, we select a total of 500 experimental scenarios for model development, and another 150 scenarios for model validation.

Detour Operations? Yes or No

Based on each generated experimental scenario, this section aims to determine how to decide whether a detour decision should be made or not. The research team has first employed the integrated diversion control model by Liu and Chang [9] to determine the best diversion rate that yields the minimum total corridor delay for each scenario, and then set a minimum threshold value for the diversion rate on the alternate route to convert the decimal diversion rate into a binary decision. Figure 3 illustrates the procedure to make the detour decision for each experimental scenario which will be used for the detour decision model development. We assume that an incident scenario would warrant a detour operation if its optimal flow distribution state demands more than 5 percent of flows to divert to the local arterial.



* The threshold is set as 5 percent in this study

FIGURE 3 The Procedure to Determine the Detour Decision

Table 3 shows how distributions of decisions vary based on different thresholds. Using 10 percent and 15 percent thresholds, the decisions for “yes” or “no” are almost evenly distributed. One can certainly take a different threshold to generate the decision function of different levels of reliability.

TABLE 3 Distributions of Decisions Based on Various Detour Rate Thresholds

Decision	Threshold: minimum detour rate			
	5%	10%	15%	20%
Yes	347 (69%)	267 (53%)	223 (45%)	179 (36%)
No	153 (31%)	233 (47%)	277 (55%)	321 (64%)

The Experimental Data Set and Preliminary Analyses

In addition to key variables described in Table 2, the research team has added the percentage of reduction in freeway capacity as one of the model input variables (denoted by PER_CAP_DROP). The associated values are computed based on the number of freeway, the number of lanes blocked, and the proportion of freeway capacity reduction from the Highway Capacity Manual [17]. Before calibrating the decision model, the research team has performed a preliminary analysis based on the study dataset and decision criteria used by different highway agencies. The purpose is to explore how decisions made by different criteria in the literature can lead to different decisions. In Table 4, the ***Total*** represents the total number of scenarios satisfying the criteria listed in Table 1. Numbers in the columns of ***Yes*** and ***No*** indicates the number of cases that satisfy the decision rule set by this study (i.e., the optimal detour rate to the alternate route should exceed 5 percent), and those do not, respectively, among the cases in ***Total***.

TABLE 4 Comparisons of Decisions Made by Criteria in the Literature vs. the Rule by the Research Team

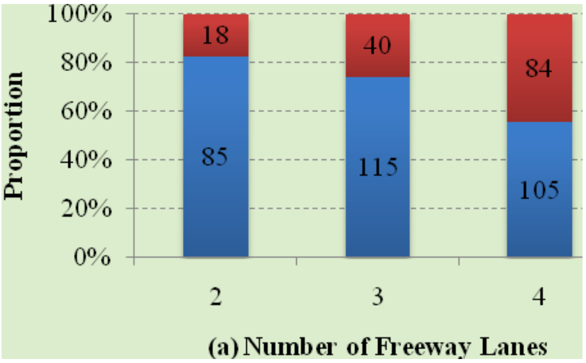
AGENCY		Yes	No	Total
North Carolina DOT– main office		134 (82%)	29 (18%)	163
North Carolina DOT– Charlotte regional office		122 (81%)	28 (19%)	150
New Jersey DOT		50 (82%)	11 (18%)	61
Oregon DOT		255 (78%)	73 (22%)	328
New York State DOT Region 1		134 (82%)	29 (18%)	163
Florida DOT– District IV		32 (73%)	12 (27%)	44
ARTIMIS (Ohio/Kentucky)	Criteria1	30 (79%)	8 (21%)	38
	Criteria2	105 (76%)	33 (24%)	138
Ada County, Idaho	Level C	305 (68%)	142 (32%)	447

	Level D	20 (87%)	3 (13%)	23

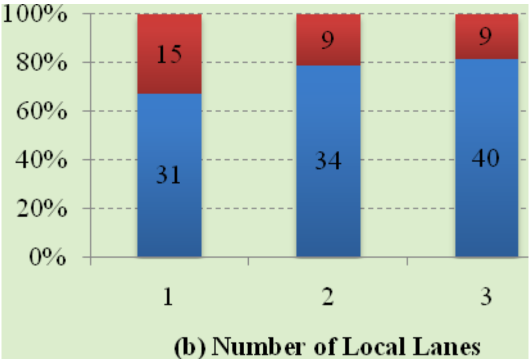
Noting that most agencies as reported in the literature use only the incident duration and lane blockage information for making the detour decision, we conduct further investigation to identify other variables that may contribute to the difference in decisions between other agencies and our results based on the optimal control model. Figure 4 presents the analysis results on the relationship between key factors and the detour decision made with different guidelines from the literature. Some interesting relations are discussed below.

- The results in Table 4 reflect that by using the existing guidelines traffic operators will reach a detour decision different from the suggestion produced by our optimal freeway diversion model in about 20-30 percent of the total cases.
- Most cases exhibit the trend that as the number of freeway lanes increases, it is less likely to make a decision for implementing detour plans, while the number of local lanes shows the opposite trend (see Figures 4(a) and (b)).
- Some cases have an obvious effect by the freeway volumes, indicating that the likelihood of implementing detour operations increases with the freeway volume (see Figure 4(c)).
- The lane blockage ratio also shows a fairly notable impact in some cases in terms of increasing the likelihood of promoting the detour operation.

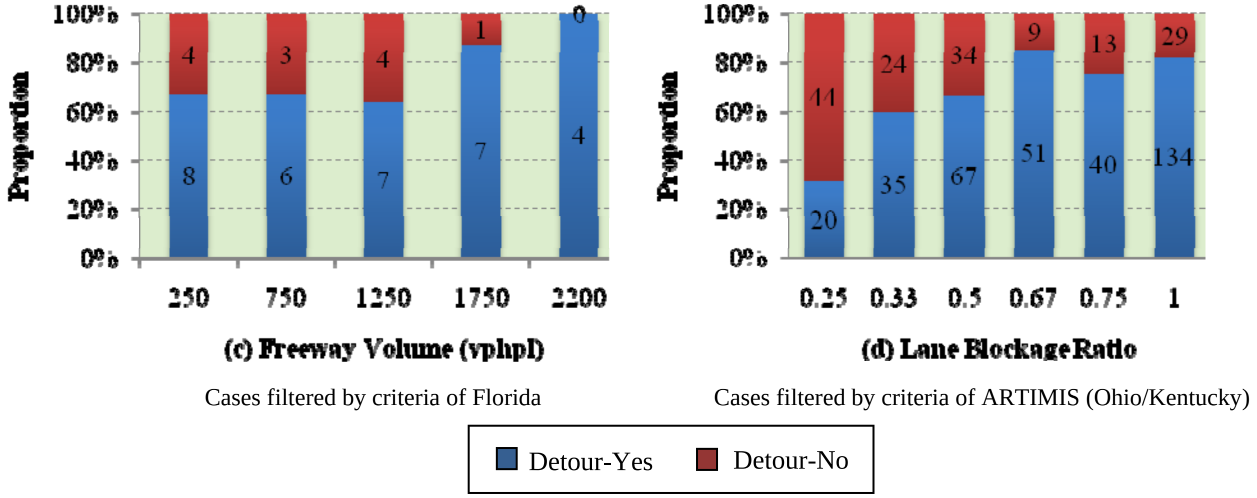
Such discrepancies among existing decision rules as shown in Table 4 indicate the need for more general criteria based on more rigorous analyses so as to support detour decisions that some time may have to be made even by non-experienced traffic mangers. We can also understand that there are some observable relations between explanatory variables and the response variable. For instance, as many lanes are closed, it is highly likely to implement a detour plan. However, there are few references to discuss regarding what value is “many”, or it is more likely to be determined by personal experience or judgment. Moreover, there must be some hidden joint effects which cannot be discovered by this preliminary analysis. Therefore, further studies are required in a more rigorous approach.



Cases filtered by criteria of Ada County, Idaho



Cases filtered by criteria of North Carolina DOT - main office



Cases filtered by criteria of Florida

Cases filtered by criteria of ARTIMIS (Ohio/Kentucky)

FIGURE 4 Proportional Distribution of Decisions by Potential Factors

The Detour Decision Model Development

Since the detour decision is binary in nature, the research team adopts a logistic regression which is one of commonly used methodologies to study a binary dependent variable. The output of a linear regression can be transformed to an appropriate probability using a logit link function as follows:

$$\text{logit}\, p = \log o = \log \frac{p}{1-p} = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k \qquad \text{(Eq.1)}$$

where p is a probability to succeed, and o is the odds representing the ratio of p to 1-p.

Since the odds (o) can be any value in (0, ∞), the log odds (log o) can vary in (-∞, ∞). This value represents what we get from the linear regression on the right hand side of (Eq.1). The inverse of the logit function is the logistic function, thus $logit(p) = z$ can be transformed to:

$$Z = \frac{e^p}{1+e^p} \qquad \text{(Eq.2)}$$

Then, the logistic function maps any value of the right-hand side in (Eq.2) to a proportional value in (0, 1). The parameters included in the model (βi) can be estimated with the maximum likelihood method. The aforementioned theory implies that a unit additive change in the value of the variable changes the odds by a constant multiplicative amount. More detailed discussion regarding logistic models would be found in many references [18]-[20].

Calibrated Model Specifications and Performance

Table 5 summarizes specifications of the selected decision model. The final model demonstrates about 76 percent and 72 percent accuracies for model estimation set and validation set, respectively. Again, the accuracy is determined by whether or not the optimal traffic distribution during the incident management period needs more than 5 percent of its total volumes to the local street. In addition, all variables included in the model are significant at a 95 percent confidence level. The calibrated results also offer the following information:

- The incident duration and the total freeway volume (vph) have negative relations with the response variable, while all other variables included in the final model show positive relations.
- The percentage of capacity reduction shows a positive sign with a high significance.
- When the flow rate on the roadway connecting from freeway to detour route (local street 1 in Figure 2 and denoted in LC_VOL1) is not heavy, it has a strong positive effect on the decision.
- The binary variable to indicate whether the primary detour route includes more than two traffic signals or not shows a high significance with a positive sign. This implies that it is more likely to implement detour plans if the primary detour route has less number of signalized intersections.

From aforementioned findings we can realize that the incident duration alone cannot be a reliable criterion to decide the need of implementing the detour operation.

TABLE 5 Calibrated Logistic Decision-Model

Variables included in the final model	Estimate	Exp (estimate)	Std. Error	z value	p-value
(Intercept)	-1.38300	0.2508	0.54390	-2.54	0.01
INC_DUR	-0.00725	0.9928	0.00323	-2.24	0.02
IF(NUM_SIGNAL <= 2)TRUE[1]	0.67700	1.9680	0.31120	2.18	0.03
IF(LC_VOL1 < 600)TRUE[2]	0.51490	1.6735	0.22140	2.33	0.02
PER_CAP_DROP	3.72800	41.5958	0.53110	7.02	0.00
LC_VOL2*LC_LN	0.00036	1.0004	0.00018	1.99	0.05
FR_VOL*FR_LN	-0.00021	0.9998	0.00004	-4.62	0.00
The number of observations used for calibration		500			
Likelihood with constants only		-307.93			
Final value of Likelihood		-261.605			
Fitted model accuracy		0.764			
Predicted model accuracy		0.723			
The number of observations used for validation		150			

<Note> [1] IF(NUM_SIGNAL <= 2)TRUE: 1 if NUM_SIGNAL <= 2 ; 0 otherwise
[2] IF(LC_VOL1 < 600)TRUE: 1 if LC_VOL1 < 600; 0 otherwise

Table 6 includes details of the re-calibrated logistic model with interaction terms. Although these interaction terms are not included in our final selected model due to their multicollinearlity, we can still get information regarding how variables interact with each other. Both dropped interaction terms are related to incident duration, which confirms its significance again.

TABLE 6 Re-calibrated Logistic Decision Models with Excluded Interaction Terms

Variables included in the final model	Estimate	Exp (estimate)	Std. Error	z value	p-value
(Intercept)	2.29900	9.9642	0.472	4.869	0.000
INC_DUR	-0.06469	0.9374	0.008	-7.692	0.000
IF(NUM_SIGNAL <= 2)TRUE	0.71610	2.0464	0.316	2.269	0.023
IF(LC_VOL1 < 600)TRUE	0.54460	1.7239	0.227	2.404	0.016
LC_VOL2*LC_LN	0.00043	1.0004	0.000	2.337	0.019
FR_VOL*FR_LN	-0.00047	0.9995	0.000	-5.921	0.000
INC_DUR:FR_VOL	0.00002	1.0000	0.000	4.219	0.000
INC_DUR: PER_CAP_DROP	0.05154	1.0529	0.008	6.766	0.000
The number of observations used for calibration	500				
Likelihood with constants only	-307.93				
Final value of Likelihood	-250.42				
Fitted model accuracy	0.774				
Predicted model accuracy	0.773				
The number of observations used for validation	150				

To determine the detour decision, first, we need to estimate the probability of being a “yes” for a decision regarding a given scenario (e.g. Scenario 1 in Table 7). Using (Eq. 3) and the estimated coefficients in Table 5, we are able to estimate u, e^u, and p. Values for u, e^u, and p for Scenario 1 are 1.103, 3.012, and 0.751, respectively. Since $p >= 0.5$, one shall decide to implement detour plans.

$$p = \frac{e^u}{1+e^u} \qquad \text{(Eq. 3)}$$

where $u = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k x_k$

To justify the proposed detour operations, one can further conduct the analysis of resulting benefits which can be estimated by the procedure presented in the next section.

3. BENEFIT ESTIMATION

The primary goal to implement detour plans is to mitigate the congestion and the resulting delay due to the unexpected lane closure. Thus, responsible traffic managers need to consider the resulting benefits for comparison with the operational costs. This section briefly illustrates how to estimate the benefits coming from the detour operations. This benefit analysis can be a way to validate the developed detour decision model, since it shows us whether the implemented detour plan is truly beneficial or not from the overall societal perspective.

To illustrate how benefits from detour plans would vary depending on different traffic conditions and incident severities, we select four different scenarios which have been decided to implement detour plans based on our detour decision model. Table 7 displays the details for selected cases and corresponding outputs from the integrated diversion control model, while Table 8 shows the benefits estimated with the following procedure:

TABLE 7 Descriptions of Scenarios for Benefit Analysis Illustrations

Categories		Scenario 1	Scenario 2	Scenario 3	Scenario 4
Freeway : Detour Route Volume Level Incident Severity Lane Closure Status		L:L* Minor Moderate	H:L Intermediate Severe	H:H Intermediate Light	L:H Major Severe
Simulation Model Inputs	Number of Freeway	4	4	4	4
	Number of Detour Route	3	2	3	3
	Number of Lane Closures	2	3	1	3
	Incident Duration (minute)	15	30	60	90
	Freeway Volume (vphpl)	1250	1750	1750	1250
	Local Volume 1 (vphpl)	300	300	500	600
	Local Volume 2 (vphpl)	300	300	700	700
	Local Volume 3 (vphpl)	200	200	200	800
	Number of Signal on Primary Detour Route	2	4	1	5
	Ratio of Lane Closures	0.50	0.75	0.25	0.75
	Percentage Capacity Reduction	0.75	0.87	0.42	0.87
Flow Rate for Each Route	Main Flow Rate	0.78	0.88	0.89	0.86
	Detour Flow Rate	0.22	0.12	0.11	0.14
Saved Outputs (w/o – w/ Detour)	Total Throughput	-666	-577	-1425	-1955
	Total vehicles in queue	437	329	1854	2296
	Total travel time (veh-hr)	114.285	70.1308	194.344	785.437
	Total queue time (veh-hr)	116.419	134.243	1260.52	2734.38
	Total delay reduction (veh-hr)	**230.704**	**204.374**	**1454.87**	**1948.94**

* L: Light H: Heavy

Step 1: Compute the difference in delay between with and without detours

In this research the ***total travel time*** and ***total time in queue*** from the integrated corridor control model output are used to compute the reduced delay due to detour operations.

Step 2: Select other impacts which could be also parts of the benefit analysis

Once the delay decreases for any reason, associated by-products also decrease. We include reduced fuel consumptions and emissions (i.e., HC, CO, NO, and CO_2) in this benefit estimation procedure.

Step 3: Estimate the reduced amount of each by-product based on related references

Assuming that all vehicles are passenger cars, the research team estimates the saved fuel directly from the saved delay using a conversion factor, 0.156 gallons of gasoline / hour, which is provided by the *Ohio Air Quality Development Authority*.

Similarly, the reduced emissions can be estimated based on either the reduced delay or fuel consumption using conversion factors as follows:

- HC: 13.073 grams / hour of delay (provided by MDOT in 2000)
- CO: 146.831 grams / hour of delay (provided by MDOT in 2000)
- NO: 6.261 grams / hour of delay (provided by MDOT in 2000)
- CO_2: 19.56 lbs CO_2 / gallon of gasoline (Energy Information Administration)

Step 4: Convert the saved delay, fuel, and emissions to the monetary value

Similar to *Step 3*, we use monetary conversion factors to estimate the reduced delay and associated by-products in a monetary value. Followings are values and sources for factors.

- Delay: $27.37/ hour (U.S. Census Bureau in 2008)
- Fuel: $2.32/gallon (Energy Information Administration in 2009)
- HC: $6,700/ton [21]
- CO: $6,360/ton [21]
- NO: $12,875/ton [21]
- CO_2: $23 / metric ton (CBO (Congressional Budget Office)'s cost estimate for S. 2191, America's Climate Security Act of 2007)

As shown in Table 7, selected scenarios cover four combinations of traffic conditions (heavy and light volumes) on both freeway and alternate route. All scenarios show significant reduction in delay and its resulting benefits. Notice that the first scenario, which reflects a minor incident case with relatively light volumes on both the freeway and detour route, still demonstrates considerable savings ($ 6,618) according to our case study. For the case with the middle level incident and high volume traffic on both the freeway and local routes, the benefit goes up to nearly $ 42,000. This result also supports that the decision for detour implementation should be made after considering various aspects of related factors and given environments.

TABLE 8 Estimated Benefit Based on Saved Delays

Estimated Benefit ($) from	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Delay	6,314.37	5,593.72	39,819.69	53,342.55
Fuel	41.78	37.01	263.44	352.91
HC	20.21	17.90	127.43	170.71
CO	215.44	190.85	1,358.62	1,820.01
NO	18.60	16.47	117.28	157.10
CO_2	7.35	6.51	46.33	62.06
Total	**6,617.74**	**5,862.47**	**41,732.79**	**55,905.34**

4. CONCLUSIONS AND RECOMMENDATIONS

Despite the increasing attention in minimizing incident-incurred congestion with optimal detour operations, effective guidelines for determining when and how to make such decisions are quite limited. Most existing guidelines are based mainly on the incident duration alone as the primary factor, offering no reliable procedure to consider the compound impacts of all related factors on the resulting detouring effectiveness and overall system benefits.

This paper presents a decision function for determining the necessity of implementing detour operations during incident management from the overall system benefit perspective. It is a part of our integrated incident system, ranging from prediction of incident duration to computation of operational benefits, for contending with non-recurrent congestion. The proposed model features its computational convenience and operational flexibility, allowing potential users to make necessary revision if more data are available. Although the proposed model is calibrated from simulation data, the estimation results of its parameters clearly indicate that several additional variables other than incident duration should be taken into account so that the responsible highway agency can make the proper decision to minimize the congestion incurred by the detected incident.

Our future research along this line is to enhance the preliminary decision model with field data. The further calibrated decision model can then be integrated with other incident management modules to assist traffic control operators in making the following critical decisions during their daily operations: what would be the required duration to clear the detected incident? How long will be the traffic queue during the incident management? Will the projected delay and congestion during the incident management period warrants detour operations? At last what would be the overall benefits and cost for a proposed detour operation?

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