Abstract
A traffic management (TM) strategy is a collection of traffic management measures intended to act upon a given transport situation (traffic problems, special events or transport development states). Such strategies should contain mutually supportive measures; otherwise the desired impact is not obtained and often leads to counter-productive results. This paper presents TM strategies which could be implemented in special cases of disasters. These strategies were developed as a part of a research program undertaken by the author. The required TM measures that form the TM strategies were investigated from disaster-prone or disaster affected regions of India and Germany. These derived TM strategies were developed with consideration of their impact on both areas of application—traffic demand reduction and transport supply augmentation.

1. INTRODUCTION

In this paper the traffic management strategies are formulated for disasters. The main purpose of the strategies is to fulfill the set disaster traffic management (DTM) goals and objectives pertaining to transport accessibility and mobility, transport safety and security, transport economics and transport environment. The DTM goals and objectives are derived from traffic management problems and issues especially in cases during disasters. The fulfillment of an individual traffic management objective may involve multiple strategies with minimum conflicts with each other. The traffic managers in real-time disaster situations implement action plans (known as strategies) through the set of established mechanisms, referred here as traffic management modules. The recognition of the type of traffic management modules makes the implementation of TM measures easier due to anticipated acknowledgement of necessary processes and resources.

An individual strategy may involve several traffic management modules for the implementation of an individual measure. Similarly, different measures form a single strategy for the fulfillment of a defined objective. While the implementation of different strategies and measures may involve the same traffic management modules, the individual TM measure can be influenced to perform differently depending on the needs of a particular strategy through the available traffic management modules in the local environment of transport development.

The formulation of a strategy consists of identifying the influence areas of traffic management which are traffic demand reduction and the transport supply...
augmentation. The influence area of traffic demand is mainly focused to avoid, shift and control traffic through five influence types pertaining:

- to avoid or reduce unnecessary car-mobility,
- to increase the vehicle utilization in road transport,
- to shift the use of individual motorized transport,
- to improve the spatial distribution of traffic volume, and
- to improve the temporal distribution of traffic volume.

Similarly, influence area concerning transport supply is mainly focused on improving the transport supply according to four influence types which are:

- to improve the transport capacity and supply,
- to reduce the traffic accidents and its impacts,
- to improve integration between different activities, and
- to reduce the disturbances in traffic flow.

The given nine influence types are included to cover the full range of disaster traffic management goals and objectives. In this paper, the purpose and the functions of a traffic management strategy are defined by the different influence types in the influence areas of traffic demand and transport supply. A total of nine disaster traffic management strategies are formulated to influence both the traffic demand and transport supply during disasters.

2. DEFINITIONS AND MEASURES OF CLASSIFICATION

In order to explain traffic management strategies, the following definitions are considered. A disaster traffic management strategy is a predefined action plan for the implementation of a set of traffic management measures to improve a specific disaster transport situation. Following this definition of DTM strategy, a traffic management measure is defined as a desired realization of an action that creates traffic impacts towards the desired improvement of a defined transport situation. A strategy is implemented in real-life conditions through the identification of traffic management modules in the local environment of study area. A traffic management module is an established traffic influencing process or mechanism for the implementation of measures.

Following the above definitions, it is clear that implementation of TM measures in the local environment would require processes and mechanisms in place e.g. Incident management,
land-use zoning, road pricing etc. The TM measures (Fig. 1) are very specific in character e.g. electronic toll collection or manual toll collection of observing road pricing. Similarly, TM strategy is an indicative of the type of influence on either traffic demand or transport supply.

A study is conducted to examine the type of TM measures implemented in disasters that occurred in Germany and India (Table 1). The city of Dresden suffered floods in the year 2002 and more than 30,000 people were evacuated. In a tsunami disaster as a result of 2004 Indian ocean earthquake, Nagapattinam, Tamil Nadu was one of the severely affected regions of India. These two cities are investigated to understand the type of TM measures implemented.

A total of 39 measures are classified based on transport modes-public transport, non-motorized transport, individual motorized transport, multi-modal and inter-modal transport, and freight transport. Since the explanation of all 39 measures is beyond the scope of this paper, the classification of TM measures is explained in the following:

- Public transport measures are aimed at patronizing the use of public transport and its associated services. The implementation of public transport measures are advocated in urban situations which experience a high use of IMT modes and a heterogeneous traffic flow conditions;
- Non-motorized transport measures are aimed at the provision of adequate right-of-way for such non-motorized transport modes as bicycles and pedestrians. The NMT measures include the provision of adequate facilities and the safe environment for the operations of both pedestrian and bicycle traffic. Such measures are implemented to harness the potential of cycling and walking to limit the use of individual motorized transport modes for short trips;
- Individual motorized transport measures are aimed at improving the traffic flow conditions and efficiency of IMT modes. Thus, the IMT measures improve traffic safety, transport economy and transport environment;
- Inter-modal transport measures are aimed at the provision and organization of inter-modal facilities especially the parking and transfer points for the purpose of promoting the use of high capacity or high occupancy transport modes (PT and IMT);
- Multi-modal transport measures are aimed at the improvement of the traffic flow conditions by the multiple modes by a single application of measure. This category includes measures such as application of green-wave for all road transport modes and pre-emption of traffic using traffic signal control; and
- Freight Transport Measures are mostly aimed at minimizing the conflicts between FT and other modes. This category also involves the use of available capacities of FT modes by coordinating different FT operators. In addition, the measures
### Table 1 Traffic Management Measures Classification

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Classification and Title of Measures</th>
<th>Investigated regions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Dresden</td>
</tr>
<tr>
<td>PT</td>
<td>Public Transport Measures</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Economic or Preferential Incentives for Public Transport</td>
<td>X</td>
</tr>
<tr>
<td>2.</td>
<td>Public Transport Network Improvements</td>
<td>✓</td>
</tr>
<tr>
<td>3.</td>
<td>Public Transport Scheduling Improvements</td>
<td>✓</td>
</tr>
<tr>
<td>4.</td>
<td>Public Transport Accessibility Improvements</td>
<td>✓</td>
</tr>
<tr>
<td>5.</td>
<td>Personalized Para-transit Services</td>
<td>X</td>
</tr>
<tr>
<td>6.</td>
<td>Public Transport Right of Way Prioritisation</td>
<td>✓</td>
</tr>
<tr>
<td>7.</td>
<td>Disaster Traffic Priority Assignment</td>
<td>✓</td>
</tr>
<tr>
<td>8.</td>
<td>Disaster Transport Services</td>
<td>✓</td>
</tr>
<tr>
<td>9.</td>
<td>Public Transport Information Services</td>
<td>✓</td>
</tr>
<tr>
<td>10.</td>
<td>Public Transport Management Center</td>
<td>✓</td>
</tr>
<tr>
<td>11.</td>
<td>Inter-state Transport Operations</td>
<td>✓</td>
</tr>
<tr>
<td>NMT</td>
<td>Non-Motorised Transport Measures</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Establishment of Footpaths &amp; Facilities</td>
<td>X</td>
</tr>
<tr>
<td>2.</td>
<td>Establishment of Bicycle lanes &amp; Facilities</td>
<td>X</td>
</tr>
<tr>
<td>IMT</td>
<td>Individual Motorised Transport Measures</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Carpooling and other Ride Sharing Programs</td>
<td>✓</td>
</tr>
<tr>
<td>2.</td>
<td>Car Rental Services</td>
<td>✓</td>
</tr>
<tr>
<td>3.</td>
<td>Fuel and Vehicle Taxes</td>
<td>X</td>
</tr>
<tr>
<td>4.</td>
<td>Special Traffic Rules Enforcement</td>
<td>✓</td>
</tr>
<tr>
<td>5.</td>
<td>Vehicle Improvements</td>
<td>✓</td>
</tr>
<tr>
<td>6.</td>
<td>Automobile Roadway Repair Service</td>
<td>✓</td>
</tr>
<tr>
<td>MIM</td>
<td>Multimodal and Intermodal Transport Measures</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Road Network Control (Diversion Routes establishment)</td>
<td>✓</td>
</tr>
<tr>
<td>2.</td>
<td>Road Network Control (Access and parking Restrictions)</td>
<td>✓</td>
</tr>
<tr>
<td>3.</td>
<td>Road Section Control (HOV Lanes Establishment)</td>
<td>✓</td>
</tr>
<tr>
<td>4.</td>
<td>Road Section Control (Speed Management)</td>
<td>✓</td>
</tr>
<tr>
<td>5.</td>
<td>Park and Ride Facilities</td>
<td>✓</td>
</tr>
<tr>
<td>6.</td>
<td>Park and Share Facilities</td>
<td>✓</td>
</tr>
<tr>
<td>7.</td>
<td>Alternate Trip Schedules and Trip substitutions</td>
<td>✓</td>
</tr>
<tr>
<td>8.</td>
<td>Interoperable and Multi-functional Transport</td>
<td>X</td>
</tr>
<tr>
<td>9.</td>
<td>Multimodal Integrated Time Scheduling/Connection Matching</td>
<td>X</td>
</tr>
<tr>
<td>10.</td>
<td>Trip Chaining/Multipurpose Tours</td>
<td>?</td>
</tr>
<tr>
<td>11.</td>
<td>HOV Economic or Preferential Incentives</td>
<td>X</td>
</tr>
<tr>
<td>12.</td>
<td>Improvement of Junction Control</td>
<td>✓</td>
</tr>
<tr>
<td>13.</td>
<td>Improvement of Traffic Signal Control</td>
<td>✓</td>
</tr>
<tr>
<td>14.</td>
<td>Land use ordinances</td>
<td>X</td>
</tr>
<tr>
<td>15.</td>
<td>Traffic and Disaster Information Updates</td>
<td>X</td>
</tr>
<tr>
<td>16.</td>
<td>Work Zone Coordination and Management Centre</td>
<td>X</td>
</tr>
<tr>
<td>FR</td>
<td>Freight Transport Measures</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>City Logistics System</td>
<td>X</td>
</tr>
<tr>
<td>2.</td>
<td>Household Goods Delivery Transportation System</td>
<td>X</td>
</tr>
<tr>
<td>3.</td>
<td>Freight Traffic Operations Control</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: ✓ = Implemented or observed, ? = unknown, X = Partially or not implemented
that reduce the environmental impacts of freight transport are also covered in this category.

3. TRAFFIC MANAGEMENT STRATEGIES

The basis of the formulation of disaster traffic management strategies is the established disaster traffic management goals and objectives. The establishment of disaster TM goals and objectives is based on the transport situations in disasters. The disaster transport situation consists of: (i) traffic and transport problems due to disaster impacts on transport supply and traffic demand; (ii) the transport development state of the disaster affected area; and (iii) traffic and transport operations performance.

Thus, a disaster traffic management strategy involves many individual traffic management modules for its implementation and success. The TM modules are aimed at implementing the traffic management measures and fulfilling the purpose of TM strategies. The TM measures could be influenced through the traffic management modules based on the requirements of a particular strategy. The fulfillment of an individual TM objective may involve multiple strategies, modules and measures that have minimum mutual conflicts between them.

A strategy can influence both the traffic demand and the transport supply. A total of nine TM strategies are formulated that cover a full range of TM objectives in disasters. The intended impacts of each TM Strategy on traffic demand and transport supply with a selection of possible measures are explained in the following sections.

The initial five strategies explained in the later sections are traffic demand reduction strategies and last four strategies are transport supply augmentation strategies.

3.1 Strategy to avoid or reduce unnecessary car-based mobility

Mobility is indispensably integrated in the today’s society and economic processes. Mobility is an essential requirement to achieve a standard of living and for an economic growth. But in exceptional cases like disasters, there is often a need to trade-off mobility options due to the transport deficit and increased traffic demand. The unnecessary mobility is a non-urgent mobility which can be replaced or substituted by providing different transport modes, transport destinations and transport times and thereby facilitates the needs of urgent mobility. Mobility cannot be prevented completely and therefore mobility-reduction need not be an aim of any strategy. This strategy is instead focused on evolving new mechanisms when mobility is no longer necessary (more favorable land use) and by influencing the traffic demand to be more effective such as substitution by linking trips, substitution by technology and substitution by trip modification.

Possible measures of the strategy: Economic or preferential incentives and disincentives (alternate modes, destinations and times), Trip reduction ordinances.
(compulsory closing of public and private establishments, alternative or flexible work schedules), Land-use modification ordinances (temporary land-use zoning), Traffic and disaster information service, City logistics system (freight transport coordination schemes), Household goods delivery transport system (home shopping network).

3.2 **Strategy to increase the vehicle utilization of transport modes**

This strategy increases the vehicle utilization without increasing the traffic volume on the roads. This strategy addresses the basic problem of the low-occupancy vehicle usage in motorized transport modes in disasters. Strategy proposes the full usage of passenger and freight capacity of vehicles and suggests the interoperability of transport modes in view of high traffic demand and low transport supply.

Possible measures of the strategy: Economic or preferential incentives and disincentives (alternate modes, destinations and times), Carpooling and other ride-sharing programs (car-sharing schemes), Road section control (high occupancy vehicle lanes), Traffic and disaster information service, City logistics system (freight transport coordination schemes).

3.3 **Strategy to shift the use of individual motorized transport**

The reduction of car use as well as shifting the car use to other transport modes is an important strategy to overcome accidents, reduce pollution and improve the economy of transport operations. This strategy is used to either shift the use of car to other motorized propulsion-based transport modes such as trains and buses or non-motorized-propulsion based transport modes such as walking or cycling. The application of this strategy does not hinder mobility but its application recommends restrictions on the selection and use of individual motorized transport modes. The strategy also proposes the approach of using the inter-modal and multi-modal transport for the needs of mobility. In this strategy, inadequate road capacity problems are solved with effective utilization of available capacities of alternative means of transport.

Possible measures of the strategy: Economic or preferential incentives and disincentives (alternate modes), Establishment of pedestrian routes and facilities, Establishment of bicycle routes and facilities, Road network control (automobile-restricted zones), Improvement of inter-modal and parking facilities (park and ride, park and share), Road section control (HOV lane management), Traffic and disaster information service (information kiosks).

3.4 **Strategy to improve the spatial distribution of traffic volume**

This strategy addresses the problem of congestion of road network due to a disproportionate use of the capacity of the road. A proportionate distribution of traffic on the network increases the transport capacity while decreasing the traffic
congestion and related impacts on the affected corridors. This strategy can be applied to facilitate the priority of disaster-related emergency traffic due to ambulances, police and fire-brigade vehicles. The principle of vehicle segregation is used to segregate traffic based on needs of the road capacity for other priority traffic. Segregation of traffic includes both motorized traffic (vehicle to vehicle segregation) and non-motorized traffic (vehicle to pedestrian/bicycle segregation). Traffic management objectives; especially safety and environment objectives, are fulfilled by the application of this strategy. The spatial distribution of traffic affects the destination selection as well as the route selection by the road user. Thus, the selection of alternate routes and alternate destinations should be adequately compensated by equivalent benefits such as reduction of travel time. However there exists a problem to attain the collective optimum and individual optimum simultaneously.

Possible measures of the strategy: Economic or preferential incentives and disincentives (alternate routes and destinations), Land-use modification ordinances, Road network control (automobile- restricted zones, access restrictions and modes segregation), Improvement of signalized traffic control (traffic signal control), Improvement of non-signalized traffic control, Improvement of inter-modal and parking facilities (parking management), Traffic and disaster information service (commercial radio and television, dynamic message signs)

3.5 Strategy to improve the temporal distribution of traffic volume
This strategy addresses the issue related to inefficient temporal distribution of the traffic volume. High traffic volumes during certain times can lead to deficit of supply capacity on certain corridors due to concentration of disaster management activities. In cases where the infrastructure supply capacity is underutilized during non-peak periods, this strategy influences the time selection of road users to optimize the use of transport supply in disasters.

Possible measures of the strategy: Economic or preferential incentives and disincentives (alternative work schedules/flexible work schedules/compulsory closing of public and private establishments), Land-use modification ordinances, Freight traffic operations control (freight transport entry time restrictions), Special traffic rules enforcement (access restrictions), Improvement of signalized traffic control (traffic gating), Work- zone coordination and management centre (roadway maintenance management including weather management), Traffic and disaster information service (commercial radio and television, dynamic message signs)

3.6 Strategy to improve the transport supply capacity
This strategy primarily addresses the improvement of the transport infrastructure to increase the utilization of available transport infrastructure and operation capacities. Thus, the strategy includes the operational and administrative measures
to optimally utilize the transport capacity. The construction of new infrastructure is ruled out in this strategy except for minor construction, repair and maintenance of existing infrastructure. The infrastructure is improved for all transport modes by addition to the vehicle fleet for all transport modes, establishment of routes for pedestrians and cyclists, development of missing links and the use of existing non-designed transport spaces for transport purposes.

Possible measures of the strategy: Special disaster transport services (agreements on transport service operations), Land-use modification ordinances (temporary land-use zoning) Public transport network improvement (extension and modification of routes), Public transport scheduling improvement (vehicle rotation plans), Public transport accessibility improvement (feeder services, pedestrian and bicycle routes), Public transport capacity improvement (additional wagons), Road network control, Road section control, Traffic and disaster information service, Work- zone coordination and management centre.

3.7 Strategy to reduce traffic accidents and their impacts

This strategy addresses the traffic and transport issues related to traffic accidents which cause multiple disturbances in traffic and reduce the capacity of the transport infrastructure. Therefore the strategy is intended to reduce both the occurrences of traffic accidents and the negative impacts of traffic accidents on the traffic flow.

Possible measures of the strategy: Special traffic rules enforcement (vehicle improvement), Improvement of signalized traffic control (emergency vehicle priority) Improvement of non-signalized traffic control (speed control, visibility enhancement), Traffic and disaster information service (traffic message channel, disaster training and exercises, traffic education and public awareness), Work-zone coordination and management centre (roadway maintenance management including weather management, information management).

3.8 Strategy to improve integration between traffic-related activities

This strategy adopts a multidisciplinary approach to maximize the efficiency of existing transport systems. Three main characteristics of this strategy are acknowledged. The first main characteristic of this strategy is the integration of modes by synchronizing the travel time tables of various transport modes. The second important characteristic of this strategy is the change of designated use of modes for maximizing the vehicle capacity and minimizing the empty fleet (interoperable transport). The third important characteristic of this strategy is the integration of various activities to minimize the traffic demand and maximize the resource utilization. The synergy effects of this coordination are important for the traffic management. Multi-tasking of activities and modification of roles of traffic management are some examples of this strategy implementation.
Possible measures of the strategy: Public transport scheduling improvement (synchronized travel time tables), Trip reduction ordinances (inter-operable transport, trip chaining) Work-zone coordination and management centre (manual traffic control), Disaster traffic management centre (disaster site traffic control, roadway maintenance), Traffic and disaster information service (pre-trip and en-route information)

3.9 Strategy to reduce the disturbances of traffic flow

This strategy is implemented to reduce the disturbances in traffic flow which originate from sources other than from construction sites, roadway maintenance services and accidents. The strategy includes disturbances in the traffic flow which could be due to prevailing weather conditions during disasters (rain, snow), poor driving behavior (sudden braking or other technical reasons) and non-incident related vehicle breakdowns among other similar sources of traffic flow disturbances. This strategy also reduces the consequences of disturbances on traffic flow.

Possible measures of the strategy: Special traffic rules enforcement (vehicle improvement, speed limits), Road section control (lane management, speed zoning) Improvement of signalized traffic control (traffic signal control), Improvement of non-signalized traffic control (visibility enhancement), Work-zone coordination and management centre (accident and incident management, roadway maintenance management), Traffic and disaster information service (In-vehicle traffic information and route guidance, disaster training and exercises)

4. CONCLUSIONS

Traffic Management in disasters will continue to gain significance in the future and will be an important area in order to achieve all the functions of disaster management concerning transport. The success of traffic management and thereby disaster management can be achieved if all the influence types of the strategies are properly addressed and current modules and measures are effective. In cases where the intended influences are not met, the formulated strategies can provide framework of innovative attempts for the development of necessary modules and measures.

REFERENCES

Abernethy B. and Tarnoff P. Storm warning- What transport can learn from Katrina Traffic Technology International pp.67-70, 72-77October/November 2005
Andree, R., Boltze, M. and Jentsch, H. Entwicklung von Strategien für ein dynamisches Verkehrsmanagement Straßenverkehrstechnik, Heft 12 Köln 2001
Axworthy, L., Fallick, A., Ross, K., Timmer, V. and Seymour, K.
Blees, V., Boltze, M. and Specht, G. Qualitätsmanagement in der Verkehrsplanung Schlussbericht zur Förderung durch das Zentrum für interdisziplinäre Technikforschung (ZIT) an der TU Darmstadt 2002


Boltze, M. Verkehrsplanung und Verkehrstechnik I, II, III / Grundlagen des Verkehrswesens
Skript zur Vorlesung Institut für Verkehr, TU Darmstadt 2003, 2004


Cambridge Systematics, Inc Weather-Responsive Traffic Management: Concept of operations


Centre for Research on Epidemiology of Disasters (CRED) Catholic University of Leuven International Disaster Database www.cred.be Retrieved May 2004


Chinnaraj, S. Resettlement and reconstruction strategy for tsunami affected areas- Master Thesis Department of Housing School of Planning and Architecture New Delhi 2005


Dirgantari Y. Traffic Management in case of Tsunami Disaster, Case Study: Banda Aceh, Indonesia (Master Thesis) Supervisor: Prof. Manfred Boltze, Co-supervisors: Anil Minhans/Wolfgang Kittler Institute of traffic and transport, Darmstadt University of Technology March 2006


Forschungsgesellschaft Für Strassen- Und Verkehrswesen (FGSV) Leitfaden für Verkehrsplanungen FGSV Verlag GmbH June 2001

Forschungsgesellschaft Für Strassen- Und Verkehrswesen (FGSV) Arbeitspapier NR.56 Verkehrstechnik- Einsatzbereiche und Einsatzgrenzen FGSV Verlag GmbH Köln 2002

Dr. Anil Minhans
Forschungsgesellschaft Für Strassen- Und Verkehrswesen (FGSV) Hinweise zur Strategienentwicklung für das dynamische Verkehrsmanagement Arbeitsgruppe Verkehrsführung und Verkehrssicherheit FGSV Verlag GmbH Köln 2003

Forschungsgesellschaft Für Strassen- Und Verkehrswesen (FGSV) Leitfaden für Verkehrsplanungen. FGSV Verlag GmbH Köln 2001

Forschungsschwerpunkt Integrierte Verkehrssysteme (FSIV) Hauptstudie “Vision Staufreies Hessen” Version 2006 Darmstadt University of Technology Darmstadt 2006

Forschungsschwerpunkt Integrierte Verkehrssysteme (FSIV) Strategien zur Stauvermeidung (Version 2007) Fachgebiet Verkehrsplanung und Verkehrstechnik Technische Universität Darmstadt Hessen 2007


Holle, P. Rettungsdienst im Großschadensfall Berichte der Bundesanstalt fuer Straßenwesen Verlag fuer neue Wissenschaft GmbH Bonn 1998

Indira Gandhi National Open University (IGNOU) Disaster Management: Methods and Techniques Foundation course in Disaster Management New Delhi 2005

Institute of Town Planners, India (ITPI) 55 National Town and Country Planners Congress Technical Papers www.itpi.org.in New Delhi 2007

Institute of Town Planners, India (ITPI) Development of qualitative evaluation methodology for sidewalks in Delhi ITPI Journal pp. 27-33 Vol.4 No.3 ISSN:0537-9679 New Delhi 2007

Institute of Transport Engineers, Georgia Institute of Technology, K.T. Analytics Inc. Implementing Effective Travel Demand Management Measures Ed., Institute of TRANSPORTATION ENGINEERS Washington D.C.1993


Khuat, H. Traffic Management for Motorcycle Dependent City (Doctoral Thesis) Darmstadt University of Technology Darmstadt 2006


Minhans, A. Infrastructure Safety from Natural Hazards- A paper presentation Training Workshop on Formulation of District Disaster Management Plan New Delhi 2006

Ministry of Internal Affairs And Sports Katastrophenschutz in Hessen Landesbeirat fuer Brandschutz, Allgemeine Hilfe und Katastrophenschutz August 2002


Natural Disaster Management Division (NDMD) Disaster Management in India Ministry of Home Affairs www.ndmindia.nic.in New Delhi 2004

Orski, K. Applying ITS technologies to travel demand management TDM review Vol.4 No.2 Association for Commuter Transportation (TRIS online) 2000


Safrin, P. Katastrophenschutz in Deutschland mangelhaft Stern Website http://shortnews.stern.de/ Retrieved April 2004

Saha, S. Disaster Management Helix Infrastructure Safety from Natural Hazards School of Planning and Architecture Conference held on 2nd February 2006 New Delhi


Schwartz, P. and Ogilvy, J. Plotting your Scenarios (Global Business Network) Learning from the future Wiley Publishers California 2004


Simpson, B. Accessibility planning and controlling demand Traffic Engineering and Control pp. 245-247 London July 2005

Sundnes, K. and Birnbaum, M. Health Disaster Management: Guidelines for evaluation and research in the Utstein Style Pre-hospital Disaster Medicine: Basic societal functions (14, 43-52) World Association of Disaster and Emergency Medicine (WADEM) 2002

Tanaka, S., Kuwahara, M., Yoshii, T. and Horokazu, A. Estimation of Travel Demand and Network Simulators to Evaluate Traffic Management Schemes Institute of Industrial Science University of Tokyo and Department of Civil Engineering, Chiba Institute of Technology 2005

Timmer, V. and Seymour, K. The livable city the world urban forum 2006 Vancouver 2006

United Nations Our Common Future World Commission on Environment and Development Oslo 1987

USDOT Effects of Catastrophic events on Transportation System Management US Department of Transportation 2003


White Paper on Disaster Management Department of Constitutional Development South Africa 1999

Wisner, B., Piers, B. and Terry, C. At Risk: Natural Hazards, People’s Vulnerability and Disasters Routledge (Taylor and Francis Group) London March 1994

WORLD BANK Vulnerability Atlas of India info.worldbank.org/ Retrieved May 2005


Zegras, C., Sussman, J. and Conklin C. A proposed approach for strategic regional transportation planning Transportation research board Massachusetts Institute of Technology Massachusetts 2002