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Intelligent Transportation Systems

Functional Design for Effective Traffic Management

Second Edition

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Preface

Functional design, as described in this book, is the selection of ITS management strategies and the field equipment deployments required to implement them. In most cases, functional design stops short of the selection of detailed technologies. Starting with the development of detailed objectives, functional design relates management strategies to project objectives, identifies alternative strategies for further consideration, and evaluates these strategies. It then determines whether one or more strategies can cost effectively satisfy the objectives and recommends the most appropriate alternative.

Although considerable effort has been expended by the Federal Highway Administration and others to develop high-level systems engineering processes, in practice, ITS designers have often used a "bottom up" approach. Designers often select devices and device locations without a strong connection to project objectives or to methodologies that assess the feasibility of the project and the proposed design. This book provides guidance for adapting these systems engineering processes to freeway ITS project functional requirements. It provides the basis for selecting the types of ITS components and the management strategies employed. A number of handbooks and other resources are available to provide guidance for the detailed selection of field equipment and operations to manage the equipment. This book assumes that the reader is familiar with the functions of ITS devices such as dynamic message signs, highway advisory radio, traffic detectors, and CCTV applications.

This edition is essentially an updated version of *Intelligent Freeway Transportation Systems: Functional Design*. The text discusses the increased emphasis on coordination among transportation management centers and the more intensive management techniques provided by emerging active traffic management strategies. ITS evaluation techniques are described in more detail, and examples of the communication of the results of these evaluations to decision makers and to the public are described. Several types of transportation corridors are described, and examples of corridor management strategies are included. Some material was updated and obsolete material was removed.

The book emphasizes the use of fundamental transportation planning and traffic engineering principles to develop functional designs. It is assumed that the reader is

somewhat familiar with this area. The book largely reflects the author's experience in adapting these principles to ITS design. For example, the book provides models to suggest appropriate locations for such ITS devices as CCTV cameras and dynamic message signs and describes methodologies for estimating the benefits of proposed functional designs. The models enable the designer to estimate the performance differences among alternatives and estimate benefits for functional design purposes. Approximations are introduced to expedite the use of these models by practitioners. While the author has found these models to be useful, readers are encouraged to modify and enhance them to better suit their needs. The web site http://www.springer.com/us/book/9783319147673 provides worksheets that facilitate the use of some of the models. The worksheets are provided in an unprotected format to enable users to modify them as required.

I give particular thanks to my wife, Norma, who provided support and encouragement to complete the effort.

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Contents

List of Symbols, Abbreviations, and Acronyms

The following table defines the symbols, abbreviation, and acronyms that are most commonly used in the book. Parameters and variables used in the equations are defined in the discussion of the equations. Definitions for the appendices are provided in the appendix.

Acronym	Definition
AADT	Annual average daily traffic
ACCR	Accident rate
ACR	Accident rate for section
ADD	Average vehicle delay (diversion)
ADM	Active demand management
ADMS	Archived data monitoring system
ADMS	Arterial dynamic message sign
ADND	Average vehicle delay (no diversion)
ADOT	Arizona Department of Transportation
ADUS	Archived Data Use Service
AID	Automatic incident detection
ALINEA	A local ramp metering algorithm
ANPRM	Advanced notice of proposed rulemaking
APM	Active parking management
AR	Accidents reduced
ARI	Accident rate in interchange area
ARNI	Accident rate in non-interchange area
ARTEMIS	Advanced Regional Traffic Interactive Management and Information System
ATDM	Active traffic and demand management
ATM	Active traffic management
ATSMR	Average time per mile per vehicle saved by metering

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Acronym	Definition
B1	Timely detection probability for a range of scenarios for different detector spacing
B_J	Total mainline traffic in section J
BSM	Basic safety message
C	Capacity
C2C	Center-to-center
CAD	Computer aided dispatch
CALTRANS	California Department of Transportation
CCTV	Closed circuit television
CD	Capacity deficit
CDS	Total corridor delay reduction
CFA	Coordinated freeways and arterials
CFR	Code of Federal Regulations
CMS	Changeable message sign (also known as dynamic message sign)
CO	Carbon monoxide
CONOPS	Concept of operations
crf	Capital recovery factor
CS	Capacity along arterial with signal
CVF	Commercial vehicle fraction
CVRIA	Connected Vehicle Reference Implementation Architecture
DAR	Additional delay incurred by pre-diversion traffic on diversion route
DC	Delay from TC to T
DD	Delay prior to TC
DF	Public diversion fraction for no major arterial congestion
D_I	Delay from the start of the incident up to incident clearance
DIF	Delay for non-diverted freeway traffic
DOT	Department of Transportation
DMS	Dynamic message sign
D_Q	Delay from incident clearance to queue dissipation
DQC	Delay after incident clearance
DSRC	Direct short range communication
DSS	Decision support system
D_T	Total delay
DTA	Dynamic traffic assignment
E511	Emergency telephone response service provided by PSAP
ER	Emission rate
FE	Excess fuel consumption
FHWA	Federal Highway Administration
FRM	Fraction of roadway segment influenced by metering
FRR	Fraction of ramps in roadway segment that contain ramp meters
G	Gini coefficient
GE	Excess fuel consumption rate

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