

SHRP 2 Capacity Project C10B

# **Start-up Guide for the Dynamic, Integrated Model System: Sacramento-Area Application**

SHRP 2 Capacity Project C10B

# **Start-up Guide for the Dynamic, Integrated Model System: Sacramento-Area Application**

**TRANSPORTATION RESEARCH BOARD**

Washington, D.C.

2014

[www.TRB.org](http://www.TRB.org)

© 2014 National Academy of Sciences. All rights reserved.

## **ACKNOWLEDGMENT**

This work was sponsored by the Federal Highway Administration in cooperation with the American Association of State Highway and Transportation Officials. It was conducted in the second Strategic Highway Research Program, which is administered by the Transportation Research Board of the National Academies.

## **COPYRIGHT INFORMATION**

Authors herein are responsible for the authenticity of their materials and for obtaining written permissions from publishers or persons who own the copyright to any previously published or copyrighted material used herein.

The second Strategic Highway Research Program grants permission to reproduce material in this publication for classroom and not-for-profit purposes. Permission is given with the understanding that none of the material will be used to imply TRB, AASHTO, or FHWA endorsement of a particular product, method, or practice. It is expected that those reproducing material in this document for educational and not-for-profit purposes will give appropriate acknowledgment of the source of any reprinted or reproduced material. For other uses of the material, request permission from SHRP 2.

## **NOTICE**

The project that is the subject of this document was a part of the second Strategic Highway Research Program, conducted by the Transportation Research Board with the approval of the Governing Board of the National Research Council.

The Transportation Research Board of the National Academies, the National Research Council, and the sponsors of the second Strategic Highway Research Program do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the object of the report.

## **DISCLAIMER**

The opinions and conclusions expressed or implied in this document are those of the researchers who performed the research. They are not necessarily those of the second Strategic Highway Research Program, the Transportation Research Board, the National Research Council, or the program sponsors. The information contained in this document was taken directly from the submission of the authors. This material has not been edited by the Transportation Research Board.

**SPECIAL NOTE:** This document IS NOT an official publication of the second Strategic Highway Research Program, the Transportation Research Board, the National Research Council, or the National Academies.

# THE NATIONAL ACADEMIES

*Advisers to the Nation on Science, Engineering, and Medicine*

The **National Academy of Sciences** is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. On the authority of the charter granted to it by Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Ralph J. Cicerone is president of the National Academy of Sciences.

The **National Academy of Engineering** was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research, and recognizes the superior achievements of engineers. Dr. C. D. (Dan) Mote, Jr., is president of the National Academy of Engineering.

The **Institute of Medicine** was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Victor J. Dzau is president of the Institute of Medicine.

The **National Research Council** was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purposes of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Ralph J. Cicerone and Dr. C.D. (Dan) Mote, Jr., are chair and vice chair, respectively, of the National Research Council.

The **Transportation Research Board** is one of six major divisions of the National Research Council. The mission of the Transportation Research Board is to provide leadership in transportation innovation and progress through research and information exchange, conducted within a setting that is objective, interdisciplinary, and multimodal. The Board's varied activities annually engage about 7,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation. **www.TRB.org**

[www.national-academies.org](http://www.national-academies.org)

## Acknowledgments

This work was sponsored by the Federal Highway Administration in cooperation with the American Association of State Highway and Transportation Officials. It was conducted in the second Strategic Highway Research Program (SHRP 2), which is administered by the Transportation Research Board of the National Academies. This project was managed by Stephen J. Andrie, SHRP 2 Deputy Director.

The research reported on herein was performed by Cambridge Systematics, Inc., supported by the Sacramento Area Council of Governments (SACOG); University of Arizona; University of Illinois, Chicago; Sonoma Technology, Inc.; and Fehr and Peers. Thomas Rossi, Cambridge Systematics, Inc., was the principal investigator. The other authors of this report are Yi-Chang Chiu of the University of Arizona, Scott Meeks of Cambridge Systematics, and Bruce Griesenbeck of SACOG. The authors acknowledge the contributions to this research from Michalis Xyntarakis, Vassili Alexiadis, Jason Lemp, Rich Margiotta, Eric Ziering, Gerard Vaio, Lawrence Liao, Tazeen Mahtab, and Moshe Ben-Akiva of Cambridge Systematics; Eric Petersen and Lin Zhang, formerly of Cambridge Systematics; Binu Abraham and Gordon Garry of SACOG; Brenda Bustillos, Alireza Khani, Eric Nava, and Hyunsoo Noh of the University of Arizona; Mark Hickman, currently of the University of Queensland, who performed this work while with the University of Arizona; Song Bai and Doug Eisinger of Sonoma Technology, Inc.; Jane Lin and Suriya Vallamsundar of the University of Illinois, Chicago; and David Robinson and Kwasi Donkor of Fehr and Peers.

# Contents

<b>1</b>	<b>Chapter 1</b>	<b>Introduction</b>
1	Overview	
2	Summary of Model	
3	Overview of Model Documentation	
<b>5</b>	<b>Chapter 2</b>	<b>Model Setup</b>
5	Hardware Requirements	
5	Model File Installation	
<b>11</b>	<b>Chapter 3</b>	<b>Input Data</b>
11	Inputs to DaySim	
14	Exogenous Travel	
17	DynusT Highway Network	
18	FAST-TrIPS Transit Network	
<b>20</b>	<b>Chapter 4</b>	<b>Running the Integrated Model</b>
20	Overview	
20	Setup	
24	Running DaySim	
24	Running DynusT and FAST-TrIPS	
25	MOVES	
<b>27</b>	<b>References</b>	

# CHAPTER 1

## Introduction

### 1.1 Overview

The Second Strategic Highway Research Program (SHRP 2) Project C10B—Partnership to Develop an Integrated, Advanced Travel Demand Model with Fine-Grained, Time-Sensitive Networks: Sacramento-Area Application—is an important step in the evolution of travel modeling from an aggregate, trip-based approach to a completely dynamic, disaggregate methodology. In this project, an existing disaggregate activity-based model was integrated with an existing traffic simulation model to create a new, completely disaggregate model. Both models were implemented using open source software.

The product of SHRP 2 C10B is an integrated model that simulates individuals' activity patterns and travel and their vehicle and transit trips as they move on a real-time basis through the transportation system. It produces a true regional simulation of the travel within a region, for the first time using individually simulated travel patterns as input rather than aggregate trip tables to which temporal and spatial distributions have been applied to create synthetic patterns. A unique feature of this model is the simulation of transit vehicles as well as individual person tours using transit.

The new integrated model has been developed and implemented for the entire Sacramento, California, region. The integrated model components include SACSIM, the regional travel model maintained by the Sacramento Area Council of Governments (SACOG)—the regional metropolitan planning organization—and DynusT, a mesoscopic traffic simulation model developed by the University of Arizona. SACSIM includes an activity-based demand model, DaySim. The transit simulation is performed by FAST-TrIPS (Flexible Assignment and Simulation Tool for Transit and Intermodal Passengers), also developed by the University of Arizona. The integrated model also includes the ability to run MOVES, the air quality analysis program developed by the U.S. Environmental Protection Agency (EPA).

Project C10B is documented in a summary report (Cambridge Systematics et al. 2014a). Technical documentation of DynusT as used in Project C10B is provided in a separate report (Cambridge Systematics et al. 2014b); and user information for DynusT for the C10B integrated model has been documented by Chiu et al. (2014). SACOG has documented the SACSIM model (Sacramento Area Council of Governments et al. 2008); and user documentation for DaySim has been provided by Bowman and Bradley (2006). EPA has documented MOVES (U.S. Environmental Protection Agency 2012).

This report provides information for users who wish to run the C10B integrated model. The model files to run the base scenario created for the C10B project for the Sacramento region can be downloaded from the Federal Highway Administration (FHWA) website. *It should be noted that this does not represent an official transportation planning scenario for the Sacramento region; the files are for testing purposes only.* This report instructs users how to install these files and how to run the C10B integrated model.

After this introductory chapter, Chapter 2 discusses the setup of the model on the user's hardware. Chapter 3 describes the input data files needed to run the model, and Chapter 4 provides instructions for running the model. Chapter 5 provides references, including links to the cited documents.

## **1.2 Summary of Model**

The components of the integrated model developed in SHRP 2 C10B include SACSIM, DynusT, FAST-TrIPS, and MOVES. These components are summarized below; users may refer to Cambridge Systematics et al. (2014a) for complete documentation of the C10B integrated model.

### **1.2.1 SACSIM**

SACSIM is a complete travel demand model that is used for planning in the Sacramento region by SACOG. The demand for personal travel within the region is modeled by DaySim, an activity-based demand model. DaySim incorporates a variety of model features, including

- Modeling of each person in the Sacramento region separately through the use of a population synthesizer that creates a synthetic population representing each person and household in the region;
- Modeling of the complete daily activity pattern for each individual, including the number and sequencing of activities defined by seven purposes;
- A series of logit destination, mode, and time-of-day choice models at the tour and trip levels to simulate the choices for each individual;
- Estimation of the start and end times of all activities and trips to the half-hour level of resolution; and
- Parcel-level spatial resolution for home and activity locations.

Other components of SACSIM are used to model, at an aggregate level, the remaining components of regional travel, including travel into, out of, and through the region (external travel), truck travel, and travel to and from Sacramento International Airport.

### **1.2.2 DynusT**

DynusT is a traffic simulation model that is used in a number of areas and lends itself well to the integration with both SACSIM and MOVES. DynusT is a true disaggregate simulation model that can track individual vehicles and transit travelers through the network—consistent with tracking traveler activities in a travel demand model. Furthermore, DynusT is a true dynamic traffic assignment (DTA) model that takes into account both the spatial and temporal effects of congestion. Travelers departing at different times are assigned to routes calculated on the basis of the traveler's actual experienced travel time, which is a critical capability for establishing a consistent and reliable traffic assignment outcome.



### **1.2.3 FAST-TrIPS**

The Flexible Assignment and Simulation Tool for Transit and Intermodal Passengers (FAST-TrIPS) is a model that assigns transit passengers within the transportation network and loads those passengers in a dynamic (time-sensitive) simulation of actual travel. This system essentially serves as a plug-in to DynusT, but is precompiled with DynusT and runs with the DynusT executable.

FAST-TrIPS is a regionwide dynamic transit assignment model that determines an individual-specific transit route for each transit traveler in the system, taking into account published transit schedules and transit vehicle run times that are congestion responsive and are provided by the traffic simulation component of DynusT. FAST-TrIPS deals with both transit-only and park-and-ride trips and is able to maintain multiple constraints associated with activity time-windows and the choice of modes in multimodal travel tours.

### **1.2.4 MOVES**

The Motor Vehicle Emission Simulator (MOVES) is the next generation mobile source emission model developed by the U.S. EPA. MOVES serves as a single comprehensive system for estimating emissions from both on-road and nonroad mobile sources; it replaced MOBILE as the approved model for state implementation plans (SIP) and regional or project-level transportation conformity analyses. MOVES is designed to estimate emissions at scales ranging from individual roads and intersections to large regions. A significant break in MOVES design from EMFAC (the air quality analysis program used in California) and MOBILE is that MOVES is a database-driven model—inputs, outputs, default activities, base modal emission rates, and all intermediate calculation data are stored and managed in MySQL databases. MOVES model functions query and manipulate MySQL data pursuant to scenario parameters specified in a graphical user interface (GUI). This design also provides users with flexibility in constructing and storing their own database under the unified framework in MySQL. MOVES incorporates input data that include vehicle fleet composition, traffic activities, and meteorology parameters at the macro-, meso-, or microscale and conducts modal-based emissions calculations using a set of model functions. The outputs of emissions inventories or emissions factors are functions of modal-based vehicle emission rates and detailed vehicle activities specified for the desired geographic scale.

## **1.3 Overview of Model Documentation**

Since the C10B integrated model includes several existing models, which have been completely documented elsewhere, this start-up guide does not attempt to duplicate the existing user documentation for these models. Additional references include the following:

- The software to run SACSIM is documented by Bowman and Bradley (2006). It should be noted that this report documents the original version of SACSIM, and the C10B project made some modifications to the model, as documented by Cambridge Systematics

et al. (2014a). However, the modified program to run SACSIM operates very similarly to the original DaySim05 program, with the same input files and the same file formats. Key information from the SACSIM user documentation is included in this report, and any differences from the original model operation are noted.

- General DynusT user documentation is available at [www.dynust.net](http://www.dynust.net). The University of Arizona has developed detailed user documentation for the DynusT–FAST-TrIPS integrated model system that is included in the C10B integrated model (Chiu et al. 2014). The key points from the detailed user documentation are included in this report.
- MOVES has been documented by EPA (U.S. Environmental Protection Agency 2012).

The executable versions of SACSIM (including DaySim) and DynusT that are part of the C10B integrated model are included in the file downloads from the FHWA website. SACSIM and DynusT are available under open source licenses, and the National Academy of Sciences (NAS) is the owner of all software produced initially for the C10B project (which is also included in the FHWA downloads). The tests of the model performed as part of the C10B project used some input data from SACSIM that were developed using a proprietary modeling software package licensed to SACOG and Cambridge Systematics, Inc.; however, the operation of the integrated model does not require any commercial travel demand modeling or simulation software. The files generated by the proprietary modeling software package have been converted to flat files and are included in the FHWA website downloads.

MOVES must be downloaded from the EPA website at <http://www.epa.gov/otaq/models/moves/#downloading>.

## **CHAPTER 2**

### **Model Setup**

This chapter describes setting up the model on the user’s hardware system. The minimum hardware requirements are shown, and instructions are provided on the files that need to be installed and the folder structure for these files.

## 2.1 Hardware Requirements

This integrated model runs on computers using the standard Windows operating system. The hardware requirements are as follows:

- 16 GB RAM,
- 128 GB drive [solid state drive (SSD) preferred], and
- Intel Core i7 processor or equivalent (4 cores/8 threads).

## 2.2 Model File Installation

All files needed to run the Sacramento regional model for the base test scenario can be downloaded from the FHWA website. Generally, the folder structure on the FHWA site follows the structure used in running the model, although some of the files need to be unzipped before the model is run.

A main folder where the C10B integrated model will be run should be created. Two main subfolders should be created: *DaysimRegional* and *DynusTRegional*.

### 2.2.1 DaySim

The *DaysimRegional* folder includes the following files related to running DaySim as part of the C10B integrated model:

- The DaySim executable (*DaySim\_v7\_Nov2012.exe*) and control file (*Daysim.ctl*) applicable to the C10B integrated model;
- The DaySim model coefficient file, *coeffs.txt*;
- The internal-external trip table file, *ixximat.txt*;
- Various Python scripts used to convert data between DaySim and DynusT:
  - *createPathFileS.py*,
  - *createVehFileS.py*,
  - *DynusT2DaySim\_skim.py*,
  - *popReqDictS.py*,
  - *PT2VT.py*, and
  - *TransitSkimsUpdate.py*;
- Three template files, *pfiletemplate.dbf*, *sfiletemplate.dbf*, and *tfiletemplate.dbf*. These files will be populated with DaySim output for person-level, trip-level, and tour-level data, respectively.

A flat file with the initial skims for the first iteration of DaySim, named *skims.dat*, is also located here. The file format is dictated by the requirements of DaySim. Text files with the original skim data for the base year SACSIM model are located in a subfolder named *InitialSkims*. The file names have the format *skXXYY.txt*, where *XX* represents the mode for the

skims (*au* for auto, *tw* for transit with walk access, and *td* for transit with drive access) and *YY* represents the time period from SACSIM (*am* for a.m. peak period, *md* for midday, *pm* for p.m. peak period, *ev* for evening, and *em* for early morning). These files were created by SACOG using a proprietary modeling software package licensed to SACOG; this proprietary package is not needed to run the C10B integrated model. The script *ExpandRegionalSkims.bat* creates the initial skim inputs for DaySim at the half-hour level from the more aggregate time periods.

There are two other subfolders to the *DaysimRegional* folder. The data subfolder includes various data files related to the synthetic population and other socioeconomic/land use input data to DaySim, which in the initial download are located in the zipped file *data.zip*. These include

- *parc.dbf*—Parcel data,
- *pop.dbf*—Synthetic population,
- *marg\_130.dbf*—Census Transportation Planning Products (CTPP) data used in developing the synthetic population,
- *pumssrt\_130\_mod.dbf*—Public Use Microdata Sample (PUMS) sample used in developing the synthetic population, and
- *taz.dbf*—Miscellaneous zone-level data.

See the DaySim documentation (Bowman and Bradley 2006) for more details on these files.

## 2.2.2 DynusT and FAST-TrIPS

The *DynusTRegional* folder includes the files related to running DynusT and FAST-TrIPS as part of the C10B integrated model. A large number of files are required to run DynusT and FAST-TrIPS. Table 2.1 shows these files by type. For details about these files, see Chiu et al. 2014.

In addition to the files shown in Table 2.1, the files representing “exogenous travel” must be included in the DynusT vehicle simulation. Some vehicle demand in SACSIM is not generated by DaySim, including truck, external, and airport travel. Truck travel data are located in the *demand\_truck.dat* file, while the airport and external travel data are included in the *demand.dat* file. These files are zipped (e.g., *demand.zip*) on the FHWA website and should be unzipped before the model is run.

**Table 2.1. Files Required in *DynusTRegional* Folder**

---

### Executable Files

CalculateDynamicSkimsv3_64bit.exe	ft_PassSim30_32.exe
dbfpy-2.2.5.win32.exe	ft_PassSim30_64.exe
DynusTv3bx64.exe	ft_Simulation.exe
FAST_TrIPS.exe	MIVA2012.exe
ft_intermodal.exe	vcredist_x64.exe

## Data Files

AltPath_transit.dat	moves_input-RC-EXAMP.dat
AltTime_InterModal.dat	network.dat
AltTime_transit.dat	origin.dat
bg_demand_adjust.dat	output_option.dat
bitmap.dat	parameter.dat
bus.dat	pricing.dat
BusTrajectory.dat	ramp.dat
CheckTrafficFlowModel.dat	reliability_input.dat
control.dat	scenario.dat
convergence.dat	sensor.dat
demand_HOV.dat	sim_terminate.dat
demand_superzone.dat	SpaceTimePar.dat
destination.dat	StopCap2Way.dat
DivertedVeh.dat	StopCap4Way.dat
DST-FSTRPConfig.dat	subarea.dat
epoch.dat	superdemand.dat
ft_input_accessLinks.dat	superzone.dat
ft_input_centroids.dat	super_space_split.dat
ft_input_parameters.dat	super_time_split.dat
ft_input_Park-n-Rides.dat	system.dat
ft_input_routes.dat	TAZ_mapping.dat
ft_input_stops.dat	toll.dat
ft_input_stopTimes.dat	TollRevenue.dat
ft_input_system.dat	TrafficFlowModel.dat
ft_input_transfers.dat	TransitDwellTime.dat
ft_input_transitVehicles.dat	TransitDwellTime_original.dat
ft_input_trips.dat	TransitRouteSchedule.dat
GradeLengthPCE.dat	VehPos.dat
hazmat.dat	version.dat
incident.dat	vms.dat
incident_Do_not_change.dat	WorkZone.dat
leftcap.dat	xy.dat
linkname.dat	YieldCap.dat
linkxy.dat	zone.dat
movement.dat	

---

**Table 2.1. (continued) Files Required in *DynusTRegional* Folder**

---

<b>Library Files</b>	
DLL_ramp.dll	mfc42.dll
leftcap.dat	openDTA.dll
libexpat.dll	pdbx.dll
libguide40.dll	Ramp_Meter_Feedback_CDLL.dll
libifcoremd.dll	Ramp_Meter_Feedback_FDLL.dll
libiomp5md.dll	Ramp_Meter_Fixed_CDLL.dll
libmmd.dll	Ramp_Meter_Fixed_FDLL.dll
<b>Python Scripts</b>	
DST_FT_module.py	ft_BST.py
FAST_TrIPs.py	ft_demandConv.py
<b>Other Files</b>	
node.csv	Regional Model-Transitline03262012-postETG.dws
PathInput.txt	SimPeriod.opt
pathInputNAME.txt	sktwam.txt
queue.csv	sktwmd.txt
queue_summary.csv	workingdir.ini
Regional Model-Transitline-postETG-AddTransitlines-04302012.dws	

---

The *VehicleDemandGen* subfolder resides in the *DynusTRegional* folder. This folder includes four Python scripts needed for the model:

- *createPathFileS.py*,
- *createVehFileS.py*,
- *DaySim2DynusTMAINprog.py*, and
- *popReqDictS2.py*.

*InputFile* is a subfolder of the *VehicleDemandGen* subfolder. It contains the following necessary network and parcel input files [see Chiu et al. (2014) for details on these files]:

- *DSTtoDYSzones.txt*,
- *Node-LatLong.geo*,
- *Parcel-LatLongZone.geo*,
- *parcelMOD.txt*,
- *ParcelnewXY.py*,
- *PathInput.txt*, and
- *pathInputNAME.txt*.

### 2.2.3 MOVES

The C10B integrated model can be run with or without MOVES. If MOVES is to be run, the user should download the MOVES installer from the EPA website:

<http://www.epa.gov/otaq/models/moves/index.htm>. The installer can install all requirements of the MOVES software, including MySQL and Java.

MOVES and MySQL do not have to be on the same server with DaySim and DynusT. However, once DynusT is run, it will be necessary to transfer DynusT output to a directory that MOVES can access.

# CHAPTER 3

## Input Data

This chapter briefly describes the input data for the model. The user should refer to the user documentation for SACSIM/DaySim (Bowman and Bradley 2006) and for DynusT–FAST-Trips (Chiu et al. 2014) for detailed information about these inputs.

### 3.1 Inputs to DaySim

#### 3.1.1 Zone/Parcel Information (Including Socioeconomic/Land Use Data)

The data subfolder of the *DaysimRegional* folder contains the input files for land use, parcel, and miscellaneous zone data. These files include

- *parc.dbf*—Parcel data. This file includes information about each land use parcel in the region, including location, activity in and around the parcel, transit access and parking information, and other information. Complete file format information can be found in Bowman and Bradley (2006).
- *taz.dbf*—Miscellaneous zone-level data. The file structure is shown in Table 3.1.

**Table 3.1. Zone Data File Format**

Label	Definition	
TAZ	Zone number	
AUTACC	Auto access time (min × 100) <sup>a</sup>	
AUTEGR	Auto egress time (min × 100) <sup>a</sup>	
PRKCOST	Parking cost in zone (cents/hour) <sup>a</sup>	
DAVIS	Davis dummy (0/1)	
PEDENV	Pedestrian environment score <sup>a</sup>	
PUMA	PUMA code for zone	
RAD	RAD code for zone	
XCORD	X coordinate of zone centroid (state plane feet)	
YCORD	Y coordinate of zone centroid (state plane feet)	
PKNRCOST	Park and ride lot cost in zone (cents)	
SQFT_Z	Area of zone (square feet)	

a Not used in models.

Source: Bowman and Bradley (2006), p. 5.



### 3.1.2 Synthetic Population

The file *pop.dbf* contains the synthetic population data for the region. While the DaySim model includes a synthetic population generator, for the C10B project, the same generated synthetic population was used for all testing; this is the information contained in *pop.dbf*. (For information about how to generate different synthetic populations in DaySim—for example, for a different forecast year or different land use scenario—the user should consult the DaySim documentation.)

The files *marg\_130.dbf* and *pumssrt\_130\_mod.dbf* include CTPP data and PUMS sample data, respectively, used in developing the synthetic population. These should not be changed by the user.

### 3.1.3 Travel Time/Cost Information (Skims)

For the initial iteration of DaySim, before DynusT has been run for the first time, an initial set of travel time/cost information (skims) is needed. For the testing done for the C10B integrated model, SACOG created these initial skims from SACSIM, using the network and skimming procedures associated with its proprietary modeling software package. SACSIM uses two peak periods (a.m. and p.m.) and three off-peak periods (midday, evening, and early morning) for skimming and trip assignment. The file names for the skim files created by SACOG have the format *skXXYY.txt*, where *XX* represents the mode for the skims (*au* for auto, *tw* for transit with walk access, and *td* for transit with drive access) and *YY* represents the time period from SACSIM (*am* for a.m. peak period, *md* for midday, *pm* for p.m. peak period, *ev* for evening, and *em* for early morning).

DaySim requires that the skim inputs be text files with different formats, depending on transportation mode. The formats for the skim files for the walk, auto peak, auto off-peak, transit walk access, and transit drive access modes are shown in Tables 3.2, 3.3, 3.4, 3.5, and 3.6, respectively. For transit, the reverse directions of the a.m. peak paths are used for the p.m. peak.

**Table 3.2. Walk Skim File Format**

<b>Label</b>	<b>Definition</b>
ORIG	Origin zone
DEST	Destination zone
WALKDIST	Walk distance (miles × 100)

Source: Bowman and Bradley (2006), p. 6.

**Table 3.3. Peak Auto Skim File Format**

<b>Label</b>	<b>Definition</b>
ORIG	Origin zone
DEST	Destination zone
D1TIME	Single-occupancy vehicle (SOV) time (minutes × 100)
D1DIST	SOV distance (miles × 100)
D1EXTT	SOV congested time 1 (minutes × 100)
D1EXTT2	SOV congested time 2 (minutes × 100)
D1TOLL	SOV toll (cents)
D2TIME	High-occupancy vehicle (HOV) + time (minutes × 100)
D2DIST	HOV distance (miles × 100)
D2EXTT	HOV congested time 1 (minutes × 100)
D2EXTT2	HOV congested time 2 (minutes × 100)
D2TOLL	HOV toll (cents)

Source: Bowman and Bradley (2006), p. 6.

**Table 3.4. Off-Peak Auto Skim File Format**

<b>Label</b>	<b>Definition</b>
ORIG	Origin zone
DEST	Destination zone
D1TIME	SOV time (minutes × 100)
D1DIST	SOV distance (miles × 100)
D1EXTT	SOV congested time 1 (minutes × 100)
D1EXTT2	SOV congested time 2 (minutes × 100)
D1TOLL	SOV toll (cents)

Source: Bowman and Bradley (2006), p. 6.

**Table 3.5. Transit Walk Access Skim File Format**

<b>Label</b>	<b>Definition</b>
ORIG	Origin zone
DEST	Destination zone
XFNUMW	Number of transfers
XFTIMW	Transfer time (minutes $\times$ 100)
FWTIMW	First wait time (minutes $\times$ 100)
FAREW	Fare (cents)
TRDISW	In-vehicle distance (miles $\times$ 100) <sup>a</sup>
WATIMW	Walk time (minutes $\times$ 100) <sup>a</sup>
TRTIMW	In-vehicle time (minutes $\times$ 100)

a Not used in models.

Source: Bowman and Bradley (2006), p. 6.

**Table 3.6. Transit Drive Access Skim File Format**

<b>Label</b>	<b>Definition</b>
ORIG	Origin zone (drive end)
DEST	Destination zone (walk end)
PKTAZD	Park and ride lot zone number
XFTIMD	Transfer time (minutes $\times$ 100)
FWTIMD	First wait time (minutes $\times$ 100)
DRTIMD	Drive access time (minutes $\times$ 100)
FARED	Fare (cents)
DRDISD	Drive access distance (miles $\times$ 100)
TRDISD	In-vehicle distance (miles $\times$ 100) <sup>a</sup>
WATIMD	Walk egress time (minutes $\times$ 100) <sup>a</sup>
XFNUMD	Number of transfers
TRTIMD	In-vehicle time (minutes $\times$ 100)

a Not used in models.

Source: Bowman and Bradley (2006), p. 6.

The initial skims for the first iteration of DaySim are contained in a combined file named *skims.dat*. DaySim uses skim inputs at the half-hour level of temporal resolution. The file *skims.dat* is created from the *skXXXX.txt* files by the program *ExpandRegionalSkims.bat*.

### 3.2 Exogenous Travel

Exogenous travel comprises external, truck, and airport/special generator travel. Estimates of exogenous travel can come from any source and are provided as inputs in zonal origin–destination format. In the tests performed as part of the C10B project, exogenous travel trip tables were developed using SACSIM model runs, which used a proprietary software package licensed to SACOG. These files for exogenous demand were previously created by SACOG to

reflect the base scenario and are not changed by the C10B integrated model. These versions of the files are included in the downloads from the FHWA website.

The files that include the exogenous demand are *demand.dat* for the airport and external travel data and *demand\_truck.dat* for truck travel data. [There is also an input file named *demand\_HOV.dat* for high-occupancy vehicle (HOV) travel, but since there are no HOV facilities in the base Sacramento network, this file is empty in the downloads.]

The *demand.dat* and *demand\_truck.dat* files have the same format. The data represent time-dependent origin–destination (O-D) matrices, with each matrix containing number of trips to be generated for a specified time period. The format is described in Table 3.7, with an example shown in Figure 3.1. These files are free form with spaces between the data items in each line.

**Table 3.7. File Format of *demand.dat* and *demand\_truck.dat***

<b>Parameter</b>				
Number of O-D matrices listed in this file		Multiplier for uniform increase/decrease		
<b>Start time of each O-D matrix</b>				
Timestamp for (first) demand period	Timestamp for demand period	Timestamp for demand period	.....	Timestamp for (final) demand period
<b>O-D trips</b>				
Start time = <i>xx</i>				
Demand for period	Demand for period	Demand for period	Demand for period	Demand for period

```

24 1.000
0.0 60.0 120.0 180.0 240.0 300.0 360.0 420.0 480.0 540.0 600.0 660.0
720.0 780.0 840.0 900.0 960.0 1020.0 1080.0 1140.0 1200.0 1260.0 1320.0
1380.0 1440.0
Start Time = 0.0
1.7086 9.7574 1.5430 0.7619 0.9307 0.7198
0.6268 0.0513 1.0952 0.3282 0.2562 0.7801
0.3030 0.0000 0.0000 0.0531 0.7311 1.3299
0.6478 0.0000 0.6603 0.2535 0.5571 0.2960
0.5207 0.2428 1.0720 0.5804 0.0424 0.2338
0.1187 0.2167 0.2844 0.1305 0.4086 0.5285
0.1864 0.0676 0.3907 0.0461 0.1670 0.0586
0.0822 0.0939 0.0693 0.1591 0.1285 0.1256
0.2113 0.4016 0.4969 0.3038 0.4302 0.3100
0.4551 0.1548 0.3968 0.1090 0.1274 0.1169
0.1318 0.1482 0.0081 0.2376 0.2025 0.3813
0.4495 0.8524 0.4559 0.1384 0.0604 0.9844
0.2398 0.1311 0.1809 0.1502 0.0585 0.4383

Start Time = 60.0
1.4646 8.3635 1.3225 0.6530 0.7977 0.6170
0.5372 0.0440 0.9387 0.2813 0.2196 0.6686
0.2597 0.0000 0.0000 0.0455 0.6267 1.1399
0.5552 0.0000 0.5660 0.2173 0.4775 0.2537
0.4463 0.2081 0.9189 0.4975 0.0363 0.2004
0.1017 0.1857 0.2438 0.1118 0.3502 0.4530
0.1598 0.0579 0.3349 0.0395 0.1432 0.0502
0.0704 0.0805 0.0594 0.1364 0.1102 0.1076
0.1811 0.3442 0.4259 0.2604 0.3688 0.2657
0.3901 0.1327 0.3401 0.0934 0.1092 0.1002
0.1130 0.1271 0.0069 0.2036 0.1736 0.3268

```

**Figure 3.1. Example of *demand.dat* file.**

If a user wished to create a new scenario and have exogenous travel demand estimates that are consistent with the new scenario, the parts of SACSIM related to truck, airport, and

external travel would have to be run with the appropriate scenario assumptions. SACSIM outside of DaySim requires the use of the proprietary software package, which is not part of the C10B integrated model. Other means of creating appropriate exogenous travel demand estimates consistent with the new scenario could be used, as long as the information is stored in the files *demand.dat* and *demand\_truck.dat* in the correct formats.

### 3.3 DynusT Highway Network

For the tests done as part of Project C10B, a DynusT network was created to represent the base scenario. The files associated with this network are included as part of the FHWA website downloads. This section briefly describes some of these files.

The DynusT network input file is named *network.dat*. This file describes the roadway network configurations including node IDs and link characteristics. The file format and fields are described by Chiu et al. (2014) in that document's Tables 5.18 and 5.19 in Section 5.2.

The file *movement.dat* describes the available movements of every link at the connecting downstream node. The file format and fields are described by Chiu et al. (2014) in that document's Tables 5.20 and 5.21 in Section 5.2.

The file *origin.dat* describes the "generation links" for each zone. A generation link is the location in which a vehicle will enter the network and begin travel towards its destination. Every zone (parcel) must have at least one generation link. A link can be a generation link for more than one zone when that link borders or intersects with more than one zone. The file format and fields are described by Chiu et al. (2014) in its Tables 5.22 and 5.23 in Section 5.2.

The file *destination.dat* describes the destination nodes for each zone. A destination node is the location in which a vehicle will exit the network at the completion of its trip. Every zone (parcel) must have at least one destination node. A node can be a destination node for more than one zone when that node borders or intersects with more than one zone. The file format and fields are described by Chiu et al. (2014) (Tables 5.24 and 5.25 in Section 5.2).

The remainder of Chapter 5 in Chiu et al. (2014) describes a variety of other files with settings and parameters required by DynusT. These files are all included in the FHWA website downloads.

### 3.4 FAST-TrIPS Transit Network

For the tests done as part of Project C10B, a FAST-TrIPS transit network was created based on data from the General Transit Feed Specification (GTFS) to represent the transit system in the base scenario. The input files for FAST-TrIPS are described in Chapter 5 of Chiu et al. (2014). This section provides a brief description of the network files. Chiu et al. provides the details for each of the following files in Subsection 5.1.2:

The file *ft\_input\_stops.dat* contains the information regarding the name, location, type, capacity and other properties of transit stops. No information is stored in this file regarding the transit service at each stop. Chiu et al. (2014) shows the contents of the file with a description of each field.

The file *ft\_input\_routes.dat* contains the information about transit routes. In FAST-TrIPS, a route is the group of trips displayed to riders as a single service. This file includes the general information about routes, such as the name and type of service, and does not provide any information about the service itself.

The file *ft\_input\_trips.dat* contains the list of trips which are served by each route and the associated start time of each trip at a terminal. A trip is a sequence of two or more stops that occurs at a specific time. More information is also provided in this file regarding the type of service and the capacity of vehicles.

The file *ft\_input\_stopsTimes.dat* is the main file describing transit service, in the form of a schedule. It contains the times that each transit vehicle arrives to and departs from individual stops for each trip.

The walk access/egress links are stored in the file *ft\_input\_accessLinks.dat*, which includes the estimate of walking distance and time at each zone to the stops within that zone. The estimate is based on the zone area and the density of stops. The generated links can be used both for access and egress.

Similar to the access links, transfer walking links are stored in the file *ft\_input\_transfers.dat*, which includes the distances and times between pairs of stops at which a transfer is possible. The generated transfer links can be used in both directions even though they are stored as one-way links. For the purpose of transit passenger simulation and to generate transit vehicle objects, the combination of information regarding transit service is used to generate the file *ft\_input\_transitVehicles.dat*, in which each line represents a transit vehicle. The file includes some of the details about each vehicle's movements in the network. The file *ft\_input\_park-n-rides.dat* shows the information of park-and-ride facilities in the network, where travelers can drive, park their car, and transfer to transit systems. The park-and-ride facilities must be connected to some nodes in the auto network and some stops in the transit network using walking links.

Many other files associated with running FAST-TrIPS are included in the downloads from the FHWA website. These include files with parameters and settings as well as files related to the transfer of demand and simulation information between FAST-TrIPS and both DaySim and DynusT. These files are described in the remainder of Section 5.1 of Chiu et al. (2014).





## CHAPTER 4

### RUNNING THE INTEGRATED MODEL

#### 4.1 Overview

This chapter explains how to set up DaySim and DynusT and run the C10B integrated model, including MOVES if desired. This process includes feeding the DaySim output into DynusT and generating updated skim files to feed back into DaySim. These directions assume some familiarity with DaySim [see Bowman and Bradley (2006)] but not as much with DynusT; however, they are still fairly explicit about the DaySim steps, in particular as they relate to the modifications in the skim files and processing the output for DynusT. The objective is for the user to be able to fairly easily set up new scenarios by copying files, modifying configuration parameters, and then running scripts and executables.

The following section describes setting up the initial directories for DaySim and DynusT. To run the programs, the user will first need to make copies of certain files from certain directories, replacing any input data files as needed—such as the DynusT network file. The user will then need to set various values in various configuration files appropriately.

Sections 4.3 and 4.4 describe how to run the integrated model. First, DaySim will be run, possibly with additional command line arguments. Once DaySim completes its run, a Python script will be run on the output, then the results will be copied into a particular folder in DynusT. At that point the user can run the master DynusT Python script, which takes care of preparing inputs for DynusT, running DynusT, and then running the components of the FAST-TrIPS transit simulation. Once DynusT completes its run—if another loop back to DaySim is to be run—an auxiliary program will be run that generates a raw skim file from the DynusT outputs. (DynusT's built-in process for producing the skim file is not used.) The DynusT skim file is then moved to the DaySim folder, and a script that converts the DynusT skim file into the corresponding DaySim skim files is run. At that point the user can start the process of the next loop by running DaySim again with the new skim files.

The process for running MOVES, if desired, is described in Section 4.5.

#### 4.2 Setup

To simplify understanding and keeping track of the various files, DaySim and DynusT files are kept in separate folders. These folders contain various subfolders. To prevent output files from overwriting needed input files or previous outputs, it will be necessary at various times to move or copy certain files. Several Python scripts are used to run various components or convert data, and so it is necessary to have Python installed as well as the DBF Python library.

##### 4.2.1 DaySim

The version of DaySim05 being used in the C10B integrated model has a few minor modifications compared with the original DaySim05 implementation used by SACOG:

- DaySim generates and uses variable value-of-time information.
- The a.m. and p.m. peak period skims (4- and 3-hour aggregations, respectively) have been broken out into individual half-hour aggregations, and the midday 6-hour aggregation has been broken down into individual 1-hour aggregations.

To install the DaySim regional model, the following steps should be performed:

1. Copy the *DaysimRegional* folder from the FHWA website to the destination machine.
2. Extract the zipped files from *data.zip* and *daysim.zip*.
3. Run *ExpandReginalSkims.bat*.

In addition to the standard DaySim files, there will be an additional folder (*InitialSkims*) that contains the versions of the skim files that should be used whenever DaySim is run for the first time when starting a new scenario. An additional script, *PT2VT.py*, preprocesses the DaySim output for DynusT, and an additional executable, *CalculateDynamicSkimsv3\_64bit.exe*, converts the DynusT skim file into the DaySim skims. The main DaySim control file is *daysim.ctl*, though all the parameters in that file can be overridden on the command line. More details on the DaySim files can be found in Bowman and Bradley (2006).

The installation can be tested by running *DaySimCode\_v7\_Nov2012.exe*. This will perform a 1% sample run of DaySim using the default parameters. DaySim will display output on the console and generate a *daysim.txt* output file. In addition, if the simulation completes successfully, the files *pout.dbf*, *tout.dbf*, and *sout.dbf* will be generated. If the *PT2VT.py* script is run, providing a random seed as the argument (e.g., *PT2VT.py 123*), this should produce the file *veh\_sout.dbf*. This file is the primary input from DaySim to DynusT.

#### 4.2.2 DynusT

DynusT has a very large number of both input and output files, as well as various executables and software libraries (see Section 2.2 and Table 2.1). The input files primarily include parameter files to control individual scenario runs and highway and transit network configuration files. The output files include both logging files and data files. A number of files are necessary for DynusT but not directly relevant to the C10B integrated model, and so those files will be sparsely documented. In addition, DynusT uses a number of Python scripts during its execution.

To install the DynusT regional model, the following steps should be followed:

1. Copy the *DynusTRegional* folder to the destination machine.

2. Extract *demand.zip* and *demand\_truck.zip*. *Note:* These files for exogenous demand were previously created by SACOG to reflect the base scenario and are not changed by the C10B integrated model. If a user wished to create a new scenario and have exogenous travel demand estimates that are consistent with the new scenario, the parts of SACSIM related to truck, airport, and external travel would have to be run with the appropriate scenario assumptions. SACSIM outside of DaySim requires the use of a proprietary software package that is not part of the C10B integrated model. Other means of creating appropriate exogenous travel demand estimates consistent with the new scenario could be used, as long as the information is stored in the files *demand.dat* and *demand\_truck.dat* in the correct formats (see Section 3.2).
3. If this is the initial install of DynusT on the machine, the user may need to run *vcredist\_x64.exe* to install some Visual C++ redistributables that DynusT depends on.
4. Copy the *veh\_sout.dbf* file produced from running DaySim and then the *PT2VT.py* script into the *VehicleDemandGen\InputFile* folder.

The user should now be able to run the main DynusT script, *DST\_FT\_module.py*. With the default settings, this script will print out information to the console, run some programs to set up for the transit simulation, and then loop between DynusT and the transit simulation a couple of times (DynusT itself will run two iterations internally).

A number of files must be in place before running the master script. A few of these files are updated when DynusT runs; so if DynusT quits unexpectedly, these files may be left in an inconsistent state. Because of that possibility and also because of the many output files that DynusT produces, it is recommended that the user create a copy of the files in a source directory and then copy those files into a new directory for doing the actual run.

Four main configuration files must be modified for different scenarios:

- *DST-FSTRPConfig.dat*. This is a simple file consisting of two numbers on two lines. The first number indicates the number of DynusT to FAST-TrIPS to DynusT iterations that should take place. The second number indicates whether or not FAST-TrIPS should run.
- *parameter.dat*. This file contains many parameters that control the running of DynusT. The four that the user needs to be concerned about are
  - Line 37—Number of Threads. This should generally match the number of CPUs on the server machine.
  - Line 40—Read Transit flag. Set this to 0 only if running a nontransit scenario.
  - Line 41—Generate Transit from *TransitRouteSchedule.dat*. Set this to 0 only if running a nontransit scenario.
  - Line 54—Skim output switch. Since the *skims.dat* file from DynusT is not used to generate skims for feedback to DaySim, set this to 0.
- *scenario.dat*. This file controls a number of factors related to the way DynusT runs a scenario; the only part that is relevant is Line 7, which controls the distributions of

drivers among the various responsiveness classes. This turns out not to be a major factor in the sensitivity testing or validation, and so this file likely would not be modified.

- *system.dat*. This file controls three important scenario parameters:
  - The first number of the second line controls the maximum number of iterations within DynusT that will occur if DynusT does not converge first.
  - The second number of the second line must be set according to whether or not exogenous trip demand should be included in the simulation. A “0” indicates exogenous demand should be excluded, and a “3” indicates exogenous demand should be included.
  - The fourth number on the third line sets the factor (the relative gap) used to determine whether or not the simulation has converged. The value in the file is an integer > 0; multiply the value in the file by 0.0001 to get the actual relative gap threshold used by DynusT.

In addition, several script, executable, and library files are needed:

- *DST\_FT\_module.py*—Master python control file for running the combined DynusT and transit simulation. This file controls all the other scripts and executables that have to be run for a full scenario. If everything is configured correctly and no errors occur, running this script is the only manual action needed until the DynusT simulation completes.
- *ft\_BST.py*—Script for converting *veh\_sout.dbf* into *veh\_sout.dat*, then running *ft\_intermodal.exe*.
- *DynusTv3bx64.exe*—The main DynusT executable.
- *FAST\_TrIPs.exe*—The main transit simulation executable.
- *FAST\_TrIPs.py*—Primary control script for the transit simulation executables.
- *ft\_Assignment.exe*—Simulation of transit network assignment.
- *ft\_demandConv.py*—Converts *veh\_sout.dbf* to *sout.txt*.
- *ft\_intermodal.exe*—Executable that creates intermodal trip pieces.
- *ft\_PassSim30\_64.exe*—64-bit version of the passenger simulator.
- *ft\_Simulation.exe*—Simulation of transit vehicle movements.
- *DLL\_ramp.dll*, *libexpat.dll*, *libguide40.dll*, *libifcoremd.dll*, *libiomp5md.dll*, *libmmd.dll*, *Ramp\_Meter\_Feedback\_FDLL.dll*, *Ramp\_Meter\_Fixed\_CDLL.dll*, *Ramp\_Meter\_Feedback\_CDLL.dll*, *Ramp\_Meter\_Fixed\_FDLL.dll*, and *mfc42.dll*—*.dll* files required for running the DynusT executable.

### 4.3 Running DaySim

Once DaySim has been configured, it is run by executing the file *DaySimCode\_v7\_Nov2012.exe*. This run should produce the *pout.dbf*, *tout.dbf*, and *sout.dbf* output files. Next, the *PT2VT.py* script is run, providing a random seed as the argument (e.g., *PT2VT.py 123*). This should

produce the file *veh\_sout.dbf*. This file should be copied to the *VehicleDemandGen\InputFile* folder.

## 4.4 Running DynusT and FAST-TRIPS

Copy the *veh\_sout.dbf* file from DaySim into the *VehicleDemandGen\InputFile* folder. Make any desired changes to the configuration files. Run *DST\_FT\_module.py*.

The following output files are created:

- *Convergence.dat*—Output file of iteration convergence statistics.
- *OutMUC.data*—Output file of iteration vehicle status and summary statistics.
- *ft\_convergence.dat*—Transit iteration convergence stats.
- *SummaryStat.dat*—Global summary statistics.
- *VehTrajectory.dat*—Postprocessed to generate data for display in the C10B application and to generate feedback skim files.

The following programs may be used to postprocess data from the application:

- *C10postProcessing.py*—Processes *VehTrajectory.dat*, produces *vehTripDataOut.dat*, processes *SummaryStat.dat*, and produces *networkStatDataOut.dat*.
- *routeBasedTravelTime\_FullRoute.py*—Processes *AltPath.dat* and *AltTime.dat*, and produces *routeBasedTravelTime\_FullRoute\_output.csv*.
- *CalculateDynamicSkimsv3\_64bit.exe*—Processes *VehTrajectory.dat* and produces skim files for feeding into DaySim.

DynusT produces many gigabytes of output files. The user should delete or compress and archive these files, particularly if running on an SSD with limited space.

To feed the updated skims back to DaySim, the program *CalculateDynamicSkimsv3\_64bit.exe* is run after running DynusT, and the resulting *skims.dat* files must be copied to the DaySim input directory. Next, the *DynusT2DaySim\_skim.py* script is run to convert the single *skims.dat* file into the multiple *sk\*.txt* files that DaySim uses.

## 4.5 MOVES

As previously noted, MOVES and MySQL do not have to be on the same server with DaySim and DynusT. However, once DynusT is run, it will be necessary to transfer DynusT output to a directory that MOVES can access.

If MOVES is to be run, there are specific settings that are needed in DynusT. In the file *parameter.dat*, set the value of “Switch for MOVES outputs” to 1. This will cause DynusT to generate three MOVES output files for each hour of simulation:

- *MovesCO2\_Links\_Hour\_<hour>.csv*,

- *MovesCO2\_LinkSourceTypes\_Hour\_<hour>.csv*, and
- *MovesCO2\_opmodedistribution\_Hour\_<hour>.csv*.

The specific network links for which DynusT provides outputs for MOVES are configured in the file *moves\_input.dat*. Other settings include:

- *MovesMode*—While MOVES can model other pollutants, for now DynusT only generates input for CO<sub>2</sub> modeling.
- *DayID*—This should be set to weekday since DaySim models a “typical” weekday.
- *HourID*—This will usually have a value of 0 for modeling a full day, but a specific start time could be chosen for modeling a shorter period.

The next section in the file specifies the links to be modeled. The number of links appears on a line by itself, then each subsequent line specifies the following:

“from node” \_> “to node” \_> MOVES link type \_> County ID \_> Zone ID

MOVES works on an hour-by-hour basis. It is necessary to create separate configurations for every hour of simulation to be run and then create a batch file to run all the configurations.

- *Importer.xml*. This file is a template for the files that describe how the data for 1 hour are to be imported from the DynusT output files. This template file includes the keyword “FILLIN” at every point that needs to be filled in for a particular scenario. The sections that need to be updated are
  - *timespan*,
  - *databaseselection*,
  - *link*,
  - *linksourcetypehour*,
  - *linkopmodedistribution*,
  - *agedistribution*, and
  - *zonemonthhour*.
- *RunSpec.mrs*. This file is a template for the configuration file for running the MOVES simulation for a particular hour. This template file includes the keyword “FILLIN” at every point that needs to be filled in for a particular scenario. The sections that need to be updated are
  - *timespan*,
  - *outputdatabase*, and
  - *scaleinputdatabase*.
- *RunSpecList.txt*. This file lists the *.mrs* files for each hour that the MOVES simulation should be run. Each *.mrs* file is listed on a separate line. This file is an example file for a full 24-hour scenario.

- *Moves.bat*. This is a Windows batch file which runs all the pieces for a complete scenario. This file is an example file for a full 24-hour scenario. Once all the configuration files have been updated as needed, execute this batch file to run the complete MOVES scenario.
  - The first line calls the *setenv.bat* file from the MOVES installation, which ensures that all the environment variables are set up correctly.
  - The subsequent lines except for the last line invoke the MOVES java command line processor with each of the configured *Importer\*.xml* files to import the DynusT output data into the MOVES database.

## REFERENCES

- Bowman, J. L., and M. Bradley. 2006. *SACSIM/05: Activity-Based Travel Forecasting Model for SACOG, Featuring DaySim—The Person Day Activity and Travel Simulator. Technical Memo Number 10, DaySim05 Documentation*. Sacramento Area Council of Governments. <https://www.yumpu.com/en/document/view/18810722/technical-memo-10-daysim05-documentation-jbownannet>. Accessed May 28, 2014.
- Cambridge Systematics, Inc.; Sacramento Area Council of Governments; University of Arizona; University of Illinois, Chicago; Sonoma Technology, Inc., and Fehr and Peers. 2014a. *S2-C10B-RW-1: Dynamic, Integrated Model System: Sacramento-Area Application. Volume 1: Summary Report*. Transportation Research Board of the National Academies, Washington, D.C. <http://www.trb.org/Main/Blurbs/170759.aspx>. Accessed May 28, 2014.
- Cambridge Systematics, Inc.; Sacramento Area Council of Governments; University of Arizona; University of Illinois, Chicago; Sonoma Technology, Inc., and Fehr and Peers. 2014b. *S2-C10B-RW-2: Dynamic, Integrated Model System: Sacramento-Area Application. Volume 2: Network Report*. Transportation Research Board of the National Academies, Washington, D.C. <http://www.trb.org/Main/Blurbs/170877.aspx>. Accessed May 28, 2014.
- Chiu, Y.-C., H. Noh, A. Khani, E. Nava, B. Bustillos, and M. Hickman. 2014. *SHRP 2 C10B Project: Network Users Guide for the Dynamic, Integrated Model System: Sacramento-Area Application*. Transportation Research Board of the National Academies, Washington, D.C.
- Sacramento Area Council of Governments, DKS Associates, Bradley Research and Consulting, and Transportation Systems and Decision Sciences. 2008. *Sacramento Activity-Based Travel Simulation Model (SACSIM07): Model Reference Report (Draft)*. <https://www.yumpu.com/en/document/view/2327410/sacramento-activity-based-travel-simulation-model-sacsim07>. Accessed May 28, 2014.
- U.S. Environmental Protection Agency. 2012. *Motor Vehicle Emission Simulator (MOVES): User Guide for MOVES2010b*. Office of Transportation and Air Quality. <http://www.epa.gov/otaq/models/moves/documents/420b12001b.pdf>. Accessed May 28, 2014.