**MoDOT Calibration Report Template**

June 2020

The Missouri Department of Transportation (MoDOT) may require a calibration report to be submitted in conjunction with all microsimulation projects. A calibration report is meant to serve as proof that a microsimulation model has been adjusted to better replicate real world conditions and its ability to replicate real world conditions has been thoroughly validated using observed counts and measurements.

This template is meant to aid consultants and other parties submitting work to MoDOT in their production of Calibration Reports. Written below are several guidelines which should be considered when using this template:

* *Do not delete any sections in the template*. Instead, if a section does not apply to a given project, write “N/A” and give a brief explanation for why that section does not apply.
* Blue text represents information which should be replaced with project specific information.
* Red text represents information which has been included in the template to better explain what information should go in each section of the report. This text should be deleted before submitting the report to MoDOT.
* *Green / Italicized text* represents content, usually in the form of a table, which has been included to serve as an example of a way to communicate information. This content should either be modified or removed before submitting the report to MoDOT.
* Because each report will have a unique number of tables and figures, the List of Figures and List of Tables below the Table of Contents has been left for the writer of the report to format.
* *Do not alter the format of the template* before submitting to MoDOT.

*Title of Traffic Study*

Calibration Report

Date of Completion

Prepared for:



 Missouri Department of Transportation

 105 W. Capitol Avenue

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 Prepared by:

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**TABLE OF CONTENTS**

[1.0 INTRODUCTION 1](#_Toc43293796)

[1.1 Version of Software Used 1](#_Toc43293797)

[1.2 Future Applications of Calibrated Model 1](#_Toc43293798)

[2.0 MODEL DEVELOPMENT 1](#_Toc43293799)

[2.1 Analysis Study Area 1](#_Toc43293800)

[2.2 Analysis Years 1](#_Toc43293801)

[2.3 Analysis Peak Periods 1](#_Toc43293802)

[2.4 Data Collection and Preparations 1](#_Toc43293803)

[2.4.1 Traffic and Roadway Data 1](#_Toc43293804)

[2.4.2 Base Model Development 2](#_Toc43293805)

[2.5 Model Assumptions 3](#_Toc43293806)

[3.0 MODEL PARAMETER CALIBRATION 4](#_Toc43293807)

[3.1 Calibration Procedure 4](#_Toc43293808)

[3.2 Selection of Calibration Parameters 4](#_Toc43293809)

[3.3 Measures of Effectiveness (MOEs) for Validation 4](#_Toc43293810)

[3.4 Calibration Criteria and Targets 4](#_Toc43293811)

[3.5 Parameter Refinement 6](#_Toc43293812)

[4.0 MODEL VALIDATION RESULTS 7](#_Toc43293813)

[4.1 Traffic Volumes 7](#_Toc43293814)

[4.2 Speed Contour Plots 8](#_Toc43293815)

[4.3 Travel Times 8](#_Toc43293816)

[4.4 Queue Lengths 8](#_Toc43293817)

[5.0 SIMULATION RUNS 9](#_Toc43293818)

[6.0 CONCLUSION 9](#_Toc43293819)

**LIST OF FIGURES**

**LIST OF TABLES**

A list of appendices may be included as needed.

# 1.0 INTRODUCTION

This section and the following subsections should be used to give a brief overview of the project, including but not limited to the microsimulation software being used and the anticipated future uses of the model.

## Version of Software Used

## 1.2 Future Applications of Calibrated Model

# 2.0 MODEL DEVELOPMENT

## 2.1 Analysis Study Area

This section should be used to delineate the extents of the model’s study area. Use of supporting figures, such as an aerial view of the study area with the limits of the area clearly marked, is expected.

## 2.2 Analysis Years

This section should be used to define the model’s base year and the future years for which the model will be used.

## 2.3 Analysis Peak Periods

This section should be used to define the peak AM, Midday, and/or PM periods that the model considers. If warm-up periods were used, or if traffic flow rates were adjusted at regular intervals within the peak period to better reflect dynamic traffic flow, that information should also be explained in this section.

## 2.4 Data Collection and Preparations

### 2.4.1 Traffic and Roadway Data

This section should be used to list the data items used to develop the model, as well as the source and application of each data item. A table like the one shown below may be helpful in communicating this information.

*Table 1: Data Items used for Model Development*

|  |  |  |
| --- | --- | --- |
| *Data Item* | *Source(s)* | *Model Incorporation* |
| *Dashcam video of study area operations* | *STIP Project* | *Roadway geometry, turn restrictions, number of lanes* |
| *Traffic signal timing plans* | *City of Kansas City, MoDOT* | *Detector placement, signal phasing, splits, offsets* |
| *Vehicle speed reports* | *I-70 Corridor Study, MoDOT website* | *Speed distributions* |
| *MoDOT Interactive Traffic Volumes Map* | *MoDOT website* | *Traffic volume estimates and verification of volume and heavy vehicle data collected* |

*Note: Hypothetical data items are listed (Table 1)*

If data collection was required, the corresponding data collection plan may be included as an appendix to this document.

### 2.4.2 Base Model Development

This section should be used to give an overview of the base model development procedure. The steps discussed should be roughly similar to the following: geometry coding, creating speed profiles, coding signal control measures, entering speed changes, coding conflict points and priority rules, entering vehicle inputs, coding vehicle routing, and determining the seeding period.

###

## 2.5 Model Assumptions

This section should be used to list and justify any assumptions made during the model development process, especially those where clarification would be beneficial and those that deviate from default/MoDOT recommended values. A table like the one shown below may be helpful in communicating this information.

*Table 2: Model Assumptions*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Type* | *Category* | *Setting* | *Assumption* | *Reason* |
| *Base Data* | *Distribution* | *Desired speed* | *Linear and non-linear distributions* | *Use posted speed limits +5 mph as the upper bound of desired speed. Distributions were developed based on available data.* |
| *Turn-speed* | *Varies on turn-type and vehicle types* | *Linear distribution of 9 mph, 15 mph, 20 mph, or 25 mph was defined for each turn according to its turn-type and vehicle type.*  |
| *Traffic* | *Vehicle composition* | *Highways/ local streets* | *Vehicles classified by combination trucks, single-unit trucks, and cars* | *Vehicle compositions were developed from available field data* |
| *Vehicle Inputs* | *Intervals & Volumes* | *Seeding Time Duration* | *15 minutes* | *Captures full build up and dissipation of congestion* |
| *Recording interval duration* | *90 minutes* |
| *Routing Decisions* | *Static* | *Relative Flows* | *Proportional traffic distribution* | *In the absence of any data regarding O/D patterns, all patterns were assumed to be proportional* |

# 3.0 MODEL PARAMETER CALIBRATION

This section and the following subsections should be used to explain the steps guiding the calibration process and the methodology supporting those steps.

##  3.1 Calibration Procedure

This section should be used to explain the calibration method used, either trial-and-error or systematic approach, and the procedure related to that method. Supporting figures such as decision trees are encouraged if they are useful in communicating the calibration procedure.

## 3.2 Selection of Calibration Parameters

This section should detail what references were used when deciding on calibration parameters.

##  3.3 Measures of Effectiveness (MOEs) for Validation

This section should be used to list and define the MOEs used for validation, as well as to provide an explanation as to how those MOEs were selected. If MOEs for validation were previously defined in another document, such as a Methods and Assumptions Report, that document should be referenced in this section. If MOEs for validation were selected using guidance from a microsimulation or forecasting manual, that manual should be referenced in this section.

##  3.4 Calibration Criteria and Targets

This section should be used to list the calibration measures and the corresponding targets used to judge the validity of the model. This section should also include the source of data the model results have been compared against. A table like the one shown below may be useful in communicating this information.

*Table 3: Calibration Items and Target*

|  |  |  |
| --- | --- | --- |
| ***Simulated Measure*** | ***Calibration Threshold*** | ***Field Data Source*** |
| ***Simulated Traffic Volume for Peak Hour**** *At intersections, difference targets must be met for at least 85% of approaches.*
* *For freeways, difference targets must be met for at least 85% of freeway mainline segments and ramps.*
 | *Within ± 20% for <100 vph**Within ± 15% for ≥100 vph to <300 vph**Within ± 10% for ≥300 vph to <1,000 vph**Within ± 5% for ≥1,000 vph* | *Balanced peak hour traffic counts [Insert date of counts]* |
| ***Simulated Travel Time for Peak Period****Difference targets must be met for a minimum of 85% of travel time routes. Four arterial routes and three freeway routes were used for calibration.*  | *Within ± 1 minute for routes with observed travel times that are less than 7 minutes**Within ± 15% for routes with observed travel times that are greater than 7 minutes* | *Primary: Google Maps API [Insert Source Date]**Secondary: Travel Time Runs [Insert Source Date]* |
| ***Maximum Simulated Queue Length for Peak Period****Calibration target must be met for a minimum of 85% of the critical locations. Queue impacts were used to justify calibration.*  | *Modeled queues qualitatively reflect impacts of observed queues in the following area:** *Spillback to adjacent intersections*
* *Spillback from ramp intersection to freeway mainline and vice versa*
* *Spillback from turn lanes*
 | *Field observations – [Insert Field Date]* |

##  3.5 Parameter Refinement

This section should be used to list what parameters were adjusted to better calibrate the model to real world conditions. This section should include written justification for selecting these parameters for refinement, as well as information on how the parameters were adjusted. A table like the one shown below may be useful in communicating what parameters were adjusted and how the adjusted values compare to the default values.

*Table 4: Calibrated Parameter Values by Segment Type - Freeways*

|  |  |  |
| --- | --- | --- |
| ***Parameter*** | ***Default Value*** | ***Calibrated Value*** |
| ***Basic Segments*** | ***Merges, Diverges, and Weaves*** |
| *Car Following* |
| *CC0 Standstill distance* | *4.92 ft* | *default* | *default* |
| *CC1 Headway time* | *0.90 s* | *0.50 s* | *default* |
| *CC2 ‘Following’ variation* | *13.12 ft* | *default* | *20.01 ft* |
| *CC3 Threshold for entering ‘following’* | *-8.00 s* | *default* | *-5.00 s* |

# 4.0 MODEL VALIDATION RESULTS

This section should be used to summarize how the selected MOEs were validated. This section and the following subsections should list what time periods MOEs were validated for and any relevant validation targets outlined by the FHWA’s microsimulation guidelines. Using tables to communicate how model output compares to validation targets is highly encouraged. An example of one of these tables that relates to traffic volumes is shown below. The raw data used to create these summary tables should be provided as an Appendix.

## 4.1 Traffic Volumes

*Table 5: Traffic Volume Validation Summary – AM Peak Period*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Criteria/Measures* | *Targets* | *Pre-Peak* | *Peak Hour* | *Post-Peak* |
| *Freeway* | *Arterial* | *Freeway* | *Arterial* | *Freeway* | *Arterial* |
| *Within 100 vph, for flow < 700 vph* | *> 85%* | *100%* | *99%* | *100%* | *100%* | *100%* | *100%* |
| *Within 15%, for 700 vph < flow < 2,700 vph* | *> 85%* | *100%* | *92%* | *100%* | *100%* | *100%* | *100%* |
| *Within 400 vph, for flow > 2,700 vph* | *> 85%* | *97%* | *100%* | *95%* | *100%* | *100%* | *100%* |
| *GEH < 5 for individual link flows* | *> 85%* | *99%* | *100%* | *99%* | *100%* | *100%* | *100%* |

## 4.2 Speed Contour Plots

**Exhibit 1 – Example of a Speed Contour Plot**





## 4.3 Travel Times

## 4.4 Queue Lengths

More subsections may be added depending on the number of MOEs used.

# 5.0 SIMULATION RUNS

This section should be used to document the number of simulation runs performed and show the calculations (if applicable) which determined the appropriate number of simulation runs. If an automated tool was used to determine the appropriate number of simulation runs, this section should include the inputs entered into the tool and the tool’s output.

# 6.0 CONCLUSION

This section should be used to provide a concise summary of the purpose of this document, as well as a very high-level overview of the model calibration and validation process. This may include listing any standards or guidelines which were referred to, what MOEs were used to validate the model, and the intended applications of the validated model.

As previously mentioned, appendices may be included in this document as necessary. Potential appendices include the following:

* Traffic data collection plans
* Traffic volumes reported by the model compared to observed traffic volumes
* Summary of route travel time validation
* Summary of link travel time validation
* Summary of maximum queue length validation
* Summary of validation for any other MOEs