

PD&E Traffic and Safety Analysis Scoping Tools

Guidance Documentation - Technical Manual

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prepared for

Florida Department of Transportation

date

June 2022

Table of Contents

1.0	Introduction	1
1.1	Background	1
1.2	Purpose	1
2.0	Input Parameters	1
2.1	Input Parameters for Traffic Analysis / Customization of FHWA Traffic Analysis Scoping Tool	1
2.2	Input Parameters for Safety Analysis	3
3.0	FDOT PD&E Traffic and Safety Analysis Scoping Tool Methodology	4
3.1	Methodology for Traffic Analysis	4
3.1.1	Assumptions	4
3.1.2	Calculate the labor hours	7
	Economies of Scale Multiplication Factors:	9
3.2	Methodology for Safety Analysis	12
3.2.1	Assumptions	12
3.2.2	Calculate the labor hours	16
4.0	Additional Notes	17

List of Figures

Figure 1	Safety Analysis Scoping Process	3
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1.0 Introduction

1.1 Background

The Florida Department of Transportation (FDOT) has developed a Standard Scope of Services, PD&E Staff Hour Estimation (SHE) Guidelines, and PD&E Staff Hour Estimation Forms to assist the project managers (PM) in preparing staff hour estimates for Project Development and Environment (PD&E) studies. The SHE Guidelines lack specific guidance on estimating the level of effort to conduct traffic and safety analyses for PD&E studies. Therefore, there is a need for providing additional guidance on how to estimate the level of efforts required to conduct traffic and safety analysis.

A tool was developed for the Federal Highway Administration (FHWA) for estimating the level of effort for Traffic Analyses but is not tailored to FDOT PD&E project conditions. This task was initiated to develop a customized Traffic Analysis Scoping Tool for FDOT PD&E projects, as well as to develop a similar tool to estimate FDOT PD&E Safety Analyses. The development and use of the FDOT PD&E Traffic and Safety Analysis Scoping Tools (Scoping Tools) is detailed further in the following sections.

1.2 Purpose

The purpose of this document is to provide the methodology and the algorithm used for the FDOT PD&E Traffic and Safety Analysis Scoping Tools developed. The details provided in this manual would be helpful for updating/re-developing the tools in the future if requirements change.

2.0 Input Parameters

Identifying the input parameters for the traffic and safety analysis was the initial step for developing the Scoping Tools.

The FHWA's Traffic Analysis Scoping Tool estimates staff hours for conducting traffic analysis projects. Based on the FDOT PD&E requirements for conducting traffic analysis, this document identifies the input parameters for the traffic analysis. This will ensure that the staff hour estimate output matches the tasks and activities for traffic analysis study.

The FHWA's Traffic Analysis Scoping Tool was not designed to estimate staff hours for a safety analysis. FDOT's Safety Analysis Guidebook for PD&E Studies provides guidance consistent with the requirements of safety analyses documented in Part 2, Chapter 2 of the PD&E Manual. This document identifies the input parameters for safety analysis based on these guidelines.

2.1 Input Parameters for Traffic Analysis / Customization of FHWA Traffic Analysis Scoping Tool

The FHWA's Traffic Analysis Scoping Tool (FHWA Scoping Tool) was developed to produce ballpark estimates of staff-hours to complete the tasks needed to support a traffic analysis consistent with an agency's guidelines. The objectives of the scoping tool are (1) to inform a procurement decision made by a transportation agency before procuring transportation analysis services; (2) to provide a rough order labor

hour estimate for conducting the transportation analysis; and (3) to incorporate an estimate of relative risk associated with various analysis tasks.

The focus of the FHWA Scoping Tool is on traditional, future project analysis—not on analysis conducted in real-time to actively managing aspects of the transportation system. This tool provides guidance for tasks associated with time based performance evaluations, such as those related to simulation tools and Highway Capacity Manual (HCM) analysis, and does not include guidance for design traffic growth using travel demand modeling.

The FDOT's Traffic Analysis Scoping Tool is a simple spreadsheet tool that produces ballpark estimates of labor hours required for analysis based on fourteen (14) user inputs. The tool first asks users to choose among small number of options related to the expected analytical complexity and risk. Based on user inputs, the tool assesses different complexity and risk levels and uses factors to produce task estimated outputs, including ranges of labor hours by task for three labor categories plus total labor hours by task. Assumptions and methodology were vetted in several review cycles, including both internal and external teams of analysis experts.

The user inputs and options used in the traffic analysis portion of the FDOT's Traffic Analysis Scoping Tool will be applicable for traffic analysis of FDOT PD&E studies. These are identified below:

1. Name of Study
2. Number of intersections in the study area
3. Number of on- and off- freeway ramps
4. Baseline model availability (No, Partial, Full)
5. Calibration of Baseline Model Required? (No, Yes)
6. Data collection requirements (Low, Medium or High Effort (effort is determined based on time spent in collecting data))
7. Number of time periods to be analyzed (e.g., AM, mid-day and PM peak periods)
8. Number of alternatives to be included in the analysis
9. Number of operational conditions (high demand/no incident, medium demand/minor incident, etc.) to be analyzed
10. Number of analysis horizons (Baseline year plus number of future years)
11. Complexity of analysis scenarios (multiple modes, pricing, etc.- Simple or Complex)
12. Complexity of analysis methodology (Deterministic or Dynamic/Stochastic)
13. Complexity of output performance measures (Simple or Comprehensive)
14. Analyst Experience (Some or Considerable)

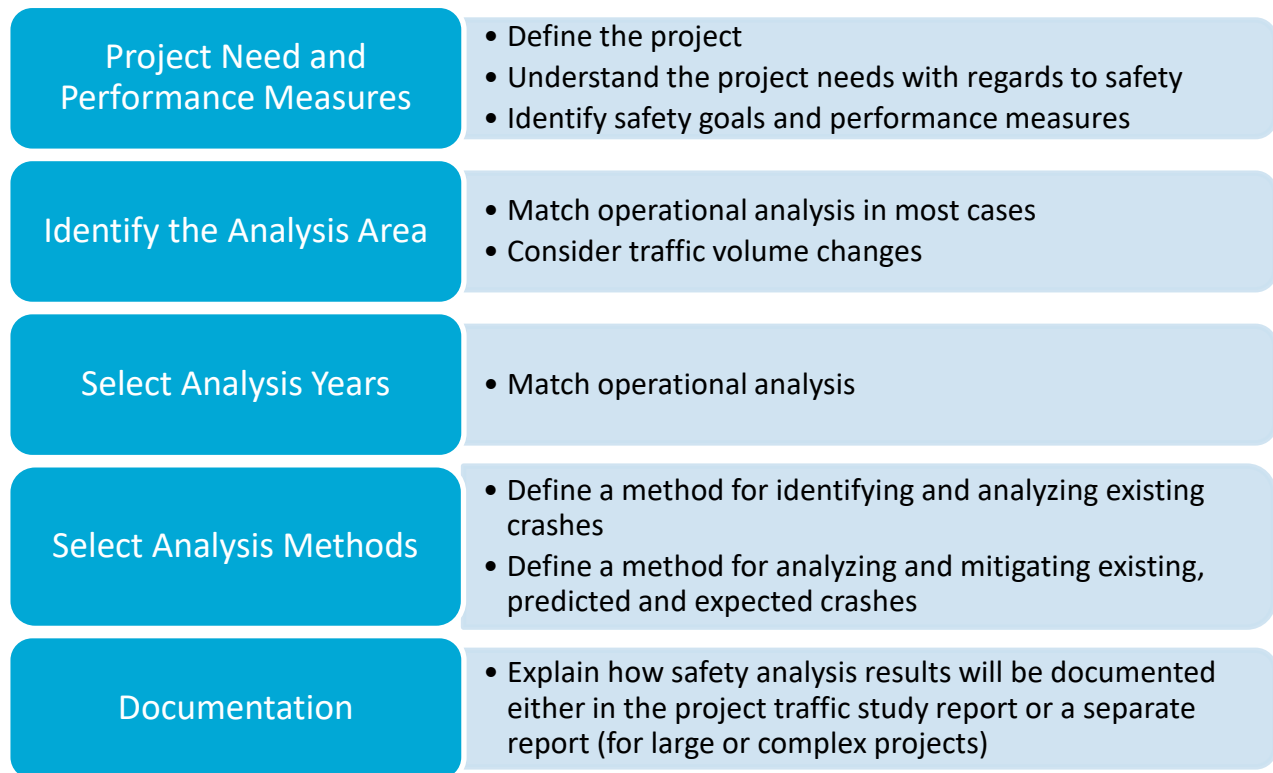
2.2 Input Parameters for Safety Analysis

As indicated earlier, FDOT’s Safety Analysis Guidebook for PD&E Studies provides safety analysis guidance consistent with the requirements of safety analyses documented in Part 2, Chapter 2 of the PD&E Manual. While there is safety analysis guidance, the safety analysis methodology for a PD&E study is typically not prescriptive as the scale and scope of analysis effort depends on:

- Selected performance measures to address the purpose and need,
- Project type (such as widening, new alignment, etc.),
- Project location, context, and existing issues, and
- Complexity or scope of alternatives being evaluated.

Figure 1 illustrates the process that should be considered when determining the appropriate scope of safety analysis for a PD&E study. These items are scalable based on the type, context, and complexity of the project. The safety analysis scope should be developed concurrently with the traffic operational analysis scope since the same analysis years and data (traffic volume, traffic control, and roadway characteristics) are used for both analyses.

Figure 1 Safety Analysis Scoping Process



Based on the guidelines included in FDOT's Safety Analysis Guidebook for PD&E Studies, user inputs and options for the safety analysis are identified below:

1. Name of study
2. Number of intersections in the study area
3. Number of highway segments in the study area
4. Number of ramp segments in the study area
5. Number of analysis horizons (Baseline year plus X number of future years)
6. Availability of baseline/no-build data related to crash and roadway (good, sufficient, limited)
7. Availability of build alternatives data related to crash and roadway (good, sufficient, limited)
8. Complexity of geometry (simple, complex)
9. Type of future alternatives analysis (CMFs, Predictive Method)
10. Analyst experience (some, considerable)

3.0 FDOT PD&E Traffic and Safety Analysis Scoping Tool Methodology

After selecting the input parameters, the algorithm used in the traffic and safety analysis scoping tool is developed using the methodology listed below.

3.1 Methodology for Traffic Analysis

The two major steps in developing the methodology are: (1) develop labor hour assumptions for each project task; and (2) calculate the labor hours for each project task.

3.1.1 Assumptions

This section describes the assumptions used in the development of the traffic analysis scoping tool. The labor hours for each project task are developed for an intersection and freeway ramp. For this effort, the labor hours for an intersection and freeway ramp were developed using the sample projects provided by the Districts 3, 4, and 5. The labor hours are not broken down by the type of intersections (number of legs, number of lanes, etc.) or type of freeway ramp (linear ramp, loop ramp, etc.). It should be noted that the number of projects provided by the Districts were limited in number and do not cover the geographic diversity across Florida. The user should consider these labor hours as a good starting point and assess the need for updating these estimates. The labor hours per average intersection and freeway ramp are provided below.

The assumptions can be updated at a later date by gathering labor hours spent on projects conducted at Districts. The project scopes shall be reviewed to identify the number of intersections, number of ramps, analysis years, alternatives and peak periods being analyzed and the methodology being employed

(deterministic or stochastic/dynamic). Based on this information, labor hours for each project task can be estimated and the assumptions from the tables below can be updated.

Number of labor hours per average intersection:				
		Manager	Engineer/ Planner	Technician
Project Task		Hours	Hours	Hours
1	Develop workplan, analysis plan, and project management	2.0	2.0	1.0
2	Select analysis tool	1.0	1.0	0.0
3	Develop data plan and process data	0.0	0.0	3.0
4	Define clusters and representative days	1.0	2.0	0.0
5	Develop and calibrate baseline model(s)	0.5	1.0	1.0
6	Develop future baseline model(s)	0.5	0.5	0.5
7	Analyze alternatives	0.2	1.0	0.5
8	Reports and presentations	2.0	2.0	1.0

Number of labor hours per average freeway ramp:				
		Manager	Engineer/ Planner	Technician
Project Task		Hours	Hours	Hours
1	Develop workplan, analysis plan, and project management	2.0	2.0	1.0
2	Select analysis tool	1.0	1.0	0.0
3	Develop data plan and process data	0.0	0.0	3.0
4	Define clusters and representative days	1.0	2.0	0.0
5	Develop and calibrate baseline model(s)	0.5	1.0	2.0
6	Develop future baseline model(s)	0.5	0.5	0.5
7	Analyze alternatives	0.5	1.0	0.5
8	Reports and presentations	2.0	2.0	1.0

Next, factors for project specific details were developed. Project specific details included the availability of a calibrated baseline model, the complexity of the study area, the number of alternatives, the type of analysis, and the project team experience. These factors were developed based on engineering judgment based from the FHWA's Traffic Analysis Scoping Tool.

Baseline model availability factor: (input parameter #4 and #5 from Section 2.1)

- Baseline model available and calibrated – 50% for Task 5
- Baseline model available and not calibrated – 80% for Task 5
- Baseline model available and partially calibrated – 90% for Task 5
- Baseline model available and calibrated model not available – 100% for Task 5

Complexity factor for different data processing requirements: (input parameter #6 from Section 2.1)

- Low – 25% for Task 3
- Medium – 50% for Task 3
- High – 100% for Task 3

Complexity factor for different scenarios/alternatives: (input parameter #11 from Section 2.1)

- Simple – 100% for all Tasks
- Complex – 120% for Tasks

Complexity factor for different traffic analysis methodologies: (input parameter #12 from Section 2.1)

- Deterministic – 100% for Tasks 5, 6 and 7
- Stochastic/Dynamic – 130% for Tasks 5, 6 and 7

Complexity factor for different types of outputs: (input parameter #13 from Section 2.1)

- Simple – 90% for Task 7
- Comprehensive – 110% for Task 7

Project team experience factor: (input parameter #14 from Section 2.1)

- Some – 120% for all Tasks
- Considerable – 90% for all Tasks

The matrix below explains the connection between the input parameters and the impact on corresponding project task. “X” identifies the tasks impacted by the selected input parameter.

Input Parameters	Project Tasks							
	1. Develop workplan, analysis plan and project management	2. Select analysis tool	3. Develop data plan and process data	4. Define clusters and representative days	5. Develop and calibrate baseline model(s)	6. Develop future baseline model(s)	7. Analyze alternatives	8. Reports and presentations
Baseline model availability factor					X			
Complexity factor for different data processing requirements			X					
Complexity factor for different scenarios/alternatives	X	X	X	X	X	X	X	X
Complexity factor for different methodologies					X	X	X	
Complexity factor for different types of outputs							X	
Project team experience factor	X	X	X	X	X	X	X	X

3.1.2 Calculate the labor hours

Using the assumptions for labor hours for each project task and the input parameter, the total labor hours for the entire project are calculated. The total labor hours are estimated by project task and labor category. An example of the output table is provided below.

		Manager	Engineer / Planner	Technician	Total	Lower	Upper
Project Task		Hours	Hours	Hours	Hours	Bound	Bound
1	Develop workplan, analysis plan, and project management						
2	Select analysis tool						
3	Develop data plan and process data						
4	Define clusters and representative days						
5	Develop and calibrate baseline model(s)						
6	Develop future baseline model(s)						
7	Analyze alternatives						
8	Reports and presentations						
Total Labor Hours							

The details for calculations in the PD&E traffic analysis tool are provided below.

Step 1 – Calculate the total number of labor hours (intersections and ramps) for each project task

$$\begin{aligned} & \text{Number of labor hours for each project task (intersections)} \\ & = \text{Number of intersections} \times \text{Number of labor hours per average intersection} \end{aligned}$$

$$\begin{aligned} & \text{Number of labor hours for each project task (ramps)} \\ & = \text{Number of ramps} \times \text{Number of labor hours per average ramp} \end{aligned}$$

$$\begin{aligned} & \text{Total number of labor hours for each project task} \\ & = \text{Number of labor hours (intersections)} + \text{Number of labor hours (ramps)} \end{aligned}$$

Step 2 – Adjustment of total number of labor hours (intersections and ramps) for project tasks 1, 2, and 8

$$\begin{aligned} & \text{Adjusted total number of labor hours (project tasks 1, 2 and 8)} \\ & = \text{Total number of labor hours (project tasks 1, 2 and 8)} \\ & \quad \times \text{Complexity factor for different scenarios or alternatives} \\ & \quad \times \text{Project team experience factor} \end{aligned}$$

Step 3 – Adjustment of total number of labor hours (intersections and ramps) for project task 3

$$\begin{aligned} & \text{Adjusted total number of labor hours (project task 3)} \\ & = \text{Total number of labor hours (project task 3)} \\ & \quad \times \text{Complexity factor for different scenarios or alternatives} \\ & \quad \times \text{Project team experience factor} \\ & \quad \times \text{Complexity factor for different data processing requirements} \\ & \quad \times (1 + \text{Economies of Scale Multiplication factor for Task 3}) \end{aligned}$$

Step 4 – Adjustment of total number of labor hours (intersections and ramps) for project task 4

$$\begin{aligned} & \text{Adjusted total number of labor hours (project task 4)} \\ & = \text{Total number of labor hours (project task 4)} \\ & \quad \times \text{Complexity factor for different scenarios or alternatives} \\ & \quad \times \text{Project team experience factor} \\ & \quad \times \text{Number of representative days} \end{aligned}$$

Step 5 – Adjustment of total number of labor hours (intersections and ramps) for project task 5

$$\begin{aligned} & \text{Adjusted total number of labor hours (project task 5)} \\ & = \text{Total number of labor hours (project task 5)} \\ & \quad \times \text{Complexity factor for different scenarios or alternatives} \\ & \quad \times \text{Project team experience factor} \\ & \quad \times \text{Baseline model availability factor} \\ & \quad \times \text{Complexity factor for different methodologies} \\ & \quad \times (1 + \text{Economies of Scale Multiplication factor for Task 5}) \end{aligned}$$

Step 6 – Adjustment of total number of labor hours (intersections and ramps) for project task 6

$$\begin{aligned}
 & \text{Adjusted total number of labor hours (project task 6)} \\
 &= \text{Total number of labor hours (project task 6)} \\
 &\times \text{Complexity factor for different scenarios or alternatives} \\
 &\times \text{Project team experience facor} \\
 &\times \text{Baseline model availability factor} \\
 &\times \text{Complexity factor for different methodologies} \\
 &\times (1 + \text{Economies of Scale Multiplication factor for Task 6})
 \end{aligned}$$

Step 7 – Adjustment of total number of labor hours (intersections and ramps) for project task 7

$$\begin{aligned}
 & \text{Adjusted total number of labor hours (project task 7)} \\
 &= \text{Total number of labor hours (project task 7)} \\
 &\times \text{Complexity factor for different scenarios or alternatives} \\
 &\times \text{Project team experience facor} \\
 &\times \text{Baseline model availability factor} \\
 &\times \text{Complexity factor for different methodologies} \\
 &\times \text{Complexity factor for different types of outputs} \\
 &\times (1 + \text{Economies of Scale Multiplication factor for Task 7})
 \end{aligned}$$

Economies of Scale Multiplication Factors:

The PD&E traffic analysis tool takes into account the time savings that can be achieved for economies of scale for developing and conducting multiple traffic simulation model runs. This is incorporated using assumption factors developed for the FHWA traffic analysis tool. Due to the small sample set of project data available from Florida, the factors from the FHWA traffic analysis tool were employed. These factors are a good starting point and can be updated by the user, if needed.

Economies of Scale Multiplication Factor for Project Task 3:

No. of Representative Days X No. of Peak Periods (Column A)	Adjustment Factor (Column B)
2	1.00
4	0.99
8	0.97
16	0.90
32	0.80
> 32	0.70

The economies of scale multiplication factor for project task 3 is determined by multiplying Column A and Column B from the table above. If the “No. of Representative Days X No. of Peak Periods” falls in between the values listed above, the multiplication factor is determined by linear extrapolation.

Economies of Scale Multiplication Factor for Project Task 5:

Base Model Calibration

No. of Peak Periods (Column A)	Adjustment Factor (Column B)
1	1.00
2	0.99
3	0.97
4	0.90
5	0.80
> 5	0.70

The economies of scale multiplication factor for project task 5 (Base Model Calibration) is determined by multiplying Column A and Column B from the table above.

Operational Condition Model Calibration

No. of Representative Days X No. of Peak Periods (Column A)	Adjustment Factor (Column B)
2	1.00
4	0.80
8	0.50
16	0.35
32	0.30
> 32	0.25

The economies of scale multiplication factor for project task 5 (Operational Condition Model Calibration) is determined by multiplying Column A and Column B from the table above. If the “No. of Representative Days X No. of Peak Periods” falls in between the values listed above, the multiplication factor is determined by linear extrapolation.

The total economies of scale multiplication factor for project task 5 is determined by summing the two factors developed above.

Economies of Scale Multiplication Factor for Project Task 6:

No. of Peak Periods X No. of Analysis Horizons (Column A)	Adjustment Factor (Column B)
2	1.00
4	0.95
6	0.80
8	0.60
10	0.40
> 10	0.20

The economies of scale multiplication factor for project task 6 is determined by multiplying Column A and Column B from the table above. If the “No. of Peak Periods X No. of Analysis Horizons” falls in between the values listed above, the multiplication factor is determined by linear extrapolation.

Economies of Scale Multiplication Factor for Project Task 7:

Base Model Analysis

No. of Alternatives X No. of Peak Periods X No. of Analysis Horizons (Column A)	Adjustment Factor (Column B)
2	1.00
4	0.80
6	0.50
8	0.35
10	0.30
> 10	0.25

The economies of scale multiplication factor for project task 7 (Base Model Analysis) is determined by multiplying Column A and Column B from the table above.

Operational Condition Analysis

No. of Alternatives X No. of Peak Periods X No. of Analysis Horizons X No. of Representative Days (Column A)	Adjustment Factor (Column B)
2	1.00
4	0.80
8	0.50
16	0.35
32	0.30
> 32	0.25

The economies of scale multiplication factor for project task 7 (Operational Condition Analysis) is determined by multiplying Column A and Column B from the table above. If the “No. of Alternatives X No. of Peak Periods X No. of Analysis Horizons X No. of Representative Days” falls in between the values listed above, the multiplication factor is determined by linear extrapolation.

The total economies of scale multiplication factor for project task 7 is determined by summing the two factors developed above.

3.2 Methodology for Safety Analysis

The two major steps in developing the methodology are: (1) develop labor hour assumptions for each project task; and (2) calculate the labor hours for each project task.

3.2.1 Assumptions

The labor hours for each project task are developed for an intersection, ramp terminal intersection, a roadway/freeway segment, ramp segment. These estimates were developed using engineering judgement based on safety analysis projects conducted nationwide. FDOT should consider these labor hours as a good starting point and assess the need for updating these estimates.

FDOT should note the following for consideration:

- The labor hours for average intersection and ramp terminal intersection are assumed to be the same, due to lack of availability of actual project data.
- Labor hours for project task 4 (alternatives evaluation) is split into two categories (1), CMF based evaluation and (2), Predictive analysis. Depending on the type of alternatives evaluation selected for the project, the tool would utilize the appropriate labor hours from these tables.

The assumptions can be updated at a later date by gathering labor hours spent on projects conducted at Districts. The project scopes shall be reviewed to identify the number of intersections, segments, analysis

years, complexity of geometry, and the methodology being employed (crash modification factors or predictive method). Based on this information, labor hours for each project task can be estimated and the assumptions from the tables below can be updated.

Number of labor hours per average intersection:				
		Manager	Engineer/ Planner	Technician
Project Task		Hours	Hours	Hours
1	Develop workplan, analysis plan, and project management	0.75	1.00	
2	Data Collection and Processing (compiling, gathering and organizing data)	0.25	1.00	1.50
3	Existing Conditions Analysis	0.50	1.25	2.00
4a	Alternatives Evaluation (CMFs) - Research, select and approval of appropriate CMFs	0.50	1.00	1.00
4a	Alternatives Evaluation (CMFs) - Apply CMFs and evaluate outcomes	0.50	1.00	1.50
4b	Alternatives Evaluation (Predictive) - Study area segmentation			
4b	Alternatives Evaluation (Predictive) - Identify and Apply SPFs, CMFs and Local Calibration Factors	0.50	1.00	1.50
4b	Alternatives Evaluation (Predictive) - Evaluate Results	0.75	1.50	1.50
5	Documentation	0.50	1.00	1.50

Number of labor hours per average ramp terminal intersection:				
		Manager	Engineer/ Planner	Technician
Project Task		Hours	Hours	Hours
1	Develop workplan, analysis plan, and project management	0.75	1.00	
2	Data Collection and Processing (compiling, gathering, and organizing data)	0.25	1.00	1.50
3	Existing Conditions Analysis	0.50	1.25	2.00
4a	Alternatives Evaluation (CMFs) - Research, select and approval of appropriate CMFs	0.50	1.00	1.00
4a	Alternatives Evaluation (CMFs) - Apply CMFs and evaluate outcomes	0.50	1.00	1.50
4b	Alternatives Evaluation (Predictive) - Study area segmentation			
4b	Alternatives Evaluation (Predictive) - Identify and Apply SPFs, CMFs and Local Calibration Factors	0.50	1.00	1.50
4b	Alternatives Evaluation (Predictive) - Evaluate Results	0.75	1.50	1.50
5	Documentation	0.50	1.00	1.50

Number of labor hours per average roadway/freeway segment:				
		Manager	Engineer/ Planner	Technician
Project Task		Hours	Hours	Hours
1	Develop workplan, analysis plan, and project management	0.75	1.00	
2	Data Collection and Processing (compiling, gathering, and organizing data)	0.25	1.50	2.00
3	Existing Conditions Analysis	0.50	1.25	2.00
4a	Alternatives Evaluation (CMFs) - Research, select and approval of appropriate CMFs	0.50	1.00	1.00
4a	Alternatives Evaluation (CMFs) - Apply CMFs and evaluate outcomes	0.50	1.00	1.50
4b	Alternatives Evaluation (Predictive) - Study area segmentation	1.00	2.00	2.50
4b	Alternatives Evaluation (Predictive) - Identify and Apply SPFs, CMFs and Local Calibration Factors	0.50	1.00	1.50
4b	Alternatives Evaluation (Predictive) - Evaluate Results	0.75	1.50	1.50
5	Documentation	0.50	1.00	1.50

Number of labor hours per average ramp segment:				
		Manager	Engineer/ Planner	Technician
Project Task		Hours	Hours	Hours
1	Develop workplan, analysis plan, and project management	0.75	1.00	
2	Data Collection and Processing (compiling, gathering and organizing data)	0.25	1.00	1.25
3	Existing Conditions Analysis	0.50	1.25	2.00
4a	Alternatives Evaluation (CMFs) - Research, select and approval of appropriate CMFs	0.50	1.00	1.00
4a	Alternatives Evaluation (CMFs) - Apply CMFs and evaluate outcomes	0.50	1.00	1.50
4b	Alternatives Evaluation (Predictive) - Study area segmentation	0.50	1.25	1.50
4b	Alternatives Evaluation (Predictive) - Identify and Apply SPFs, CMFs and Local Calibration Factors	0.25	0.75	1.00
4b	Alternatives Evaluation (Predictive) - Evaluate Results	0.75	1.50	1.50
5	Documentation	0.50	1.00	1.50

Next, factors for availability of baseline/no-build data, complexity of geometry, and project team experience are also developed.

Availability of Baseline/No-Build Data Related to Crash and Roadway Factor: (input parameter #6 and 7 from Section 2.2)

- Good – 80% for Tasks 2, 3, 4a, 4b
- Sufficient – 120% for Tasks 2, 3, 4a, 4b
- Limited – 140% for Tasks 2, 3, 4a, 4b

Complexity of Geometry Factor: (input parameter #8 from Section 2.2)

- Simple – 100% for all Tasks 1, 2, 3, 4a, 4b
- Complex – 120% for all Tasks 1, 2, 3, 4a, 4b

Project Team Experience Factor: (input parameter #10 from Section 2.2)

- Some – 120% for all Tasks 1, 2, 3, 4, 5
- Considerable – 90% for all Tasks 1, 2, 3, 4, 5

The matrix below explains the connection between the input parameters and the impact on corresponding project task. “X” identifies the tasks impacted by the selected input parameter.

Input Parameters	Project Tasks				
	1. Develop workplan, analysis plan and project management	2. Data collection and processing	3. Analysis - Existing Conditions	4. Analysis - Alternatives	5. Documentation
Availability of Baseline/No-Build Data Factor		X	X	X	
Complexity of Geometry Factor	X	X	X	X	
Project Team Experience Factor	X	X	X	X	X

3.2.2 Calculate the labor hours

Using the assumptions for labor hours for each project task and the input parameter, the total labor hours for the entire project are calculated. The total labor hours are estimated by project task and labor category. An example of the output table is provided below.

Project Task		Manager	Engineer/ Planner	Technician	Total	Lower	Upper
		Hours	Hours	Hours	Hours	Bound	Bound
1	Develop workplan, analysis plan, and project management						
2	Data collection and processing						
3	Analysis - Existing Conditions						
4	Analysis - Alternatives						
5	Documentation						
Total Labor Hours							

The details for calculations in the PD&E safety analysis tool are provided below.

Step 1 – Calculate the total number of labor hours (Intersections + Ramp Terminal Intersections + Roadway/Freeway Segments + Ramp Segments) for each project task

$$\begin{aligned} & \text{Number of labor hours for each project task (intersections)} \\ & = \text{Number of intersections} \times \text{Number of labor hours per average intersection} \end{aligned}$$

$$\begin{aligned} & \text{Number of labor hours for each project task (ramp terminal intersections)} \\ & = \text{Number of ramp terminal intersections} \\ & \times \text{Number of labor hours per average ramp terminal intersection} \end{aligned}$$

$$\begin{aligned} & \text{Number of labor hours for each project task (roadway/freeway segments)} \\ & = \text{Number of roadway/freeway segments} \\ & \times \text{Number of labor hours per average roadway/freeway segments} \end{aligned}$$

$$\begin{aligned} & \text{Number of labor hours for each project task (ramp segments)} \\ & = \text{Number of ramp segments} \times \text{Number of labor hours per average ramp segment} \end{aligned}$$

$$\begin{aligned} & \text{Total number of labor hours for each project task} \\ & = \text{Number of labor hours for each project task (intersections)} \\ & + \text{Number of labor hours for each project task (ramp terminal intersections)} \\ & + \text{Number of labor hours for each project task (roadway/freeway segments)} \\ & + \text{Number of labor hours for each project task (ramp segments)} \end{aligned}$$

Step 2 – Adjustment of total number of labor hours for project tasks 2, 3, 4 and 5

$$\begin{aligned}
 & \text{Adjusted total number of labor hours (project tasks 2, 3, 4 and 5)} \\
 & = \text{Total number of labor hours (project tasks 2, 3, 4 and 5)} \\
 & \times \text{Availability of Baseline and NoBuild Data Related to Crash and Roadway Factor} \\
 & \times \text{Complexity of Geometry Factor} \\
 & \times \text{Project team experience factor}
 \end{aligned}$$

Step 3 – Adjustment of total number of labor hours for project task 1

$$\begin{aligned}
 & \text{Adjusted total number of labor hours (project task 1)} \\
 & = \text{Total number of labor hours (project task 1)} \\
 & \times \text{Complexity of Geometry Factor} \\
 & \times \text{Project team experience factor}
 \end{aligned}$$

4.0 Additional Notes

The user should take note of the following items which would be helpful for reviewing and updating the tools.

- The user should review the labor hours for an average intersection, ramp terminal intersection, roadway/freeway ramp, freeway ramps provided in the tool and update as needed based on the best engineering judgement.
- If prompted, the user should enable macros for the spreadsheet. The tool is made available to the user “as is” and if any changes are made to the tool, the user should reach out to FDOT Office of Environmental Management.
- The tool currently is limited to the input parameters described in Section 2. If the user desires to consider additional input parameters, they should reach out to FDOT Office of Environmental Management.
- The cells in the traffic and safety analysis tools are highlighted in light blue or white which denote the following:
 - The information in “light blue” colored cells can be updated by the users to update the assumptions.
 - The information in “white/uncolored” cells contain formulae and should not be updated by the user.
 - The information in “grey” colored cells contain a summary of calculations from earlier steps and should not be updated by the user.