Subject:	From:	Date:
2019 BUILD Grant BCA	**Florida Department of Transportation**	**06/21/2019**

Introduction

This document serves as a technical memorandum to explain the procedures used to complete the benefit-cost analysis (BCA) for the Florida Department of Transportation (FDOT) 2019 BUILD Grant Application for the Escambia/Santa Rosa Regional Advanced Traffic Management System (ATMS) project. All the assumptions and methodologies used to produce the analysis are outlined in this document. The expected benefits and costs of the implementation, operation, and maintenance of the ATMS are identified and compared. This technical memo along with the spreadsheet presents the calculations and describes the analysis in detail. While preparing the BCA, different impacts of ATMS upgrade on the infrastructure are identified. The BCA outlined in this memo is consistent with the United States Department of Transportation (USDOT) guideline[1] published in December 2018.

Overview

The Escambia/Santa Rosa ATMS project would be deployed in the year 2019 and the service life of the project would be 20 years from 2019 to 2039. The analysis period considered for the BCA is 20 years, as well with 2019 being the baseline year or the no-build alternative scenario year. To account for inflation in the future years of operation, discount rates of three percent and seven percent are assumed. This discount rate is applied to the operation & maintenance costs as well as the benefit costs. The baseline crash risk is one, which suggests that the future year crashes would be the same as the average annual crash from historical data in the baseline year.

Assumptions

The assumptions taken into consideration are listed in Table 1.

Table 1. Assumptions

General Assumptions	
Service life for the Project (years)	20
Analysis period for Benefit - Cost (years)	20
Baseline year for the purpose of BCA	2019
Project deployment year	2019
Project operational analysis period	2019-2039
Net Present Value APR	3% and 7%
Annual Working Days	260
Average Travel Speed on the corridor	45
There would be no closure of right-of-way, or no disruption of the infrastructure. As a result, the operation would be unaffected, and the dis-benefit cost would be zero.	
Mobility Assumptions	
Vehicle value of travel time ($ per person per hour)	$16.10
Number of weekdays in a year	260

[1] https://www.transportation.gov/office-policy/transportation-policy/benefit-cost-analysis-guidance-2017

AADT yearly growth rate for first 10 years	1%
Savings in travel time is similar to Park Blvd analysis from Pinellas County	
Assumes 30-minute reduction in crash clearance for crashes occurring during peak periods. This is used to compute savings in travel time for incident management.	
Safety Assumptions	
Crash Reduction Factor for vehicles based on market penetration	41%
Incident happening during peak period	60%
Crash year data for average annual crashes (years)	2016 - 2018
Source of crash data: Signals Four Analytics; https://s4.geoplan.ufl.edu/	
Baseline crash risk is similar to the existing conditions risk in no-build scenario	
The average annual crashes is used for future years; baseline risk = 1	
Environmental Assumptions	
Stops per vehicle is similar to Park Blvd analysis from Pinellas County	

Project Costs

The ATMS upgrade would be deployed in 2019 and the base year for the deployment cost and the previously incurred cost (shown in Table 2) of $25 million estimations is in 2019.

Table 2. Project cost distribution

Phase	Federal	State	Total
Construction	$ 19,504,888	$ 225,529	$ 19,730,417
Construction Support		$ 4,340,693	$ 4,340,693
Total Project Cost	$ 19,504,888	$ 4,876,222	**$ 24,381,110**

Operation and Maintenance Costs

The operation and maintenance (O&M) costs is assumed to be approximately 3% of the initial project cost. The annual O&M cost in base year dollars is $750,000 (shown in Table 3) and the total O&M cost for the project discounted by 7% rate is $8.29 million.

Table 3. O&M cost

Operation and Maintenance	Service Life
$750,000	20

Benefits

There are three main derivatives for benefits – safety, mobility, and environmental. The BCA procedures mentioned in the following sub-sections explain about different modes of transportation including freight, transit, emergency vehicles, as well as all the vehicles.

Travel Time Savings

The savings in travel time due to the Escambia/Santa Rosa ATMS project is estimated for all the six project corridors. Annual average daily traffic (AADT) from these corridors and the average speed are used to compute the total travel time in vehicle-mile for each working day. The savings in delay from a similar

corridor – Park Blvd in Pinellas County, District Seven is used to compute the savings in travel time. Along with the travel time, the savings from incident management is also computed.

The implementation of the ATMS would improve the traffic flow and so it would result in travel time savings. The units for a value of travel time savings (VTTS) would be presented in dollars per person/hour.

Vehicle Travel Time Savings

In this study, it is assumed that the savings in travel time due to the deployment of ATMS will result in a decrease of 14.3 seconds of delay time for each vehicle. The annual savings in delay is 77,249 hours.

*Vehicle Annual Travel Time Savings = Vehicle Travel Time Savings per day*Annual working days*
*= 297 * 260 = 77,249 hours*

Value of Travel Time Savings = $16.10 (for all-purpose)

*Vehicle Annual Value of Travel Savings = Vehicle Annual Travel Time Savings*Value of Travel Time Savings*
*= 77,249*16.10 = $ 1,243,707*

Total Vehicle Annual Value of Travel Time Savings = Savings from Signal + Savings from Incident Management
= $2,072,243 + $1,243,707
= $3,315,949

Based on the calculations above, the total vehicle annual value of travel time savings for the base year is $3.31 million. Using the AADT growth factor of 1% from 2020-2029 and the discount rate of 7%, the net present value of travel time savings for the project obtained is estimated at $43.76 million for vehicles.

AADT – Demand Forecast

There is no induced demand on the corridor due to the ATMS upgrade. The growth in AADT is assumed to be similar in both build and no-build scenarios. The annual growth rate is not constant over the entire period of analysis since upon doing so the travel speed would reduce significantly, which would be unrealistic. The commuters would instead opt for possible transfer facilities or a scattered time period if the demand increases that leads to traffic queues and high delays. For ten years, from 2020 to 2029, the growth rate is assumed to be 1%. The assumption is in about 10 years the traffic saw a growth of 10%. The growth rate after 2029 is assumed to be 1. This is because the assumption is made that if the demand increases capacity, the additional traffic would change their commute patterns.

Safety Benefit

The crash data for three years from 2016-2019 are obtained from the FDOT's signal 4 analytics[2] webpage. These crash data are classified into different crash types based on their severity – fatal, incapacitated, non-incapacitated, injury, and property damage only. The annual average crashes are obtained from the three-year crash data. The future year crashes would be the same as the average annual crash from

[2] https://s4.geoplan.ufl.edu/

historical data in baseline year and the baseline crash risk is 1. Further, these crashes are monetized using USDOT guidelines for a KABCO level monetized value as shown in Table 4.

Table 4. KABCO monetized value

KABCO Level	Monetized Value
O – No Injury	$3,200
C – Possible Injury	$63,900
B – Non-incapacitating	$125,000
A – Incapacitating	$459,100
K – Killed	$9,600,000
U – Injured (Severity Unknown)	$174,000
# Accidents Reported (Unknown if Injured)	$132,200

To obtain the crash modification factor (CMF), there are direct CMF reporting. It is assumed thee is 41% reduction in crashes due to this project.

$$Safety\ benefits = \sum(annual\ average\ crash\ for\ each\ type * monetized\ value\ for\ respective\ type) * CRF$$
$$= \$68{,}816{,}887/year$$

The savings in safety benefits for future years are discounted to obtain the net present value for the base year of 2019. The total monetized value of safety benefit for vehicles is $1,445.15 million and the 7% discounted value is $646.39 million.

Environmental Benefits

The emission benefits due to a reduction in emissions of pollutants like CO2, VOCs, NOx and CO are estimated. The number of reduced emissions of each pollutant in the future 20 years is multiplied by the dollar value of avoiding each ton of emissions of that pollutant.

For the example calculation, the project will lower NOx by 2,196 Kilograms or 2.42 short tons annually; using the recommended monetized value for damage costs of emission, this reduction would result in $20,098 in benefits annually over its lifetime for all the vehicles.

Other emissions should be calculated similarly with their respective monetized value.

$$\text{NOx}\ Reduction\ Benefit = Quanity\ Reduced\ x\ Monetized\ Value$$
$$= 2.42\ short\ tons\ x\ \$8{,}300/short\ ton$$
$$= \$20{,}098/year$$

The economic value of reduced emissions during each year of the project's lifetime is discounted to its present value for use in the overall BCA evaluation. The total environmental cost of the project after the 7% discount rate is $6.56 million for all the vehicles.

Disbenefits

During this project there would be no right-of-way closure and the traffic would be operational throughout the day. Due to no work zone or lane closure, the disbenefit for this project is assumed to be zero.

Residual Value

Residual value is estimated using the total value of the asset and the remaining service life at the end of the analysis period. The analysis period is 20 years of operation from 2019 to 2039. The service life for the ATMS project is 20 years as well. Therefore, the residual value of the project would be zero. There would be no residual value in the numerator during the calculation of the Benefit-Cost (BC) ratio.

Benefit-Cost Ratio

The benefit-cost ratio of this project is calculated taking into consideration all the benefits (mobility, safety, and environmental) along with the operation and maintenance cost and the deployment cost. The disbenefit and the residual costs are zero. To obtain the Benefit-Cost ratio, the O&M cost is subtracted from the Benefit in the numerator and the deployment cost is placed in the denominator:

$$B/C = \frac{Total\ Benefit\ - O\&M\ Cost}{\text{Project Cost}}$$

$$\left(\frac{B}{C}\right) 7\%\ Discounted\ NPV = \frac{\$696{,}687{,}500 - \$8{,}294{,}300}{\$24{,}381{,}100}$$

$$\left(\frac{B}{C}\right) 7\%\ Discounted\ NPV = 28.23$$

The Benefit-Cost ratio (shown in Table 5) for 20-year analysis of the project after 7% discount rate is 28.23.

Table 5. Benefit-Cost Ratio Summary

Escambia/Santa Rosa ATMS BCA - 20 Years			
Benefits	**Undiscounted**	**NPV (3% Discount)**	**NPV (7% Discount)**
Safety	$ 1,445,154,600	$ 1,092,638,400	$ 646,393,200
Travel Time	$ 74,983,700	$ 56,381,900	$ 43,734,800
Environmental	$ 14,665,300	$ 11,088,000	$ 6,559,500
Total Benefit	**$ 1,534,803,600**	**$ 1,160,108,300**	**$ 696,687,500**
Project Cost	**$ 24,381,100**	**$ 24,381,100**	**$ 24,381,100**
O&M Cost	**$ 14,250,000**	**$ 11,065,100**	**$ 8,294,300**
B/C	**62.37**	**47.13**	**28.23**