ODOT Research Section
555 13th Street NE; Ste 2
Salem OR 97301-5192

Phone (503) 986-2700
Fax (503) 986-2844

# Research Problem Statement

## I. TITLE

17-047 A life cycle based Benefit-Cost Analysis Framework for comparing Roundabouts and Traffic Signals

## II. PROBLEM

Roundabouts and traffic signals are two popular forms of intersection control. The choice of whether to construct a roundabout or a traffic signal at an intersection is a complex decision that involves many factors including current and projected values of: (i) traffic volume, (ii) directional distribution of traffic, (iii) vehicular volume classification, and (iv) number and types of crashes. In addition to the above mentioned mobility and safety related metrics, generally bring about smoother and continuous traffic flows that reduce emissions and other sustainability related metrics such as noise levels. Unfortunately, roundabouts have higher initial costs due to greater real estate footprint compared to a traffic signal. However, roundabouts have significantly smaller operations and maintenance costs throughout the service life of the facility. Therefore determining whether a roundabout or a traffic signal would be most appropriate for an intersection, requires careful analysis and the final result will vary from location to location.

The goal of this research is to develop a life cycle based benefit cost analysis tool to compare the effectiveness of a roundabout versus a traffic signal including construction, operation and maintenance costs, as well as mobility, safety, and sustainability benefits. The project will create a tool, which will provide benefits in a number of RAC priorities including “Enhance transportation safety”, “Enhance mobility”, “Incorporate methods that extend the service life and reduce the life cycle cost of infrastructure investments”, and “Lead to other efficiencies, cost savings and cost avoidance.”

## III. PROPOSED RESEARCH, DEVELOPMENT, OR TECHNICAL TRANSFER ACTIVITY

The benefit-costs analysis framework is often used to rank and compare different alternatives based on benefits and costs estimated over the life cycle of the projects (Rodegerdts et al., 2010). There are multiple costs and benefits that take place over the life of a roundabout or signalized intersection. Costs include capital, operations, and maintenance costs. Benefits include operational improvements, crash reduction, and environmental benefits (Rodegerdts et al., 2010; Sides et al., 2005). The capital costs could include initial right of way acquisition costs, construction cost, excavation and mobilization cost, signage, pavement markings, equipment, pavement structural components, and the lighting costs. The operation and maintenance costs for a roundabout are mainly landscaping, signage inspection and replacement costs, whereas for a signalized intersection will include the costs associated with the maintenance of the detection loops and control equipment, bulb replacement, and power. The primary operational benefit for both roundabouts and signalized intersection is the reduction in delay for the drivers at the intersection. This will depend on the geometry of the approach roads and traffic volume distribution and classification. Other quantifiable benefits will include the costs associated with the crash reduction or likelihood of crash reductions and environmental benefits. The environmental benefits will involve reduction in fuel consumption and emission reductions at the intersection.

An excel based tool will be developed to compute benefit-cost ratios for both signalized intersections and roundabouts. Benefit-cost ratios vary depending on the life of the facility, cost inflation, vehicular growth, as well as discount factors all of which are subject to significant uncertainties. Users of the benefit cost analysis tool will be able to perform a sensitivity analysis by varying the different inputs to understand the robustness of the final decision. The tool will be demonstrated on a case study chosen by ODOT.

## IV. POTENTIAL BENEFITS

The project will significantly enhance ODOT decision-making and investment in terms of providing guidance on the choice of appropriate control strategy for intersection management. The tool developed can be later enhanced and extended to consider others forms of intersection control such as stop signs. The life cycle benefit cost framework guidelines developed can also be used for ranking other project alternatives through appropriate identification of costs and benefits.

## V. IMPLEMENTATION

The main products of this research are: (i) a tool which can immediately applied by ODOT, MPOs, cities, and counties to study the benefit of construction a roundabout or a traffic signal at a signalized intersection, (ii) a set of guidelines describing the benefit cost analysis framework based on the life cycle quantification of benefits and costs.

## VI. LIST OF REFERENCES *(optional)*


- Rodegerdts, Lee, Justin Bansen, Christopher Tiesler, Julia Knudsen, Edward Myers, Mark Johnson, Michael Moule, Bhagwant Persaud, Craig Lyon, Shauna Hallmark, Hillary Isebrands, R. Barry Crown, Bernard Guichet, and Andrew O'Brien. *Roundabouts: An Informational Guide, Second Ed*. National Cooperative Highway Research Program, 2010. *<http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_672.pdf>*.
- Sides, Ken, John Seals, and Michael Wallwork. *Impact Study: Conversion of Three Signalized Intersections and Three Stop-controlled Intersections to Modern Roundabouts on Cleveland Street in Clearwater, Florida.* Transportation Research Board National Roundabout Conference, 2005.


## VII. CONTACT INFORMATION


**Your name: Avi Unnikrishnan, M.Figliozzi, S. Hernandez** **Person Responsible for Implementation: Zahiddul Siddique**

Affiliation: Portland State University, Oregon State Univ. Affiliation: ODOT

Telephone:5037252872, 5037252836, 5417371757 Telephone:

Email:{uavinash, figliozzi}@pdx.edu, sal.hernandez@oregonstate.edu Email: zahidul.q.siddique@odot.state.or.us