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TECHNICAL MEMORANDUM

Central Region Traffic Engineering On-Call (Task Order 12-039)

Roundabout Policy and Process Scanning Review

Date: January 18, 2013 Project #: 11764.8
To: Michael Clements, PE
From: Chris Tiesler, PE, Ed Myers, PE, Alek Pochowski, and Pete Jenior
cc: Terry Knouse, PE
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Modern roundabouts are increasingly recognized in the United States as a successful alternative intersection control to improve safety and operational performance. It is currently estimated that there are nearly 2,500 modern roundabouts in the United States, and the number continues to grow exponentially.

Jurisdictions with successful roundabout programs generally have a **policy** statement, a **process** for internally applying the intent of the policy and assessing roundabouts and other forms of intersection control, and, in some cases, recommended or agency-specific **tools** for performing assessments.

Roundabout **policies** are high-level statements that identify a general goal or operating procedure for an agency. For example, Maryland State Highway Administration (SHA) has a policy stating that roundabouts will be considered at all intersections where improvements are being considered. **Policies** generally originate from a legislative body (state legislature, city council, etc.) or the leadership level of a state DOT.

Roundabout **processes** provide a means of implementing a policy within the framework of an agency's project planning process. They generally specify:

- the appropriate steps within the planning process at which roundabouts should be considered,
- the appropriate factors to consider (examples include safety, traffic operations, and cost), and
- recommended analysis techniques (examples include use of the Highway Capacity Manual for traffic analysis, or use of an agency's unit cost database for cost estimating).

Roundabout **tools** perform specific analysis procedures and are generally software programs. For example, the Pennsylvania Department of Transportation is developing a spreadsheet that takes user

inputs related to safety, traffic operations, maintenance, and construction costs and returns the benefit/cost ratio of a roundabout compared to a signalized or stop-controlled intersection.

In July 2008, VDOT revised its Road Design Manual (See Appendix B – *Subdivision Street Design Guide*) to include a policy statement on roundabouts. Text from the VDOT **policy** states:

> *VDOT recognizes that roundabouts are frequently able to address safety and operational objectives better than other types of intersections. Therefore, it is VDOT policy that roundabouts be considered when a project includes reconstructing or constructing new intersection(s), signalized or unsignalized. The Engineer shall provide an analysis of each intersection to determine if a Roundabout is a feasible alternative based on site constraints, including right of way, environmental factors and other design constraints. The advantages and disadvantages of constructing a roundabout shall be documented for each intersection.* ***When the analysis shows that a roundabout is a feasible alternative, it should be considered the Department's preferred alternative due to the proven substantial safety and operational benefits [emphasis added].***

This is one of the stronger policy statements of any state in the United States. However, to date it has been difficult to consistently implement and adhere to this policy on intersection projects throughout the state without a supporting process and/or tool and appropriate guidance.

Kittelson & Associates, Inc. (KAI) has conducted a scanning review of policies, processes, and tools with regard to roundabouts from several agencies outside of Virginia.

- Maryland State Highway Administration
- New York State Department of Transportation
- City of Bend, Oregon
- City of Carmel, Indiana
- Georgia Department of Transportation
- Pennsylvania Department of Transportation
- Indiana Department of Transportation
- California Department of Transportation
- Wisconsin Department of Transportation
- Federal Highway Administration

The review was primarily focused on early adopters of roundabouts that have well-established roundabout programs (Maryland, New York State, City of Bend, Oregon, City of Carmel, Indiana) as well as states that have begun to consider and/or construct roundabouts at an accelerated rate in recent years (Georgia, Pennsylvania, Wisconsin). California is included because of similarities with Virginia: they have a strong roundabout policy, and are currently developing processes and tools to implement the policy. Finally, FHWA policies and support processes were included in the review. A synopsis of the findings is provided below in fulfillment of the Task 1 scope of work.

AGENCIES REVIEWED

Maryland State Highway Administration (SHA)

The Maryland State Highway Administration was the first agency to establish a roundabout program in the United States. After first considering roundabouts as an intersection control in the late 1980s, SHA spent several years conducting research and developing roundabout guidelines and site selection procedures, prior to the first roundabout being constructed in Maryland in 1993. These efforts developed into the Maryland roundabout program, and a **policy** was established requiring the consideration of roundabouts at all intersections where improvements are being evaluated.

The early adoption of the policy coupled with the support by leaders within SHA (including the SHA Administrator, Deputy Administrator and Chief Traffic Engineer) and the Maryland Department of Transportation (MDOT) has led to Maryland having one of the largest numbers of roundabouts constructed on a state system in the country (over 170). In addition, SHA has designated a person to be the statewide roundabout coordinator. This **process** (implemented through the coordinator) ensures that the policy is uniformly implemented and that all roundabouts are peer reviewed and designed/constructed in a consistent manner.

New York State Department of Transportation (NYSDOT)

Leaders from NYSDOT were introduced to roundabouts at technical conferences and a scanning tour to Maryland. Based on the advice of NYSDOT's lawyers (who found that NYSDOT could be liable for crashes that occurred at intersections where a roundabout was not considered as an alternative if a roundabout could be shown to have prevented the crash), NYSDOT developed one of the strictest roundabout policies in the nation. Text from NYSDOT's Highway Design Manual states:

> *When the analysis shows that a roundabout is a feasible alternative, it should be considered the Department's preferred alternative due to the proven substantial safety benefits and other operational benefits.*

This **policy**, coupled with a strong internal champion for roundabouts within NYSDOT, has led to aggressive growth and consideration of roundabouts in New York, especially in regards to the conversion of rotary intersections to roundabouts, and the establishment of roundabout corridors on the state system. Recent estimates indicate New York has approximately 70 roundabouts statewide.

City of Bend, Oregon

In 2001, the Bend City Council passed a resolution establishing roundabouts as the preferred intersection control within the city. The resolution states:

> *Staff shall continue the current policy of considering roundabouts the preferred option for intersection improvement. Staff shall report to the Basic Services Committee any intersections where improvements are to be made and roundabouts are not considered feasible.*

To assist with implementation of this **policy**, the city's transportation department developed Roundabout Design Guidelines that reiterate the council's statement and provide a specific **process**[1] for the comparing roundabouts and traffic signals. The process document provides a framework for evaluating different intersection forms (considering a wide range of factors from intersection footprint to pedestrian safety) as well as specific evaluation techniques for traffic analysis. Although there has been turnover on City Council since 2001, support for roundabouts remains high among both council members and city engineering staff. There have been no fundamental changes to the policy since it was first adopted. There are over 25 roundabouts in Bend.

City of Carmel, Indiana

Since the mid 1990's, the City of Carmel has constructed over 65 roundabouts within the city limits within a wide range of contexts – from the intersection of two local streets to grade-separated interchanges. Many of these roundabouts replaced existing traffic signals, a trend that continues today. The City does not have any formally adopted **policy** or code provision that requires the consideration of roundabouts, but there has been strong support for the implementation of roundabouts by both local politicians (notably, the longtime mayor) and the public works staff.

Regarding analysis **tools**, Mike McBride, the City's traffic engineer, noted in a recent interview that from a traffic operations perspective, the City has generally studied roundabouts in isolation, even if multiple roundabouts were being studied on the same corridor at the same time. Mr. McBride also stated that the City tends to consider roundabouts by default, and prefers them over traffic signals.

Georgia Department of Transportation (GDOT)

Georgia's roundabout **policy**, per the GDOT Design Policy Manual is:

> *Roundabouts are the preferred safety alternative for a wide range of intersections. Although they may not be appropriate in all circumstances, they should be considered as an alternative for all proposed new intersections on federally-funded highway projects, particularly those with major road volumes less than 90 percent of the total entering volume. Roundabouts should also be considered for all existing intersections that have been identified as needing major safety or operational improvements. This would include freeway interchange ramp terminals and rural intersections.*

Specifically, a roundabout shall be considered in the following situations:

- for any intersection being designed on new location or to be reconstructed;
- for any existing intersection that has been identified as needing major safety or operational improvement (or where improvements are otherwise planned); and
- for all intersections where a request for a traffic signal has been made

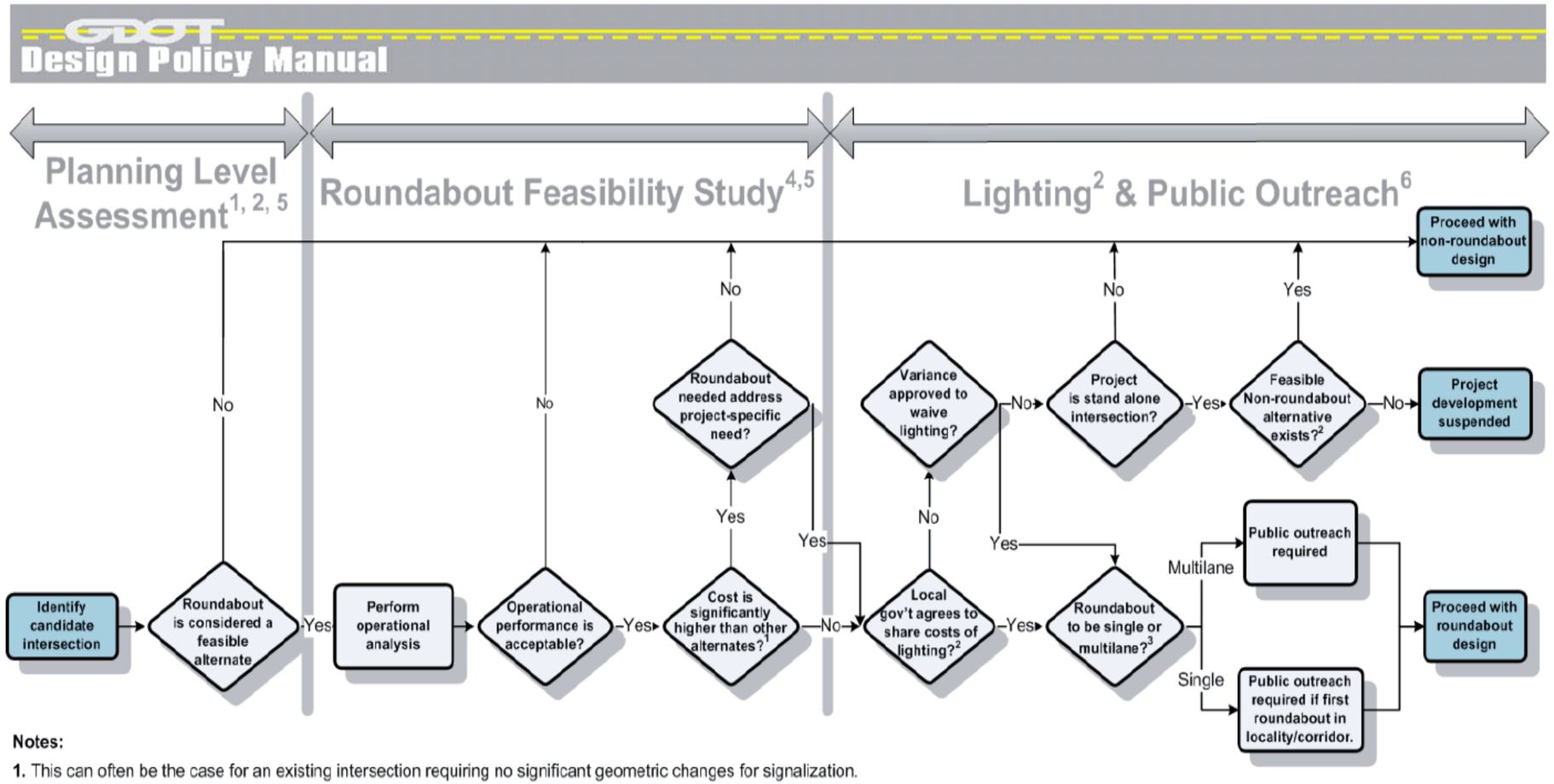
[1] http://www.ci.bend.or.us/modules/showdocument.aspx?documentid=2512

While GDOT clearly lays out the requirement to study a roundabout, the approval of a roundabout in Georgia follows a **process** with several steps. Ultimately, approval can only be made by the State Traffic Engineer, and only after a preliminary planning-level assessment followed by a fairly complex roundabout feasibility study. The roundabout feasibility process includes, among other things, a letter from the local jurisdiction indicating their support for the project, a comparison of a roundabout to other alternatives, an operations and safety assessment, concept sketches of various alternatives, cost estimates, and a concept design. In addition, all feasibility studies must be peer reviewed "by a consultant peer reviewer having extensive experience with the planning, analysis, and design of single-lane and multilane roundabouts." **Error! Reference source not found.** displays the GDOT roundabout validation process.

Rather than use a commercial software package for traffic analysis, GDOT staff developed a spreadsheet **tool**[2] that implements the roundabout analysis procedure of the 2010 Highway Capacity Manual.

GDOT has constructed 27 roundabouts to date, with plans and funding to construct approximately 10 per year for the next five years.

[2] http://www.dot.state.ga.us/travelingingeorgia/trafficcontrol/roundabouts/Pages/AnalysisTools.aspx



Notes:

1. This can often be the case for an existing intersection requiring no significant geometric changes for signalization.
2. A written commitment letter must be received from a local government agreeing to share the costs of lighting (by funding the energy, operation and maintenance of the lighting system) for the proposed roundabout to move forward to detailed design
3. If a single-lane roundabout is found to be adequate up to 10 years after the opening year, a single-lane roundabout should be constructed. If a multilane roundabout is required before the design year, the single-lane roundabout should be constructed having the footprint of a multilane roundabout and be designed to be easily retrofitted to a multilane roundabout.
4. For a stand-alone intersection project where a complex roundabout is proposed, the feasibility study should be peer reviewed prior to the concept team meeting. Complex roundabouts include all multilane roundabouts; and single lane roundabouts having more than four legs, with approach skews less than 60 degrees, or closely spaced roundabouts where the operations of one impacts the operations of another. For other roundabouts, peer reviews should be performed no later than the early part of the preliminary design phase.
5. A list of items to be considered as part of a planning level assessment is provided on the Roundabout Design Checklist (Concept Development, Part 1) located on the GDOT ROADS web page. http://www.dot.ga.gov/doingbusiness/PoliciesManuals/roads/Pages/OtherResources.aspx. A list of items to be considered as part of the concept report for a stand-alone intersection project is provided on the Roundabout Design Checklist (Concept Development, Parts 2 - 5).
6. The public involvement process should include outreach to local government officials and the local community and should be initiated as soon as practical during concept development. At minimum, a public information open house (PIOH) should be held for all multilane roundabouts and for single-lane roundabouts where there are no other well-functioning roundabouts in the community or nearby along the corridor.

GDOT Design Policy Manual **Figure 8.1. Roundabout Validation Process** 8-5

Figure 1. GDOT Roundabout Validation Process

Pennsylvania Department of Transportation (PennDOT)

PennDOT's roundabout **policy** is:

> *When planning intersection improvements, a variety of improvement alternatives should be evaluated, including roundabouts, to determine the most appropriate alternative.*

This policy statement is contained in a soon-to-be published update to PennDOT's Design Manual Part 2 (DM-2) that will include a section dedicated exclusively to roundabouts. The roundabout section will be added to the design manual in early 2013. To increase awareness of roundabouts within the state, the PennDOT Central Office has a roundabout coordinator who conducts outreach activities within the Central office and the PennDOT District offices. In Pennsylvania, project planning, design, and construction generally takes place at the district level. The PennDOT Central Office also has contracts with two consulting firms to provide peer review services for district roundabout projects as needed. PennDOT is currently developing a spreadsheet **tool** that compares the life cycle costs of roundabouts to other intersection forms and produces a benefit/cost ratio of the roundabout in comparison to other intersection forms. Life cycle costs include elements ranging from construction cost to the economic costs of crashes. Some components of the life-cycle cost, such as the number of crashes, are computed by the spreadsheet. Others, such as delay, are input by the user after being computed elsewhere (such as within a traffic analysis program). A forthcoming project through the National Cooperative Highway Research Program (NCHRP Project 3-110) is anticipated to develop a similar tool in several years.

There are 19 roundabouts in Pennsylvania, including some on locally maintained roadways. Most have been constructed in the past five years.

Indiana Department of Transportation (INDOT)

INDOT followed the lead of the City of Carmel, Indiana in establishing their roundabout **policy**. Text from the Indiana Design Manual states:

> *A roundabout should be considered as one potential intersection option within an INDOT-sponsored or -funded planning study or project since it offers improved safety, cost savings, and enhanced traffic operations.*

While the state agency has historically been less enthusiastic about roundabouts than the City of Carmel, roundabouts have been in the state since the mid to late 1990s, and based on the success of roundabouts in Carmel and elsewhere in the state, INDOT now has roundabout projects throughout the state (approximately 25 already constructed and operational – over half in neighboring suburbs of Carmel).

California Department of Transportation (Caltrans)

Caltrans is preparing an Intersection Control Evaluation document containing the agency's **policy** on the selection of intersection control, a process for evaluating intersection control, and recommendations on analysis **tools**. Caltrans' roundabout policy has been in effect for a number of years, but the process through which it was applied was cumbersome. Consideration of a roundabout required a much greater amount of planning and analysis in the early stages of a project, and agency staff and consultants tended to avoid this and thus not consider roundabouts. The intent of the Intersection Control Evaluation document is to apply a consistent and streamlined process to select intersection control, rather than apply a special process for roundabouts. Recent estimates indicate California has approximately 200 roundabouts statewide.

Wisconsin Department of Transportation (WISDOT)

WisDOT's roundabout **policy** is:

> *If an intersection warrants a signal or a four-way stop within the design life of the proposed project, the modern roundabout shall be evaluated as an equal alternative. Where there is an existing four-way stop or signal and there are operational problems with the current control, then the roundabout shall be considered as a viable alternative. As stated above the roundabout may be a viable alternative for a two-way stop control in certain circumstances. In either case, roundabouts are a potential intersection control strategy until such time that the evaluation indicates that the roundabout alternative is not appropriate.*

This policy is stated in the WisDOT Facilities Development Manual, and reproduced in the WisDOT Roundabout Guide. These documents also offer considerable guidance on the **process** that is used to select intersection control, including:

- A life-cycle timeline illustrating specific steps in the WisDOT project development process
- An intersection control evaluation process
- A list of factors to consider in the intersection control evaluation process:
    - Safety
    - Operational Analysis
    - Construction Cost
    - Right-of-Way
    - Practical Feasibility
    - Operations and Maintenance Costs
    - Environmental
    - Pedestrians and Bicycles

For some of these factors such as traffic operations, specific evaluation **tools** are recommended. After assessing these factors, conceptual roundabout design should begin if a roundabout is determined to be a "viable alternative." Recent estimates suggest WISDOT has approximately 200 existing roundabouts in the state.

Federal Highway Administration (FHWA)

FHWA does not have a formal **policy** on roundabouts, but does actively maintain a roundabouts website (http://safety.fhwa.dot.gov/intersection/roundabouts/) which provides technical **tools**, guidance on the use and implementation of those tools, research results related to roundabouts, and resources. The FHWA Office of Safety has also established a Roadway Safety Peer-to-Peer (P2P) Program. Experts in the area of roundabouts volunteer their time to serve as Peers and provide guidance to agencies requesting assistance. This Peer Expert Corps can offer valuable insights and lessons learned from early adoption experiences with roundabouts. Roundabouts are identified by FHWA as one of their "Nine Proven Crash Countermeasures."

In a phone interview with Hillary Isebrands, Safety Engineer with FHWA, Ms. Isebrands offered some key points for consideration based on her extensive experience in several states with regard to the development and implementation of roundabout policies:

- Roundabouts are too often eliminated in the planning stage due to lack of tools/understanding of how to properly consider a roundabout
- When considering and/or comparing roundabouts as an intersection control form, do not make decisions exclusively on operations/capacity. Even at a planning level, consideration should be given to factors such as
    - Safety
    - Life-cycle costs
    - Context
- Existing tools and guidance documents are readily available, and can be used in conjunction with engineering judgment to objectively assess roundabouts

KEY PROCESS ELEMENTS

Agencies may approach the consideration of roundabouts in a variety of ways, but those who are most successful tend to have a well-developed **process** that contains similar elements. Table 1 summarizes key process elements used by several agencies, with whom KAI is most familiar, when considering roundabouts as an intersection control and provides a brief description of how each jurisdiction approaches each element.

Table 1 Process Elements from Selected Agencies

Process Element	Georgia DOT	Maryland SHA	PennDOT	Caltrans*	City of Bend, Oregon
Point in Process Where Roundabout Addressed	• During a planning level assessment	• Early states of project planning	• Varies. Many PennDOT roundabouts have been built because of specific interest in roundabouts by agency staff or public advocacy groups.	• During Traffic Investigation, Local Development Review, and Project Study Report/Project Development Support processes	• At the start of project planning due to Bend's "roundabouts first" policy.
Type of Project(s) Where Roundabout Considered	• Intersections being designed on new location or to be reconstructed • Existing intersections that have been identified as needing major safety or operational improvement (or where improvements are otherwise planned) • Intersections where a request for a traffic signal has been made	• Most projects where substantial changes to an intersection are under consideration, including safety improvements, capacity improvements, and new facilities.	• Varies by District. Roundabouts are relatively new in Pennsylvania and many agency staff are unfamiliar with them.	• "Broader transportation planning and capital project development business processes that proposed…new intersections or modification of existing intersections."	• Most projects where substantial changes to an intersection are under consideration or a new intersection is being built.
Processes/ Tools for Selecting Roundabouts or Other Intersection Traffic Control	• Operations analysis shows expected operational performance to be acceptable, and if the cost is significantly higher than other alternatives, the roundabout needs to be shown to be needed to address a project-specific need.	• None	• Benefit/Cost Spreadsheet incorporating operations, safety, maintenance, and capital costs (under development)	• Intersection Control Evaluation (ICE) process. Includes safety, operations, service life, and life cycle benefit/cost analysis.	• Intersection Form Evaluation Framework. Includes quantitative and qualitative considerations.
Project-specific Public Outreach/ Education	• For a single-lane roundabout, public outreach is needed if the roundabout is the first one in the locality or corridor. All multilane roundabouts require public outreach.	• Usually minimal since most drivers in Maryland are familiar with roundabouts.	• Public meetings, with information on roundabouts in general and specific project alternatives	• Caltrans generally supports outreach but there are no specific requirements.	• No specific requirements, but does have a City Education Program that is flexible to cover hands on and user specific needs such as pedestrian, bicycle, trucks, etc.
General Public Outreach/ Education	• Website	• Website	• Website, Brochures	• Website provides links to their own design guidelines, standard reference documents, and other informational materials (memos, videos, etc.).	• Website, Brochures • City supports a Safe Routes to Schools program which includes teaching school-age children how to ride a bike in a roundabout and act as a pedestrian.
Point of Contact/ Responsibility	• Office of Operations and the Office of Design Policy and Support	• Central office reviews larger District projects in Maryland. If project may include roundabout, central office engages state roundabout coordinator. roundabout coordinator usually remains engaged for remainder of project	• Districts are encouraged to contact the state roundabout coordinator for feasibility study and peer review services	• Each District has an ICE coordinator. They are consulted at multiple times. They assist with analysis (safety, traffic, etc.) selection of control, and documentation.	• City Traffic Engineer
Peer Review	• Peer reviews are performed by a consultant peer reviewer having extensive experience with the planning, analysis, and design of single-lane and multilane roundabouts.	• Historically, peer reviews have been done by a consulting firm with roundabout expertise. Currently, reviews are done by a consulting firm and in-house roadway design staff.	• Two consulting firms with roundabout expertise have contracts with PennDOT and are used for peer reviews	• Not specifically required, but generally supported by Caltrans.	• Not specifically required, but generally supported by the City.

*The Caltrans process described here is currently under development. Implementation anticipated in July 2013.

SUMMARY AND CONCLUSIONS

Previous research conducted on statewide roundabout programs and policies revealed several key areas that can assist or derail a statewide roundabout initiative. These areas include:

- Public perception, validation and acceptance
- Statewide roundabout policy
- Institutionalization and organizational structure
    - Support from leadership
    - Staff level champion(s)

Negative public perception continues to be the key impediment to the construction of roundabouts in a jurisdiction, especially in areas without previous roundabout installations. After the construction of roundabouts in a jurisdiction, the public perception of roundabouts typically swings from negative to positive.[3,4,5] The best thing a jurisdiction can do to increase public perception of roundabouts is to have examples of roundabout successes in their jurisdiction. Public perception should not supersede sound engineering judgment or objective analysis.

In VDOT's case, it is important that roundabouts that are constructed are properly designed, and are peer reviewed by a central source with enough roundabout expertise to ensure quality and consistency of roundabout design throughout the jurisdiction. Additionally, emphasis should be placed not only on public education, but on education internal to VDOT as well. This also helps to institutionalize roundabouts within the state agency.

With the exception of perhaps NYSDOT, VDOT has the strongest **policy** in regards to the consideration and implementation of roundabouts of any agency included in the scanning review. However, VDOT can likely improve implementation of its policy across the state through a well-defined **process** that includes a thoughtfully designed **tool** and appropriate supporting guidance for its use. With these, VDOT would have a more functional and repeatable mechanism to ensure that roundabouts are consistently considered as an alternative.

[3] Retting, R.A., G. Luttrell, E.R. Russel, "Public Opinion and Traffic Flow Impacts of Newly Installed Modern Roundabouts in the United States," ITE Journal, September 2002, pp. 30-32, 37.

[4] Jacquemart, G. "Synthesis of Highway Practice 264: Modern Roundabout Practice in the United States."

[5] Retting, R.A, S.Y. Kyrychenko, A.T. McCartt. "Long-Term Trends in Public Opinion Following Construction of Roundabouts." Transportation Research Record No. 2019. 2009. pp. 219 – 224.

NEXT STEPS

Future efforts on this task will be focused on strategies for better incorporating roundabouts into VDOT's project planning **process** in support of its current **policy**.

- KAI will recommend the appropriate time in the project planning process to consider intersection control. This will be at an early stage, when design has not advanced beyond the concept level.
- KAI will identify specific data, elements, and contextual conditions to consider when selecting intersection control. This will be a mix of quantitative factors such as expected safety, operational performance and cost as well as qualitative factors such as environmental impacts and urban design considerations.
- KAI will develop a spreadsheet **tool** to compare the quantitative factors. Inputs into the spreadsheet will be limited to data that is currently available early in the planning process.

In support of the tool, KAI will develop a concise guidance document that provides additional resources and additional details for successful use of the tool. The intent of the document is that it could eventually be converted into an Informational and Instructional Memorandum (IIM) for VDOT.