VTRC
Virginia Transportation Research Council

Multimodal Public-Private Partnerships: A Review of the Practices of Other States and Their Application to Virginia

http://www.virginiadot.org/vtrc/main/online_reports/pdf/17-r11.pdf

CHANGJU LEE, Ph.D.
Research Associate

JOHN S. MILLER, Ph.D., P.E.
Principal Research Scientist

Final Report VTRC 17-R11

VIRGINIA TRANSPORTATION RESEARCH COUNCIL
530 Edgemont Road, Charlottesville, VA 22903-2454

www.VTRC.net

Standard Title Page - Report on Federally Funded Project

1. Report No.: FHWA/VTRC 17-R11	2. Government Accession No.:	3. Recipient's Catalog No.:

4. Title and Subtitle:
Multimodal Public-Private Partnerships: A Review of the Practices of Other States and Their Application to Virginia

5. Report Date:
February 2017

6. Performing Organization Code:

7. Author(s):
Changju Lee, Ph.D., and John S. Miller, Ph.D., P.E.

8. Performing Organization Report No.:
VTRC 17-R11

9. Performing Organization and Address:
Virginia Transportation Research Council
530 Edgemont Road
Charlottesville, VA 22903

10. Work Unit No. (TRAIS):

11. Contract or Grant No.:
109937

12. Sponsoring Agencies' Name and Address:

Virginia Department of Transportation	Federal Highway Administration
1401 E. Broad Street	400 North 8th Street, Room 750
Richmond, VA 23219	Richmond, VA 23219-4825

13. Type of Report and Period Covered:
Final

14. Sponsoring Agency Code:

15. Supplementary Notes:

16. Abstract:

Virginia planners have asked how other states have implemented multimodal (i.e., serving two or more transport modes) public-private partnership (P3) investments. Accordingly, this study was designed to determine factors that cause P3 projects in other states to have or not have multimodal components. Interviews were conducted regarding other agencies' pursuit of 23 candidate multimodal P3 projects in nine other states plus the District of Columbia: Alaska, California, Colorado, Florida, Georgia, Illinois, Maryland, Rhode Island, and Texas. Transportation may influence land development, and P3s are no exception, but the interviews showed variation in how land use impacts are considered. In most decisions regarding multimodal P3s, land impacts were considered to some degree, but the reasons varied: no expected impact, more intense development in a particular location, impacts near the facility but no exact location pinpointed, and increased real estate values near the facility. The diverse nature of P3s suggests that an opportunity may exist for agencies to use a flexible process that encourages consideration of multiple modes at multiple decision points. As one way of making this consideration easier to accomplish, this study examined how land development impacts can be evaluated for a multimodal P3 using a Virginia case study. A hedonic price model suggested that a multimodal P3 project could increase residential and commercial property values, with market-adjusted values being slightly higher after construction than before construction. For example, for residential properties, the model suggested that after construction, a parcel's value drops by approximately $5 for each additional meter the parcel was located away from the express bus routes. Because the models are sensitive to assumptions such as the size of the project impact area, this study was preliminary. Eventually, however, the completion of additional studies may suggest how value capture can support multimodal P3 projects.

Five conclusions may be drawn regarding P3 projects in other states. First, it is not unusual for a project's status to change from P3 to non-P3: 10 of the 23 projects for which interviews were conducted were found not to be P3s. Second, obtaining additional funds is not the sole reason for pursuing a P3. Third, milestones for considering multiple modes in P3s are not generally used: reasons include such decisions are part of the environmental review process and conditions are so fluid that milestones are infeasible. Fourth, land development impacts were considered in most, but not all, of the projects. Fifth, the conditions supporting a multimodal P3 are diverse and include the implementation of a region's long-term vision, public pressure, and a unique opportunity to bring together stakeholders to create a project that was otherwise infeasible or to solve a specific problem. Especially because of this last conclusion—that conditions supporting a multimodal P3 are diverse—there may be merit to agencies considering multiple modes at multiple decision points as P3s are developed. Accordingly, the study recommends that Virginia's Office of Public-Private Partnerships share the results of the interviews and the value capture case study, or excerpts thereof, as appropriate, with local, regional, and Virginia Department of Transportation planners. By knowing about practices elsewhere, it is possible that there may be insights that are applicable to a given P3 project in Virginia.

17 Key Words:
Public private partnerships, multimodal transportation, value capture, programming (planning)

18. Distribution Statement:
No restrictions. This document is available to the public through NTIS, Springfield, VA 22161.

19. Security Classif. (of this report):	20. Security Classif. (of this page):	21. No. of Pages:	22. Price:
Unclassified	Unclassified	65	

FINAL REPORT

MULTIMODAL PUBLIC-PRIVATE PARTNERSHIPS: A REVIEW OF THE PRACTICES OF OTHER STATES AND THEIR APPLICATION TO VIRGINIA

Changju Lee, Ph.D.
Research Associate

John S. Miller, Ph.D., P.E.
Principal Research Scientist

In Cooperation with the U.S. Department of Transportation
Federal Highway Administration

Virginia Transportation Research Council
(A partnership of the Virginia Department of Transportation
and the University of Virginia since 1948)

Charlottesville, Virginia

February 2017
VTRC 17-R11

DISCLAIMER

The contents of this report reflect the views of the authors, who are responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the Virginia Department of Transportation, the Commonwealth Transportation Board, or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation. Any inclusion of manufacturer names, trade names, or trademarks is for identification purposes only and is not to be considered an endorsement.

EXECUTIVE SUMMARY

Virginia planners have asked how other states have implemented multimodal (i.e., serving two or more transport modes) public-private partnership (P3) investments. Accordingly, this study was designed to determine factors that cause P3 projects in other states to have or not have multimodal components. Interviews were conducted regarding other agencies' pursuit of 23 candidate multimodal P3 projects in 10 other states including the District of Columbia: Alaska, California, Colorado, District of Columbia, Florida, Georgia, Illinois, Maryland, Rhode Island, and Texas. A complication is that pre-interview communications between staff of the Virginia Transportation Research Council staff and transportation agency representatives to set up the interviews showed that almost one-half of a larger sample of 35 P3s identified as such in the literature were not P3s—thus, the label "P3" is fluid. The interviews showed that when agencies decide to pursue a multimodal project as a P3, a frequent reason is to obtain private financing. Other reasons are the speed of construction, the opportunity to obtain expertise in specific areas such as land development, and an enhanced ability to relate monies paid to quality of transit service provided. However, when modes were being added to a P3 project, revenue was a reason for only a minority of projects: other reasons included multiple modes being a part of the region's long-term vision, public opinion, and the project being inherently multimodal (e.g., redevelopment of an area supporting rental car parking and commuter rail).

Transportation may influence land development, and P3s are no exception, but the interviews showed variation in how land use impacts are considered. In most decisions regarding multimodal P3s, land impacts were considered to some degree, but the reasons varied: no expected impact, more intense development in a particular location, impacts near the facility but no exact location pinpointed, and increased real estate values near the facility. The interviews showed that aside from the environmental process (e.g., where the National Environmental Policy Act addresses impacts associated with scope), most P3s do not have specific points at which multiple modes are formally considered, in part because conditions evolve rapidly but also in part because multimodal aspects of the scope may be considered before the project becomes a P3.

The diverse nature of P3s suggests that an opportunity may exist for agencies to use a flexible process that encourages consideration of multiple modes at multiple decision points. As one way of making this consideration easier to accomplish, this study examined how land development impacts can be evaluated for a multimodal P3 using a Virginia case study. The reason for the case study was to determine how a multimodal P3 project affects nearby property values, with the rationale being that if an increase in value could be detected, then in other locations it might be possible to use an expected increase in land values to provide some funding for P3 projects—a process known as value capture. In the case study, a hedonic price model detected the relationship between distance and property values after controlling for other factors such as property characteristics, the distance of the parcels from the P3 project, and changes in economic conditions. The model suggested that a multimodal P3 project could increase residential and commercial property values, with market-adjusted values being slightly higher after construction than before construction. Further, for residential properties, the model suggested that after construction, a parcel's value drops by approximately $5 for each additional meter the parcel was located away from the express bus routes. For commercial properties, after construction a

parcel's property value decreased by approximately $300 for each additional meter the parcel was located away from the ramps for the high-occupancy toll lanes. Because the models are sensitive to assumptions such as the size of the project impact area, this study was preliminary. Eventually, however, the completion of additional studies may suggest how value capture can support multimodal P3 projects.

Five conclusions may be drawn regarding P3 projects in other states:

1. It is not unusual for a project's status to change from P3 to non-P3: 10 of the 23 projects for which interviews were conducted were found not to be P3s.

2. Obtaining additional funds is not the sole reason for pursuing a P3.

3. Milestones for considering multiple modes in P3s are not generally used: reasons include such decisions are part of the environmental review process and conditions are so fluid that milestones are infeasible.

4. Land development impacts were considered in most (at least 18 of 23) of the projects, but the level of specificity varied by project, ranging from no impacts (3 projects), more intense development expected in a specific location (5 projects), some type of general land use impact but not necessarily tied to a specific location (8 projects), and some form of value capture from an anticipated increase in land value (2 projects).

5. The conditions supporting a multimodal P3 are diverse and include the implementation of a region's long-term vision, public pressure, and a unique opportunity to bring together stakeholders to create a project that was otherwise infeasible or to solve a specific problem. Regarding a P3 in Virginia where land development impacts were examined in detail, based on the results of a preliminary model developed by the researchers, it was concluded that the P3 may have increased parcel values. However, because the impacts on residential properties differed from the impacts on commercial properties and because these impacts varied by location, additional effort would be needed to use these findings to determine value capture.

Because success for multimodal P3s is measured in different ways—financial viability always matters but other metrics have included transit performance and the potential impact on land development—and given that P3s are sufficiently new so that a role for new participants is not always clear—there may be merit to agencies considering multiple modes at multiple decision points as P3s are developed. Accordingly, the study recommends that Virginia's Office of Public-Private Partnerships share the results of the interviews and the value capture case study, or excerpts thereof, as appropriate, with local, regional, and Virginia Department of Transportation planners. The reason is that there are a couple of opportunities during the project development process to consider multimodal components of P3 projects. For example, other states' practices collectively suggest that in a few (but not all) cases, explicit consideration of land development impacts can be one factor in implementing a P3 project. In a few other cases in other states, factors other than financial viability, such as improved service quality, were important for implementing a P3 project.

By knowing about practices elsewhere, it is possible that there may be insights that are applicable to a given P3 project. As discussed in this report, the high-level screening for P3 projects is one instance where local transportation plans can be related to P3 projects.

FINAL REPORT

MULTIMODAL PUBLIC-PRIVATE PARTNERSHIPS: A REVIEW OF THE PRACTICES OF OTHER STATES AND THEIR APPLICATION TO VIRGINIA

Changju Lee, Ph.D.
Research Associate

John S. Miller, Ph.D., P.E.
Principal Research Scientist

INTRODUCTION

A public-private partnership (P3) entails an agreement "between a public agency and a private sector entity that allows for greater private sector participation in the delivery and financing of transportation projects*"* (FHWA, undated a). For example, Virginia's Public-Private Transportation Act of 1995 (PPTA), as amended, was enacted in order to supplement public funding with private financing and encourage creative, timely, and less costly transportation projects. Although the term "PPTA projects" is the recognized term in Virginia to convey public-private partnerships, for consistency with other literature on this topic, this report uses the term "P3s."

The Attractiveness of P3s

At least 31 countries have an entity that is dedicated to supporting "government agencies to procure projects through a PPP process" (Istrate and Puentes, 2011), and over two decades, more than 2,000 P3s representing $887 billion existed worldwide (AECOM Consult, Inc., 2005). P3s comprise a valuable delivery tool to increase private investment in transportation projects. P3s have received attention in Virginia since the passage of the PPTA, with projects such as the Elizabeth River Tunnels, Dulles Greenway, Pocahontas Parkway, Transform 66–Outside the Beltway, Route 28, Route 288, I-495 Express Lanes, and I-95 Express lanes; Dotson (2014) described Virginia as a "leader in P3s."

AECOM Consult, Inc. (2007) suggested that P3s with a multimodal component can yield greater societal benefits and increased private sector participation. As an example of the latter, the multimodal component can improve access to economic development opportunities and more diverse financial markets for transportation investment. Exemplifying the former, for the Regional Transportation District of Denver (2016) multimodal Colorado P3 project (which was a plan to expand transit service throughout the Denver area), every $1 invested in transit infrastructure translates into a $4 dollar return over a 20-year period. In Virginia, the Elizabeth River Tunnels project is estimated by Elizabeth River Crossings (2016a) to generate between $170 and $254 million in regional economic development benefits and more than 1,500 jobs (direct and indirect)

(Elizabeth River Crossings, 2016a). The same project was also viewed as a way of encouraging public transportation by eliminating tolls for bus users and increasing the capacity of local ferry service, which would increase the attractiveness of transit (Crawford, 2013). Multiple definitions of "multimodal" exist, but a simple one adopted for this study is "a facility that serves two or more transportation modes." One reviewer of this report noted that a project that serves both passenger traffic (e.g., an automobile mode) and freight traffic (e.g., heavy trucks) might also be considered multimodal given that although these all involve rubber tired vehicles, they are fundamentally different modes of transportation (A. Biney, personal communication, August 16, 2016).

Accordingly, P3s may be judged not only by their financial viability but also by their societal benefits. For example AECOM Consult, Inc. (2007) cited previous research showing societal benefits of transit-oriented development. These may include, for example, a reduction in traffic congestion and expenses for roadway infrastructure, more opportunities for affordable housing, an increase in retail sales and land values, and a reduction in crime near the transit facility. For example, for the aforementioned Elizabeth Rivers Tunnels project, Nichols and Belfield (2016) reported a net reduction in delay at four river crossings of 32% (two for which tolls were added and two for which tolls were not added). To be clear, an examination of the impacts listed by AECOM Consult, Inc. (2007) suggests that they may not all materialize immediately; for example, direct benefits (e.g., faster travel times between two locations by transit) may have latent secondary benefits (e.g., redevelopment of an economically depressed area.)

Cautions of P3s

However, any transportation project (including a P3) can have negative impacts. For the aforementioned Elizabeth Rivers Tunnels project, Nichols and Belfield (2016) reported that although the addition of tolls at two river crossings (Midtown and Downtown tunnels) reduced delay there by 53%, the resultant increase in traffic at two other crossings (High Rise Bridge and Military Highway) increased delay at those two locations by 16%. Such impacts can also include higher costs for commuters. For example, a criticism in a newspaper of the Elizabeth River Tunnels project was that higher tolls were being levied at present to pay for future infrastructure (Layne, 2015); this later led to a renegotiation to reduce these tolls on the existing midtown and downtown tunnels in Portsmouth (Forster, 2015; Virginia Department of Transportation [VDOT], 2015e). The allocation of risk is project dependent; in one instance, the public sector spent about 29% of the total cost ($400 million of a total cost about $1.4 billion) on environmental work before the project received approval for environmental documents (Watts, 2014).

In terms of financing, P3s are not a panacea: worldwide, roughly 40% of P3 projects initiated during the 1990s required that the contractual agreement be renegotiated, implying some type of project failure (Orr, 2006). (This percentage includes not just roadway projects but also projects for other modes [e.g., rail, airports, and seaports] and dams [Orr, 2006].) For instance, Virginia's 1988 P3 effort—the Dulles Greenway project (an extension of the existing Dulles Toll Road from Dulles International Airport to Leesburg)—required such a renegotiation, with initial daily traffic volumes of 8,000 vehicles rather than the 35,000 forecast (Parsons

Brinckerhoff et al., 2015). The Pocahontas Parkway (Route 895) P3 project also failed financially because of the unexpected low traffic, achieving only 42% of predicted levels in the year after opening (Grymes, 2014). Reinhardt (2011) noted that few of the currently proposed P3 projects can be financially self-sustaining if tolls alone are the only source of revenue, noting that the most "viable" P3 projects are often already taken by toll authorities or governments. Vock (2015) noted that the cost of financing is one factor that affects the attractiveness of P3 projects (relative to building the same project but not as a P3). On this matter, language from the Congressional Budget Office (2012) suggested that such costs may in fact ultimately be project specific and depend heavily on the particular agreement negotiated between the private and public sectors:

> The cost of financing a highway project privately is roughly equal to the cost of financing it publicly after factoring in the costs associated with the risk of losses from the project, which taxpayers ultimately bear, and the financial transfers made by the federal government to states and localities. Any remaining difference between the cost of public versus private financing for a project will stem from the effects of incentives and conditions established in the contracts that govern public-private partnerships.

Just as costs may be project specific, so may risks. Parsons and Rubin (2016) reported on other research suggesting that a contributing factor to the bankruptcy of the State Highway 130 P3 (in Texas) may have been an over-forecast of the number of heavy trucks that would use the facility. One can find relatively high hourly values of time for commercial motor vehicle drivers in the literature; for example, Smalkoski and Levinson (2005) reported a commercial vehicle value of time of $49.42 (which appears to be in 2003 dollars; conversion to 2016 dollars appears to yield a value of time of almost $65 per hour [Bureau of Labor Statistics, 2016]). Numbers from Trottenberg (2011) would suggest commercial vehicle travel time to have an hourly value of almost $28 per hour after adjusting for inflation. For the State Highway 130 facility, however, drivers had a relatively "wide time window" to make their delivery and thus tended to take slower parallel routes that did not require a toll (Parsons and Rubin, 2016).

Use of P3s Serving Multiple Modes

Not surprisingly, P3s may tend toward a single transportation mode based on tolls: of the 11 Virginia P3 projects at the procurement, construction, or completion stage as of 2016 listed in Table 1, almost one half focused on some type of tolling system, such as high-occupancy toll (HOT) lanes (Office of Transportation Public-Private Partnerships, 2014; Virginia Department of Transportation and Department of Rail and Public Transportation, 2015). Whereas auto-oriented modes can generate a return on investment through tolls, other modes such as transit may require an operational subsidy. Indeed, Arnold et al. (2012) implied that multimodal P3 solutions may be implementable to the extent that auto revenue can support transit. Ankner (2008) noted that non-compete clauses in concession agreements may hinder the provision of public transportation for a tolled facility. For instance, Ankner (2008) noted one such clause that applied to the Pocahontas Parkway: if for the next 80 years VDOT built a competing "transportation facility" such as a highway or light rail line, VDOT would have to make up to the private partner any loss of revenues that resulted.

Table 1. Virginia P3 Projects (Underway or Completed)

No.	Name of P3	Toll Terminology[a]	Status in 2016[b]
1	Transform 66–Outside the Beltway: Multimodal Solutions, I-95 to Haymarket	HOV/HOT	Procurement
2	Dulles Corridor Metrorail Project	-	Under construction
3	Elizabeth River Tunnels	Toll	Under construction
4	Coalfields Expressway	-	Under construction
5	Route 58	-	Under construction
6	Route 28	-	Under construction
7	I-495 Express Lanes	HOV/HOT	Completed
8	I-95 Express Lanes	HOV/HOT	Completed
9	Route 199	-	Completed
10	Pocahontas 895	Toll	Completed
11	Route 288	-	Completed

HOV = high-occupancy vehicle; HOT = high-occupancy toll.
[a] Indicates the terminology reported in Office of Transportation Public-Private Partnerships (2014) or Virginia Department of Transportation and Department of Rail and Public Transportation (2015).
[b] Indicates status as of May 2016 based on a review of Office of Transportation Public-Private Partnerships (2014).

Maloof (2014) showed that the benefits of P3s may be fundamentally different by mode: transit projects might generate revenue through increased land development rather than through tolls. The Federal Highway Administration (FHWA) (2010) noted that one misconception about P3s is that they are a revenue source: although tolls or some other type of user fee may make a P3 viable, for transit modes, especially if an availability payment is used, some other revenue source, e.g., value capture (Maloof, 2014), may be required. An availability payment entails the public sector providing a level of funding to the private sector to build and operate a facility at a certain service level; the FHWA (2010) suggested, for example, that an availability payment for a highway might be based on a private provider meeting certain criteria regarding pavement roughness and time for incident response.

A research need from the Virginia Transportation Research Council's (VTRC) Transportation Planning Research Advisory Committee in 2012 conveyed an interest in knowing the feasibility of implementing multimodal P3s as reported in other states (VTRC, 2012). At the time the research need was formulated, the term "PPTA projects" was used in Virginia to convey public-private partnerships. An excerpt of this research need suggested that there might be opportunities to implement P3s if the lessons from other states could be considered in Virginia:

> PPTA projects will continue to be a vital funding mechanism for Virginia's transportation infrastructure, and no TPRAC research project will affect that outcome. However, there may be opportunities for Virginia to encourage multimodal considerations in PPTA projects that might otherwise not occur. This research would examine PPTA projects in other states and ask (1) were such projects multimodal (if not, why not?) and (2) how the multimodal aspects were implemented for such projects. (For example, project A might have included alternative modes as a way to "sell" the project to the community whereas project B might have included alternative modes because it increased revenue for bondholders.)

The research need statement does not explicitly define "multimodal," and it is apparent from examination of several projects that "multimodal" can be achieved in a number of ways. For example, three potential P3 projects may be considered:

1. *The I-564 Intermodal Connector.* The purpose of this project is to realign I-564 such that a better connection is provided to Naval Station Norfolk and Norfolk International Terminals (VDOT, 2015a)—an intermodal freight facility that can handle truck, rail, and shipping modes. One might argue that this connector is multimodal because it provides access for both automobile traffic (notably the 80,000 vehicles per day that go to or from Naval Station Norfolk) and truck traffic (taking 740 trucks from city streets in Norfolk) (McCabe, 2015); further, it is part of a suite of projects that remove at-grade rail crossings such as between Route 337 and the Norfolk Southern/Norfolk Portsmouth Beltline Railroad (VDOT, 2015b). Also by virtue of connecting to Norfolk International Terminals (Michael Baker Inc. et al., 2013), it connects truck traffic to an interchange point between rail and truck traffic.

2. *The I-495 Express Lanes.* In their first year of operation, high-occupancy vehicle (HOV) customers accounted for up to 9% of total traffic (Gilroy, 2013). According to Gilroy, the term "up to" was used because 9% of total traffic comprised drivers of vehicles that did not pay a toll: these included HOVs, vanpools, and public transportation buses but may have also included exempt vehicles such as emergency responders).

3. *Transform 66–Outside the Beltway: Multimodal Solutions, I-95 to Haymarket (hereinafter Transform 66–Outside the Beltway) (VDOT, 2015c).* This project includes high-frequency bus service and commuter lots. The underlying transit report from the Tier 2 Environmental Impact Statement (Kimley-Horn and CH2M, 2015) suggested between 4,400 and 5,800 commuter and rapid bus riders per day by 2025.

Clearly each of these projects is multimodal in that more than one mode is supported; however, the extent to which they are multimodal, as indicated in Table 2, may vary. For instance, for the I-564 Intermodal Connector, the extent to which it is characterized as multimodal could depend, in part, on what happens to truck traffic after it arrives at the Norfolk International Terminals facility.

In sum, to answer the question of how other states have implemented multimodal components of P3 projects, at least three issues need to be considered.

1. For multimodal P3 projects, two questions may be asked: What causes a P3 project to become multimodal? What causes a multimodal project to become a P3?

2. Given that many projects can at least provide some support to more than one mode, how *multimodality* is defined, as shown in Table 2, may affect the number of multimodal projects observed in other states.

3. The existence of non-compete clauses in some P3 agreements (Ankner, 2008) suggests that how project-specific factors facilitated (or inhibited) multimodal components is germane. For example, given that Maloof (2014) noted possible land development impacts, one might ask whether other states have considered value capture as a way of enabling multimodal P3 projects.

Table 2. Multimodal Components of Three Potential Virginia P3 Projects

Project (Location)	Multimodal Components (Beyond Single Occupant Auto)	Ways to Quantify Use of Non-Single Occupant Autos	Ways to Show Greater or Lesser Multimodality
I-564 Intermodal Connector (Norfolk)	Provides connection for heavy trucks to a freight (rail and truck) intermodal facility: Norfolk Intermodal Terminals	740 trucks per day are removed from Norfolk city streets	Change amount of truck traffic shifted to rail at Norfolk Intermodal Terminals
I-495 Express Lanes (Fairfax and Alexandria)	Provides for HOV and bus traffic	Up to 9% of total express lane traffic was HOV, vanpools, and transit	Change percent of express lane traffic that is HOV rather than HOT lanes
Transform 66–Outside the Beltway (Prince William and Fairfax)	Provides for HOV and express bus service	In 2025, there may be up to 5,800 commuter and rapid bus riders in corridor	Change percent of traffic that uses express bus rather than HOT lanes

HOT = high-occupancy toll, HOV = high-occupancy vehicle.

PURPOSE AND SCOPE

The purpose of this study was to determine factors that cause P3 projects in states other than Virginia to have or not have a multimodal component. The study had five objectives:

1. Determine why multimodal projects in other states have been pursued as P3 or non-P3 projects.

2. Determine reasons for other states including multiple modes in an existing P3 project.

3. Identify milestones other states have used for deciding whether to include or exclude multimodal components for P3 projects.

4. Determine expected land development impacts of P3 projects in other states.

5. Develop a method for forecasting how a multimodal P3 project will influence land development, and demonstrate this method with a Virginia case study.

METHODS

Five steps were used to achieve the study objectives.

1. *Clarify research questions*.

2. *Select multimodal P3 projects that were candidates for the subject of an interview*. Such projects were in states other than Virginia and were identified for the purpose of understanding how such projects came to incorporate multimodal components.

3. *Conduct interviews.* The interview subjects were staff affiliated with transportation agencies that implemented or intended to implement the projects noted in Step 2. The purpose of the interviews was to determine how multimodal elements of P3 projects came to be included in such projects.

4. *Synthesize interview results and related literature*. The related literature was identified through examination of websites noted by interviewees, sources suggested by members of the technical review panel, and literature that appeared to the researchers to answer the questions noted in Step 1.

5. *Develop a value capture methodology and apply it to a Virginia case study*.

Step 1. Clarify Research Questions

In-person meetings with staff of Virginia's Office of Transportation Public-Private Partnerships (now the Virginia Office of Public-Private Partnerships) and VTRC's Transportation Planning Research Advisory Committee (in November 2013 and October 2014) suggested two broad areas of interest.

1. *To what extent are U.S. P3s multimodal?* A review of Litman (2012), Bielli et al. (2006), and Chen et al. (2011) led the researchers, for the purposes of conducting interviews of transportation agency staff for the purposes of asking such staff how P3 projects came to include or exclude multimodal components, to define "multimodal" as stated previously: a facility that serves two or more transportation modes, recognizing that this definition does not indicate the degree of multimodality. Later study showed the need to characterize multimodality by degree (e.g., a facility that carries 50% of passengers by bus and 50% by auto is more multimodal than a facility that carries 99% of passengers by bus and 1% by auto) rather than a binary "yes" or "no" statement, although the simplicity of the latter approach was suitable for the purposes of conducting interviews. "P3" was defined as financed or operated through a partnership between at least one public entity and at least one private entity (FHWA, undated a).

2. *How were these multimodal components implemented?* Some modes, notably transit, require an operational subsidy. Thus, there was interest in knowing other factors states use to evaluate P3s, such as economic development, safety, and productivity impacts.

Step 2. Select Multimodal P3 Projects That Were Candidates for the Subject of an Interview

Initially, 135 P3 projects were identified based on a review of the literature (e.g., AEM Consult Team, 2007; Center for Transportation Public-Private Partnership Policy, 2014; U.S. P3 Deal Flow Suffers from Delays, Attrition, 2015); project lists (e.g., InfraPPP, 2013, 2014; Office of Transportation Public-Private Partnerships, 2014); and funding from the Transportation Infrastructure Finance and Innovation Act (TIFIA) program (e.g., FHWA, , 2014; U.S. Department of Transportation, undated). Funding from the TIFIA program does not necessarily mean that a project is a P3, but it can be an indicator of that status (Lee, 2012) as the TIFIA program encourages private investment in transportation infrastructure (U.S. Department of Transportation, 2015). Then, from these 135 projects, candidate projects were identified if four criteria were met:

1. *One additional source indicated the project was a P3*. Sources included (1) unsolicited proposals; (2) requests for proposals; (3) requests for qualifications; (4) documents associated with the environmental review process (such as a draft or final environmental impact statement or a record of decision; (5) information on websites maintained by a state department of transportation, the U.S. Department of Transportation, or entities that had a history of studying P3 projects (e.g., Center for Transportation Public-Private Partnership Policy, 2014; FHWA, , 2014; InfraPPP, 2013); and (6) direct inquiries from the researchers by email to the director, manager, or coordinator of the P3 office or related division of select state departments of transportation. The researchers did not contact all state DOTs but rather sought to contact as many as possible in order to balance two competing objectives: having enough P3s where interviews could be conducted and having few enough P3s such that there would be sufficient time for additional analysis after the interviews had been completed.

2. *The project was in a state that as of 2014 had enacted P3 legislation or had a P3 office or division*. As of February 2014, 33 states and Puerto Rico had enacted laws authorizing P3s for transportation projects (FHWA, undated b; Rall, 2014). As of August 2014, 14 states had P3 offices or related divisions as determined by viewing their websites. (The researchers did not record whether these P3 offices were housed within the state department of transportation or some other entity.) The researchers also included projects in Washington, D.C., as candidates despite not knowing if they met this criterion. That said, as of 2015, Washington, D.C., did have a P3 office (DC.gov, 2015, 2016).

3. *Either the project's description or related literature suggested the project was multimodal as defined in Step 1*.

4. *The project was not located in Virginia*. (To be clear, a Virginia case study was considered in Step 5, but for the purposes of interviews, only non-Virginia projects were used.)

After the projects were screened based on these four criteria, one project was added despite the state not having P3 enabling legislation and a P3 office (FHWA, undated b; Rall, 2014): Rhode Island's InterLink, which appeared likely (in the researchers' opinion) to be a P3 given its involvement of private sector modes such as car rental facilities. (However, as discussed later, the researchers could not confirm this was a P3 until the question was posed during the interview.)

It was also determined that what had been thought to be 3 separate projects were in fact part of a single megaproject (Colorado's FasTracks). Step 2 thus yielded 35 candidate multimodal P3 projects. Efforts were made to interview agency staff familiar with the 35 candidate projects. An interviewee could be affiliated with a state department of transportation (e.g., the Georgia Department of Transportation), a regional transit service provider (e.g., the Regional Transportation District), a locality (e.g., Pasco county), or an entity directly affiliated with delivering the project that was not necessarily a public sector entity (e.g., Atlanta Beltline, Inc.) Interviewees were thus affiliated with an agency that provides some type of transportation service. For 12 projects, interviews were not scheduled: for 6 of these projects, the potential interviewee indicated the project was no longer a P3; for the remaining 6 projects, it was not possible to identify a person who was able to grant an interview. For the 23 projects for which an interview was granted (see Table 3), questions similar to those listed in Step 3 (see Table 4) were posed.

The project titles shown in Tables 4 through 8 initially came from the websites from which the researchers had learned about the projects. In some cases, the websites were specific to the project and were not directly linked to a transportation agency, e.g., a website maintained by Atlanta Beltline, Inc. (2017) that used the project title "Atlanta Beltline." In other cases, the websites were specific to a project but were clearly linked to a transportation agency, e.g., "High Desert Corridor," which is used by the Los Angeles County Metropolitan Transportation Authority, known also as "Metro" (Los Angeles County Metropolitan Transportation Authority, 2017). In other cases, the project was described by an external source, e.g., "CREATE," which described the P3 project run by the City of Chicago (FHWA, undated c). In some cases, two or more sources used a different name for a given project, e.g., InfraPPP (2014) referred to the "I-4 Ultimate P3 Project whereas FHWA (undated d) referred to the "I-4 Ultimate Project," which can be accessed from a list of P3 projects (FHWA, 2016). Thus, when interviewees provided a different name than that used by interviewers, the name provided by interviewees was used in this report. For example, the researchers had referred to a project as the SR 54-56 Toll Road Concession; however, an interviewee used the term "54 Express," so that name was used in Tables 4 through 8. There was a simplification made for the 14th project shown in Table 3: although the name during the interview had been "Atlanta Beltline P3," because that project was found not to be a P3, the name "P3" is not shown in Table 3.

Table 3. Projects for Which Transportation Agency Staff Were Interviewed[a]

No.	State	Project (No. of Interviewees)[b]	P3?[c]	Phone or Email Interview Date
1	Colorado	I-70 Mountain Corridor (1)	No	May 30, 2014
2	Georgia	Atlanta Downtown Multi-Modal Passenger Terminal (1)	Yes	June 13, 2014
3	Colorado	Regional Transportation District (RTD) FasTracks (2)	Yes	June 18, 2014
4	California	Anaheim Regional Transportation Intermodal Center (1)	No	June 18, 2014
5	Colorado	US 36 Express Lanes Project (1)	Yes	June 20, 2014
6	California	High Desert Corridor (1)	Yes	September 17, 2014
7	District of Columbia	Washington D.C. Streetcar PPP Project (1)	No	September 24, 2014
8	Alaska	Anton Anderson Memorial Tunnel (1)	Yes	September 24, 2014
9	Florida	Miami Intermodal Center (1)	Yes	October 3, 2014
10	Georgia	Northwest I-75/575 HOV/BRT (1)	Yes	October 21, 2014
11	Florida	54 Express (2)	No	October 20, 2014
12	Florida	I-4 Ultimate P3 Project (3)	Yes	October 20, 2014
13	Rhode Island	InterLink Project (2)	Yes	October 20, 2014
14	Georgia	Atlanta BeltLine (3)[e]	No	October 22, 2014
15	Maryland	Light Rail Purple Line P3 (1)	Yes	October 30, 2014
16	Florida	I-595 Express Corridor (1)	Yes	November 14, 2014
17	Illinois	Riverwalk Expansion/Wacker Drive Reconstruction Project (1,1)[d]	No	November 17, 2014[d] June 1, 2015[d] June 2, 2015[d] June 10, 2015[d]
18	Illinois	CTA 95th Street Terminal Improvement Project (1,1)[d]	No	
19	Illinois	Chicago O'Hare International Airport (1)	No	
20	Illinois	Chicago Region Environmental and Transportation Efficiency Program (CREATE) (1,1)[d]	Yes	
21	Texas	SH 183 Managed Lanes Toll Concession (1)	Yes	January 21, 2014
22	Texas	Katy Freeway Reconstruction (1)	No	January 15, 2015
23	California	Crenshaw/LAX Transit Corridor Project (1)	No	June 3, 2015

HOV = high occupancy vehicle; BRT = bus rapid transit, CTA = Chicago Transit Authority.

[a] Six projects from 35 candidate multimodal P3 projects are not shown because pre-interview communications with transportation agency staff indicated the projects were not P3s: Highway Goods Movement Package PPP Projects (California); 91 Express Lanes (California); South Capitol Street Corridor Design-Build Project (Washington, D.C.); Eleventh Street Bridge Project (Washington, D.C.); Washington Metro Capital Improvement Program (Washington, D.C.); and Charlotte Gateway Station (North Carolina).

[b] Project titles used in the table were those the researchers had obtained from various websites and then subsequently used in communications with interviewees (unless interviewees changed the project title in which case the new project title is used). Interview information is current as of the time the interview was conducted.

[c] Although the researchers, before conducting the interviews, thought that all projects listed in the table were multimodal P3s, a "yes" indicates the interviewee confirmed that the project was indeed a P3 and a "no" indicates that the project was not a P3.

[d] The first interview for the 4 Illinois projects occurred at the same time with one person. Then, because the interviewee suggested other persons should be contacted for additional information, additional queries by email were conducted for the Riverwalk Expansion/Wacker Drive Reconstruction Project (June 1, 2015) and the CTA 95th Street Terminal Improvement Project (June 2, 2015), and a telephone interview with another person was conducted for the Chicago Region Environmental and Transportation Efficiency Program (June 10, 2015).

[e] At the time of the interview, Georgia's Atlanta BeltLine project interviewees were considering the feasibility of adopting a P3 approach. Later communications with one interviewee (Atta, 2015) revealed that this project is not being pursued as a P3 because of the cost of implementation; however, Atta (2015) noted this decision might be reconsidered in the future.

Step 3. Conduct Interviews

As indicated in Table 3, interviews related to the 23 projects were conducted: 18 initial interviews by phone, 2 initial interviews by email (at the interviewee's request), and then 3 additional follow-up communications (1 interview by telephone and 2 queries by email). Table 4 shows the two types of interviews that were conducted: a project-specific interview (for P3 projects) and a general interview (for non-P3 projects). At least two staff from VTRC were present for each phone interview.

Permission was sought from interviewees to record the interview. Then, based on notes taken by the researchers during the interview and the recording, a transcript was made. The transcript was then converted to a summary that, along with any necessary follow-up questions, was sent to interviewees for verification (except for the instances where questions and answers were provided by email.) The summaries from the interviews totaled approximately 75 pages: some interview notes provided very limited information such that the notes were less than a page and others providing substantial detail such that six pages of notes were resulted. (For example, in the interview regarding Rhode Island's Interlink Project, seven questions were posed, with the last question pertaining to mode shares by rental car, commuter rail, and auto/taxi.)

If an interviewee was unavailable to provide a verification (e.g., in the case of the Texas SH183 project, the interviewee left the Department of Transportation after the interview but before verifying the notes), the researchers sought to provide another person in the same agency with the interview summary. In those cases the individual could not verify exactly the information provided in the interview but could indicate whether the information appeared to be correct given what the individual knew about the project. In one case, verification was obtained only after providing the interviewee with a draft copy of the final report; thus, rather than the interview summary being verified, the draft report's contents (with respect to the particular project) were verified. That said, for all 23 projects, the researchers either obtained verification (often with modifications) from the interviewees or were able to reach another individual who could indicate that the information in the summary appeared to be correct. The purpose of this verification was to ensure that the interview notes, as understood by the researchers, were accurate.

Step 4. Synthesize Interview Results and Related Literature

Each interview summary was reviewed to obtain four pieces of information: (1) factors that determine whether a project is pursued as a P3; (2) reasons for including multiple modes; (3) the presence of milestones for deciding whether to incorporate multimodal components; and (4) expected land development impacts. Because the interviews were open-ended discussions, it was not unusual for these four pieces of information to be found in different sections for each interview, and the researchers sought to group similar responses to the extent possible.

Table 4. Interview Question Template and Target Audiences[a]

Type	Details	
Project-specific interview	Target audience	A person who could discuss P3 project-specific details. This interview was conducted if the candidate project from Step 2 was confirmed to be a P3 by the interviewee.
	Sample questions	1. Why did the *Rhode Island Department of Transportation* pursue the *InterLink project* as a public-private partnership? [If clarification is needed, the following may be stated.] What were the key factors that led to pursuing this as a P3? Clearly P3s are an opportunity to leverage private sector resources, but is there any unique justification for this project that outside observers might not be aware of? 2. Are there project developments milestones where decisions are made to include or exclude alternative modes? [If clarification is needed, the following may be stated.] We asked this question because in Virginia it is possible for a given mode, such as Bus Rapid Transit (BRT), to be proposed in one phase and then eliminated in another phase. [Then if they ask what phases are used in Virginia, this may be stated:] Typically, in Virginia, P3 projects use 5-phase process, which is identification, screening and prioritization, development, procurement, delivery. [b] 3. To what extent does consideration of multiple modes influence how a P3 decision is made? [If the interviewers believe that the above question is confusing or not helpful, the following may be asked instead of, or in addition to, Question 3.] In general, what factors lead you to consider multiple modes in a given project? For example, a given project might have included multiple modes as a way to increase revenues for stakeholders. Do you have any reasons to involve multiple modes in this project? 4. What are the expected land use impacts? Land use impacts include any changes in population, the use of land (for example, changing residential area to commercial area), or land values around the *InterLink project* including rail stations and park-and-ride facilities.
General interview	Target audience	A person who could discuss the state's approach to P3s. This interview was conducted if the candidate project from Step 2 was ultimately found not to be a P3 project.
	Sample questions	1. I want to confirm that the *I-70 Mountain Corridor Project* will not be pursued as a public-private partnership. 2. Does Colorado have a standard process for developing a P3 project? Here in VA, we have a phased process which starts with identification, the second step is screening and prioritization, third step is development, fourth step is procurement, and the fifth step is delivery. [b] 3. VDOT is interested in the multi-modal aspects of P3 projects and surprisingly, there are not that many that have multi-modes that it looks like this is at least going to have multi-mode features. We noticed that in some of the reference work they were talking about, buses, rails or the advanced guideway system (high speed rail). So to what extent does that effect whether CDOT is going to do a P3 or not?

[a] Although the questions shown served as a template for conducting the interview, additional or fewer details were sought based on the interviewee's familiarity with a given project or process. For example, in one interview (regarding FasTracks), Question 2 was posed first (with a short follow up to clarify that this was a P3 project and a clarification that answered Questions 1 and 3) and Question 4 was posed last (consistent with Table 4); however, the bulk of the interview focused on the nature of the concession agreement given the interviewee's expertise in this area. In another interview (Florida's 54 Express) the project was found not to be a P3, however, expected land use impacts (e.g., Question 4 from the project-specific interview set) was posed given the interviewees' experience in this area. In another instance (regarding the 54 Express), Question 2 regarding project development milestones was not posed, which left time for the interviewers to ask about the history of that particular project.

[b] This table reflects the questions posed during the interviews starting in 2014. Since that time after the interviews were completed, however, internal review comments for this report show that the 5 phases for P3s in Virginia are identification, screening, development, procurement, and implementation (Cromwell, 2016).

For example, in the response to Question 4 (which pertained to land use as shown in Table 4) for the Anaheim Regional Transportation Intermodal Center (ARTIC), interviewees noted that the city's vision for ARTIC had been in existence for two decades in terms of supporting a mixed use area; in response to Question 3 (concerning multiple modes), the interviewees had noted that this vision also included an intermodal transportation center. For the Northwest I-75/575 HOV/BRT project, interviewees had noted the use of "future transit plans" in response to Question 3. In summarizing this information for Item 2 (reasons for including multiple modes), the summary table in this report (Table 6) lists both these projects as exemplifying the reason that multiple modes are part of the long-term vision for the region.

Information from the interviews related to an unexpected finding—the potential value of a more structured process for inclusion of other modes—was also documented. In several cases, the researchers supplemented the interview summaries with a review of project documents (often suggested by interviewees) in order to understand better the interview content, and in those cases these project documents have been cited in the reference list and in the Results section.

A meeting with the study's technical review panel on September 24, 2015, resulted in the suggestion that mention of Virginia projects with innovative financing techniques be noted, as appropriate, when summarizing the interview results. Accordingly, information from the literature concerning six Virginia projects was obtained: Elizabeth River Tunnels (Elizabeth River Crossings, 2016a, 2016b), Dulles Greenway (Parsons Brinckerhoff et al., 2015), Pocahontas Parkway (Grymes, 2014), Transform 66–Outside the Beltway (VDOT, 2015c), Route 28 (Route 28 Corridor Improvements, LLC, 2014), and Route 288 (Kozel, 2005). Information from a seventh Virginia project—the I-495 Express Lanes (Gilroy, 2013)—was also extracted for use with a subsequent step in this study. In the results section of this report, when information was obtained regarding Virginia projects and not from the interviews, the Virginia projects have been referenced accordingly, with the Virginia projects placed at the end of each subsection of results.

Step 5. Develop a Value Capture Methodology and Apply It to a Virginia Case Study

A methodology was developed for evaluating land development impacts by multimodal P3 projects where the distance to express bus routes and HOT lanes was considered a key determinant with which a given location was assessed. The underlying assumption of this methodology is that if a multimodal P3 project changes the ease of traveling, then such a change should be reflected in newly calculated property values. If such a change is statistically significant, then the increase could be used in a value capture mechanism in the future. To account for the fact that the economic recession of 2007 occurred during the study period, the market change rate, described in the Appendix based on data provided by Fairfax County (2006, 2007, 2013, 2014) estimated the median and average market values of residential properties, was used to examine how proximity to the P3 project affected property values during the before period; this relationship of property to value to price was then examined during the after period.

The methodology has four major components.

1. *Develop the hedonic price model.* One way that a multimodal P3 project may affect land values is by changing the ease of travel between one location and another; also, in the long run, the P3 may alter the balance between the residential locations (e.g., households) and the commercial locations (e.g., firms that provide employment opportunities or services for members of those households). This determination can be made through the use of a hedonic price model. Hedonic price theory basically assumes that the price (or rent) of a property is a function of several sets of characteristics that collectively describe the property; examples of such characteristics are the quality of construction, quantity or size of buildings, and property's location within the relevant real estate market (Iacono and Levinson, 2013). Two main data sources were necessary: multiple years' parcel-level property information including property values and attributes (e.g., the number of bedrooms in a residence), and distances between each property and the multimodal P3 project.

2. *Construct the multimodal transportation network.* The multimodal transportation network is necessary to accommodate the attributes of multiple modes in a given area. To ensure the repeatability of the methodology, non-proprietary or otherwise "open" data sources were actively used, such as OpenStreetMap (Undated) and the General Transit Feed Specification (GTFS) (GTFS Data Exchange, 2015).

3. *Establish the impact boundary.* There is no exact guideline to designate the suitable impact boundary, but to capture the impacts by a multimodal P3 project, a proper impact boundary needed to be established considering the disamenities of the project, i.e., negative localized effects of the transportation facility such as noise, fumes, or vibration.

4. *Select study variables.* To establish a model evaluating the changed property values (as a dependent variable), independent variables, otherwise known as explanatory variables, needed to be defined that could help differentiate the P3 project impacts on property values from other sources that might also affect property values. For example, one such variable might be the number of stories in the building situated on a land parcel.

The proposed methodology was applied to one site in Virginia selected after the researchers reviewed data availability and locational importance of several multimodal P3 projects in the United States. Because the county in which the P3 project was situated had seen an actual overall decrease in property values of 20.9% from the before period (2006-2007) to the after period (2013-2014), the "before" property values were reduced by 20.9% to control for the actual overall change in economic conditions as described in the Appendix.

RESULTS AND DISCUSSION

The lessons learned from the reviewing the 75 pages of notes from the interviews for the 23 projects (including additional communications with interviewees outside the initial interview and related literature) and the development of a value capture methodology that could be applied to Virginia are presented with respect to five categories:

1. factors that determined why a multimodal project was pursued as a P3 or a non-P3

2. reasons for including multiple modes in a P3 project

3. milestones used to determine whether multimodal components should be included in the P3 project

4. expected impacts of the P3 project on land development

5. a Virginia case study regarding the application of the value capture methodology developed in this study.

Factors That Determined Why a Multimodal Project Was Pursued as a P3 or a Non-P3

Of the 23 projects examined, 13 were P3s, and 10 were not. Table 5 shows the reasons for a multimodal project being pursued as a P3 or non-P3 as expressed by the interviewees. Note that Table 5 shows 19 bullets for projects with a P3 status rather than 13 bullets because four projects (Anton Anderson Memorial Tunnel, FasTracks, Atlanta Downtown Multi-Modal Passenger Terminal, and I-4 Ultimate P3 Project) appear twice as two reasons apply to those projects, and Northwest I-75/575 HOV/BRT appears three times. Similarly, as is shown in Tables 6 through 8, a project may appear in a table more than once if there are multiple reasons for the project meeting the conditions given in the table.)

Reasons for a Multimodal Project Being Pursued as a P3

Not surprisingly, the most common reason interviewees gave for pursuing a project as a P3 was to obtain private assistance: this reason applied to most (10 of the 13) P3 projects listed in Table 5. For example, Florida's I-595 Express Corridor required approximately $1.4 billion—compared to about $0.7 billion available in the public sector work program. Based on the results of the Colorado US 36 interview, the researchers learned that even if a shortfall is not apparent, the private sector involvement can address risk. That is, the interviewee stated that although Colorado obtained subsidies from local governments, federal sources, and the TIFIA program, Colorado recognized that there was a significant risk that the toll revenue would not always cover the operations and maintenance costs for the US 36 Express Lanes.

Table 5. Reasons Given by Interviewees for a Multimodal Project Being Pursued as a P3 or a Non-P3[a]

Status	Reason	Project
P3	Obtain private sector financial assistance	• Atlanta Downtown Multi-Modal Passenger Terminal, Georgia • US 36 Express Lanes, Colorado • High Desert Corridor, California • InterLink, Rhode Island • I-4 Ultimate P3 Project, Florida • Miami Intermodal Center, Florida • I-595 Express Corridor, Florida • SH 183 Managed Lanes Toll Concession, Texas • Northwest I-75/575 HOV/BRT, Georgia • Chicago Region Environmental and Transportation Efficiency Program, Illinois • FasTracks, Colorado
	Increase speed of construction	• Anton Anderson Memorial Tunnel, Alaska • I-595 Express Corridor, Florida • I-4 Ultimate P3 Project, Florida • Northwest I-75/575 HOV/BRT, Georgia
	Obtain expertise appropriate for this effort	• Atlanta Downtown Multi-Modal Passenger Terminal, Georgia • Maryland Light Rail Purple Line P3, Maryland • Northwest I-75/575 HOV/BRT, Georgia • Anton Anderson Memorial Tunnel, Alaska
	Improve service quality	• FasTracks, Colorado
Non-P3	Became non-P3: lack of financial viability was a contributing factor	• I-70 Mountain Corridor, Colorado • Anaheim Regional Transportation Intermodal Center, California • 54 Express, Florida • Atlanta BeltLine, Georgia
	Became non-P3: incompatibility of design could have become a contributing factor	• 54 Express, Florida
	Was never a P3	• Crenshaw/LAX Transit Corridor Project, California • Katy Freeway Reconstruction, Texas
	Reasons unknown	• Washington D.C. Streetcar PPP Project • Riverwalk Expansion/Wacker Drive Reconstruction Project • Chicago Transit Authority (CTA) 95th Street Terminal Improvement Project • Chicago O'Hare International Airport

HOV = high occupancy vehicle; BRT = bus rapid transit; CTA = Chicago Transit Authority.
[a] Project titles used in the table were those that the researchers had obtained from various websites and then subsequently used in communications with interviewees (unless interviewees changed the project title in which case the new project title is used). Interview information is current as of the time the interview was conducted.

As another example, Colorado's FasTracks involves about $1.6 billion from the public sector and an almost additional $0.5 billion from the private sector in debt and equity. For the Miami Intermodal Center, the public entity (Florida DOT) undertook the loan on behalf of the private entity (a car rental facility); the load is recovered via a customer facility charge administered by the county. The state DOT's interest was in relieving traffic on local streets (which was reduced through consolidating the car rental facilities.) In at least one case, the need for private sector involvement was not initially apparent: it was not realized that California's High Desert Corridor project would be a multi-billion dollar effort until the environmental and preliminary engineering processes were underway. Rhode Island's InterLink and Florida's Miami Intermodal Center are fundamentally private: rental car agencies are a major landowner in those locations. (A similar rationale applies to the Chicago Region Environmental and Transportation

Efficiency Program, which has a fundamentally private component—freight railroads—who are contributing funds "commensurate with their expected benefits.")

Table 5 shows three additional reasons given for pursuing a project as a P3.

1. *Construction time.* This reason was given for four of the 13 P3s in Table 5. Without a substantial quantity of private funds (about one-half the total project cost), Florida's I-595 Express Corridor would have been broken into 15 segments that would have been built incrementally over a 20-year period—such that capacity benefits for through traffic might not have been realized for two decades. The P3 approach shortened the time frame to about 5 years. For Alaska's Anton Anderson Memorial Tunnel, accelerating construction was critical: the interviewee noted that the federal government altered rules that previously had permitted the hauling of cars on flatcars, meaning that some other approach for providing access to a relatively remote area was needed. This reason was also mentioned as a consideration for one non-P3 in Table 5: for Georgia's Atlanta BeltLine, the P3 approach was considered because it could shorten the projected time frame from 17 to about 10 years or less. The Mayor's Office of Communications (City of Atlanta, 2013) further noted that pursuit of this project as a P3 would make certain elements—light rail transportation as well as parks and walking trails—be built faster than would otherwise be the case. Expedited project delivery was also noted for the Northwest I-75/575 HOV/BRT. For the I-4 Ultimate P3 project, interviewees noted that the "time frame is especially acute" because without the P3 model, the 21 mile series of improvements would have to performed as six separate projects—and a schedule that maximized constructability (e.g., coordination between adjacent contractors) might not be the same as a schedule that maximizes drivability (e.g., motorists would not want to have a section of express lanes, then a gap, and then another section of express lanes).

2. *Private sector expertise.* This reason was given for 4 of the 13 P3s in Table 5. The Georgia DOT sought a master developer for the Atlanta Downtown Multi-Modal Passenger Terminal project who could partner with other land developers; the state wanted experience in such multimodal terminals. Given that the Maryland Light Rail Purple Line P3 requires coordination among the design, build, operations, and maintenance phases to account for the life cycle needs of the full project, private sector experience from transit projects worldwide was an asset. For the Northwest I-75/575 HOV/BRT, interviewees also noted that the P3 process allowed the "introduction of alternative technical concepts." For the Anton Anderson Memorial Tunnel, Alaska, the private sector involvement yielded one other benefit: because the contractor operated the facility for an initial period (as part of the construction contract prior to turning it over to the Alaska Department of Transportation and Public Facilities), the contractor solved certain "bugs" in the system. For instance, interviewees noted that one problem was with the ice melt system, which required additional plumbing and design.

3. *Better transit service quality.* Although it had invested hundreds of millions of dollars in the project, the private sector did not want to take the fare box revenue risk. Rather,

> a public transit provider, the RTD, will make performance-based payments to the private sector. These payments will be based on metrics such as frequency of service (15-minute headways or better), on-time performance, cleanliness of vehicles, and safety record. In short, the desire to improve transit service quality explicitly influenced the concession agreement between the public and private entities.

Although Virginia P3 projects were not included in the survey, Virginia's Elizabeth River Tunnels project benefitted from a shorter construction time under the P3 structure (Elizabeth River Crossings, 2016b). In addition, Virginia's Route 288 project used $236 million, which allowed the entire 16.7-mile-long interstate-standard four-lane freeway to be built immediately; otherwise, this road would have been mostly two lanes on a four-lane right of way (Kozel, 2005). (The $236 million was the capital cost for the project; this capital was obtained by the private partner issuing bonds; Virginia will pay back this capital cost plus interest [Kozel, 2005]).

Reasons for a Multimodal Project to Transition From P3 to Non-P3

One reason for changing from P3 to non-P3 status was that as more information was learned about the project, its financial viability was brought into question—but the way in which this reason manifests is specific to each project. This reason was given for 4 of the 10 non-P3s in Table 5. For Colorado's I-70 Mountain Corridor, after an unsolicited proposal had been received, the interviewee noted that a separate traffic and volume study performed by the state DOT suggested that the revenue could not meet the costs for the project. The Louis Berger Group, Inc. (2014) indicated that although a peak shoulder lane with tolling could be feasible under some conditions, this was not the case for full widening: if two lanes were added, tolls would not cover the sum of capital plus operating and maintenance costs. In the case of Florida's 54 Express (a term used by the interviewee) after an unsolicited bid was received from a private sector consortium, the project was cancelled when the private sector entity requested an additional $100 million (beyond the original unsolicited bid submitted previously). For California's Anaheim's Regional Transportation Intermodal Center, two factors contributed to the project not appearing to be financially viable: the weakening of the economy (in 2008), and the fact that because this was a relatively new business model, it was difficult to find a single entity who could finance, operate, and maintain the facility over a long period of time. For the City of Atlanta, "costs of implementation" led to the decision not to pursue the project as a P3.

Interviewees for one of the 10 non-P3 projects in Table 5 provided an additional factor that could terminate pursuing a P3 for a project: design compatibility. Although the private bid for Florida's 54 Express had already been rejected, interviewees noted that had negotiations continued, operational questions (such as how much to charge for transit access to congestion-priced lanes) and design questions (such as how to enable transit stations to provide access to adjacent land uses) would have required answers.

For four projects shown in Table 5 (Anaheim Regional Transportation Information Center, Atlanta Beltline, U.S. 54 Express, and Washington D.C. Streetcar PPP Project), although they had been listed as P3s in the literature (InfraPPP, 2014), interviews clarified they were not P3s. (Note also that in that literature the U.S. 54 Express had been referred to as the "SR – 54 & 56 Toll Road

Concession" [InfraPPP, 2014]). In addition, for another project the researchers had initially believed to be a P3, an interviewee with the Crenshaw/LAX Transit Corridor Project noted: "We do not consider Crenshaw/LAX a P3 project, but that depends on your definition. It is DB delivery method which is considered P3 under FTA/FHWA definition." To be clear, the methodology used by the researchers for determining that a project was or was not a P3 was to use the content of the interview: if the interviewee stated the project was not a P3, this label was used in Table 5, regardless of what was stated in the literature.

In the case of North Carolina's Charlotte Gateway Station, which was not included in the survey, although there was initial interest in a P3, it was determined that state statutes prohibited such an endeavor, and the representative who provided this information also noted that the layout of the property was not compatible with such a development, relating to the design compatibility factor (Newton, 2014).

Upon review of the initial draft of this report, it was pointed out (O'Leary, 2016) that P3 negotiations can be quite complex, such that a shift from a P3 to a non-P3 can occur for a variety of reasons. For example, the manner in which risk is allocated, the tolls that are allowed, or other factors that lead to P3 agreements becoming complex can all lead to a shift from P3 to non-P3 (O'Leary, 2016).

Reasons for Including Multiple Modes in a P3 Project

The interviews did not reveal an exact point at which multiple modes were considered but did reveal four reasons for including two or more modes in P3 projects as summarized in Table 6.

1. *The region's vision called for multiple modes for 2 of the 23 projects.* For California's Anaheim Regional Transportation Intermodal Center, fixed guideway service (i.e., rail service) in the 820-acre Platinum Triangle area had been part of city plans for two decades and would support existing mixed-use development. For Georgia's Northwest I-75/575 HOV/BRT, future transit plans included express bus service on several Atlanta radial freeways.

   In addition, for Georgia's Northwest I-75/575 HOV/BRT, the interviewees noted consideration of multiple modes was supported by two studies conducted by the public sector. The interviewees described these two studies as the Northwest Connectivity Study (conducted by the Greater Regional Transportation Authority) and one by the Georgia DOT Planning Office (a specific name for that study was not given in the interview). The interviewees explained that the former study looked at managed lanes and bus rapid transit, and the latter study looked at truck-only lanes. In general, the interviewees noted that when there is overlap between transit network needs and roadway network needs, multimodal solutions are often considered.

Table 6. Reasons From Interviews for the 23 Study Projects to Involve Multiple Modes[a]

Reason	Project
Multiple modes are part of the long-term vision for the region.	• Anaheim Regional Transportation Intermodal Center, California[b] • Northwest I-75/575 HOV/BRT, Georgia
Multiple modes are sought because of public opinion.	• US 36 Express Lanes, Colorado • High Desert Corridor, California • I-595 Express Corridor, Florida • 54 Express, Florida[b] • Atlanta BeltLine, Georgia[b] • Washington D.C. Streetcar PPP Project, Washington, D.C.[b]
Multiple modes are naturally part of the project.	• Anton Anderson Memorial Tunnel, Alaska • Miami Intermodal Center, Florida • InterLink, Rhode Island • I-4 Ultimate P3 Project, Florida • SH 183 Managed Lanes Toll Concession, Texas • Chicago Region Environmental and Transportation Efficiency Program, Illinois
Use of multiple modes increases availability of financial resources.	• US 36 Express Lanes, Colorado • InterLink, Rhode Island • Atlanta BeltLine, Georgia[b] • I-595 Express Corridor, Florida • Katy Freeway Reconstruction, Texas[b]
Other	• I-70 Mountain Corridor, Colorado • Atlanta Downtown Multi-Modal Passenger Terminal, Georgia • Regional Transportation District (RTD) FasTracks, Colorado • Light Rail Purple Line P3, Maryland • Riverwalk Expansion/Wacker Drive Reconstruction Project, Illinois • CTA 95th Street Terminal Improvement Project, Illinois • Chicago O'Hare International Airport, Illinois • Crenshaw/LAX Transit Corridor Project, California

HOV = high occupancy vehicle; BRT = bus rapid transit; CTA = Chicago Transit Authority.
[a] Project titles used in the table were those the researcher had obtained from various websites and then subsequently used in communications with interviewees (unless interviewees changed the project title in which case the new project title is used). Interview information is current as of the time the interview was conducted.
[b] The project was initially believed to be a P3; however, the interview, or communications after the interview, showed it was no longer a P3. Thus in Table 5 it is listed as not being a P3.

2. *The public favored multiple modes for 6 of the 23 projects.* For two projects, interview results suggested this pressure appeared to begin with public participants and public officials. The interviewee for California's High Desert Corridor noted the public was interested in green energy (using the right of way for energy transmission lines from solar sources and wind farms) and rail and bicycle modes; in particular, the public wanted a multimodal project that would encompass various elements instead of the undertaking of separate environmental analyses and decisions in the future. For Georgia's Atlanta BeltLine, demand for a bicycle lane and transit was evident from a regional survey of 4,500 people showing that almost 74% supported additional transit service. For four other projects, this pressure was evident through the actions of elected officials. For example, an executive order required that multiple modes, including transit, be considered within Colorado's P3 process; a draft policy, provided by the interviewee, showed this consideration for managed lanes projects. (That policy is now

in place.) (In addition, the interviewee noted that a tax increase for an area-wide transit initiative had been passed in 2004.) Interviewees with the Washington D.C. Streetcar PPP Project noted that a policy decision is made regarding inclusion of multiple modes before finances are discussed; this is consistent with Florida's I-595 Express Corridor, where bus service was included because it was desired by the county (Broward) where the improvements were made. For Florida's 54 Express, interviewees noted that although multimodalism was not the main component of the P3 proposal, this aspect was of interest to the county, the metropolitan planning organization, and the Florida DOT.

3. *They were fundamental to the project for 6 of the 23 projects.* Florida's Miami Intermodal Center links disparate transportation services—train, taxi, rental car, and bus—and helps reduce congestion on side streets near Miami International Airport. Rhode Island's InterLink—which enables Rhode Island's T.F. Green Airport to serve as a reliever to Massachusetts' Boston Logan International Airport—accommodates a street-level bus stop, a bus layover facility, commuter rail, rental cars, and a moving skywalk. Alaska's Anton Anderson Memorial Tunnel already provided rail service, but highway service was needed in response to federal rules that limited rail's ability to move vehicles. Florida's I-4 Ultimate P3 Project entails managed lanes that, the interviewee explained, do not provide preferential treatment for buses. (However, such lanes now allow public transit vehicles to use the lanes free of charge [Florida DOT, undated.]) A similar explanation applies to Texas' SH 183 Managed Lanes: transit buses can use the lanes free of charge. Illinois' CREATE program involved grade separation between multiple surface modes (e.g., local streets, bus transit, and railroads) and also coordination between multiple rail modes (e.g., slower and longer freight trains and shorter and faster passenger trains).

4. *The P3 structure allowed for funding that would otherwise not have occurred for 5 of the 23 projects.* An additional fee placed on car rental customers will pay the bond for Rhode Island's InterLink, which was the primary reason for the P3 model. For Colorado's US 36 Express Lanes and Georgia's Atlanta BeltLine, transit is subsidized through different mechanisms. For the US 36 Express Lanes, the transit operator was the beneficiary of a tax increase enabling bus rapid transit service as part of a managed lanes project. For the Atlanta BeltLine, interviewees noted that pursuit of the P3 enabled consideration of more expansive transit service rather than acquiring service for "absolutely the least amount of money," which could be the case for projects relying solely on federal funds. Florida's I-595 Express Corridor interviewee noted that consideration of multiple modes may depend on how payment is structured: rather than a true toll where the private sector takes the risk, the state makes an availability payment that does not vary with traffic. The interviewee noted for I-595 that availability payments were used to repay long-term TIFIA loans and final acceptance payments used to repay short term bank debt. Although not a P3, cost sharing by the transit provider and the toll road authority (for the same facility) was a reason for interest in multiple modes for Texas' Katy Freeway Reconstruction.

In addition to the four reasons cited in Table 6, interviewees gave some additional viewpoints related to the involvement of multiple modes, and these have been categorized as "Other" in Table 6. Interviewees with the I-70 Mountain Corridor noted that in general, multiple modes are considered when analyzing any project that will include some form of managed lanes. A similar view was expressed for the Light Rail Purple Line, where the decision to include multiple modes depends on the specific needs and scope of the solutions, and is made prior to deciding how a project will be delivered. An interviewee who provided initial information for the Riverwalk Expansion/Wacker Drive Reconstruction Project, the CTA 95th Street Terminal Improvement Project, and the Chicago O'Hare International Airport noted that in general, one can consider multimodal elements in order to improve connectivity or when examining projects from a systems perspective. For the Washington D.C. Streetcar PPP Project, the interviewee noted that once the policy decision has been made, the interviewee's role was to determine the most reasonable way to finance the project. For the Crenshaw/LAX Transit Corridor Project, interviewees noted that in general, multiple modes may be considered in order to increase revenue, but such consideration does not usually affect mode selection when the project is planned or when alternatives are scored. For the remaining two projects, the relevant questions (see Question 3 in the notes to Table 4) were not posed during the initial interview.

With regard to one Virginia P3 project (Transform 66–Outside the Beltway), multiple modes were considered as a way to enhance transportation safety and travel reliability (VDOT, 2015c).

Milestones Used to Determine Whether Multimodal Components Should Be Included in the P3 Project

No interviewees of the 23 projects noted the existence of a decision point specific to the P3 project development process where multiple modes were formally considered. That said, four categories of explanations regarding the use of milestones (to determine whether multimodal components should be included in the P3 projects) are evident in Table 7.

The first reason is that milestones cannot be used until the project is well defined, which is shown for two projects in Table 7. With regard to the first reason, interviewees affiliated with Alaska's Anton Anderson Memorial Tunnel and California's High Desert Corridor explained that the inclusion or exclusion of such modes defined the project. Further, interviewees affiliated with Alaska's Anton Anderson Memorial Tunnel noted that in general, consideration of multiple modes in a given project is done on an ad-hoc basis; for example, interviewees noted that the need for multiple modes for this project was already apparent and it was that need that led to the use of the P3 mechanism. (Interviewees noted the existence of construction milestones that are not geared toward deciding whether other modes should be considered.)

The second reason, applicable to five projects, is that project conditions are evolving such that milestones are not appropriate.

Table 7. Reasons Given by Interviewees for Not Having Milestones for Consideration of Multiple Modes in P3 Projects[a]

Reason	Project
Milestones cannot be used until the project is well defined.	• Anton Anderson Memorial Tunnel, Alaska • High Desert Corridor, California
Milestones are not used because project conditions are evolving.	• I-4 Ultimate P3 Project, Florida • Atlanta Downtown Multi-Modal Passenger Terminal, Georgia • Anaheim Regional Transportation Intermodal Center, California[b] • InterLink, Rhode Island • Atlanta BeltLine, Georgia[b]
Milestones are not needed because other processes are in place.	• Northwest I-75/575 HOV/BRT, Georgia • I-595 Express Corridor, Florida • Miami Intermodal Center, Florida • Chicago Region Environmental and Transportation Efficiency Program, Illinois • FasTracks, Colorado • Light Rail Purple Line P3, Maryland
Formal milestones for P3 projects are being developed.	• I-70 Mountain Corridor, Colorado[b] • US 36 Express Lanes, Colorado
Other	• Katy Freeway Construction, Texas[bc] • Washington D.C. Streetcar PPP Project[c] • 54 Express, Florida[c] • Riverwalk Expansion/Wacker Drive Reconstruction Project, Illinois[c] • CTA 95th Street Terminal Improvement Project, Illinois[c] • Chicago O'Hare International Airport, Illinois[c] • SH 183 Managed Lanes Toll Concession, Texas[c] • Crenshaw/LAX Transit Corridor Project, California[c] • Anton Anderson Memorial Tunnel, Alaska[c]

HOV = high occupancy vehicle; BRT = bus rapid transit; CTA = Chicago Transit Authority.

[a] Project titles used in the table were those the researchers had obtained from various websites and then subsequently used in communications with interviewees (unless interviewees changed the project title in which case the new project title is used). Interview information is current as of the time the interview was conducted.

[b] This project was initially believed to be a P3; however, the interview, or communications after the interview, showed it is no longer a P3.

[c] The Katy Freeway Construction interviewee noted that project milestones exist but not for the consideration of multiple modes. An interviewee for four Illinois projects (Riverwalk Expansion/Wacker Drive Reconstruction Project, CTA 95th Street Terminal Improvement Project, Chicago O'Hare International Airport, and Chicago Region Environmental and Transportation Efficiency Program) noted that generally the decision to include or exclude multiple modes will be project specific but should be considered as part of the planning process. For the Crenshaw/LAX Transit Corridor Project, the interviewee had noted previously that modes do not play as much of a role as the need for the project at the project planning and screening phase. For the Anton Anderson Memorial Tunnel, interviewees noted that bicycle and pedestrian facilities were considered as a result of public requests, however, the expected demand did not justify the additional cost for these modes. No related questions were posed for the Washington D.C. Streetcar PPP project, the 54 Express, and the SH 183 Managed Lanes Toll Concession.

Rhode Island's InterLink interviewees noted that the most important factor (in terms of deciding whether to include or exclude modes) was the interdependent interests of stakeholders; for instance, the decision to involve multiple modes resulted, in part, when the airport, nine rental car companies, a commuter rail system, and the local mayor realized that there could be joint benefits to developing a corridor linking an existing airport and train station. These joint benefits became apparent because with the northeast corridor located a quarter mile away from the InterLink, the desire to consolidate rental car facilities, the city mayor being interested in redeveloping the area, and a state extension of commuter rail. (The interviewees noted that *for that particular project*, a milestone occurred when the nine rental car companies realized they needed to speak with one voice in negotiating with the Rhode Island Airport Corporation.)

A related example of milestones not being used because project conditions are evolving was noted for four other projects besides Rhode Island's InterLink. For California's Anaheim Regional Transportation Intermodal Center, interviewees noted that until more experience with P3 projects is obtained, the decision will be governed by the "current economy, policy, and funding"—all of which can change rapidly. For three other projects, interviewees noted other factors that govern the inclusion of multiple modes that basically define the project: for the Atlanta Beltline, interviewees pointed out that the scope of multimodal projects is influenced by obtaining federal dollars; for the I-4 Ultimate P3, interviewees noted that P3 decisions are governed by (1) how badly an improvement is needed; (2) the source of funds for those improvements; and (3) if there are other options that are feasible; and for the Atlanta Downtown Multi-Modal Passenger Terminal, interviewees noted that "each individual case would be different," further noting that for that particular project, the Georgia DOT decided to include almost all modes at the inception of the project: bicycle, pedestrian, rental car, streetcar, bus, heavy rail, and light rail.

Interviews for six of the 23 projects noted that additional P3-specific milestones are unnecessary because other processes are already in place.

- Three of these six interviewees noted that for the alternatives analysis phase within the federal environmental process already considers multiple modes: Georgia's Northwest I-75/575 HOV/BRT, Colorado's FasTracks, and Illinois' Chicago Region Environmental and Transportation Efficiency Program, interviewees noted elements of the federal National Environmental Policy Act (NEPA) process. For Colorado's FasTracks, interviewees noted the Regional Transportation District had worked with the Colorado DOT to determine that a managed lane project was the preferred alternative in the Environmental Impact Statement (EIS). For Illinois' Chicago Region Environmental and Transportation Efficiency Program, interviewees noted that some projects may merit a Categorical Exclusion (CE) [meaning no alternatives need to be considered]), but that for those that require an EIS, a full alternatives analysis will be needed. For Georgia's Northwest I-75/575 HOV/BRT, interviewees noted that multiple modes are evaluated as part of NEPA.

- For Florida's I-595 and Florida's Miami Intermodal Center, the state environmental process would, for a given location, result in consideration of a variety of alternatives. For instance, Florida's Miami Intermodal Center interviewees noted the existence of the state-level Project Development and Environmental Study that recommends alternative modes that may make sense for a given corridor. For a separate project in the same state (I-595 Express Corridor), interviewees noted that two such studies were conducted: one for the express lanes (which include bus service) and one that includes light rail. Because a referendum to increase the sales tax to support light rail had failed, that project has not advanced; however, the I-595 corridor has saved right of way that could be used for light rail if light rail becomes feasible. Florida's I-595 Express Corridor interviewees further noted the role of local support in deciding whether to include multiple modes, which is part of the environmental review process.

- The Maryland Light Rail Purple Line interviewee noted that the decision to include multiple modes is made before the project delivery decision (e.g., should this be a P3?) is made. Similarly, for Georgia's Northwest I-75/575 HOV/BRT, interviewees also noted that the decision to include or exclude multiple modes is made prior to the project being made available for a P3 submission. (For this particular project, a concern was a 50 year lease where the state could possibly be held liable if toll revenues dropped due to construction of a parallel facility; this liability was removed when the state changed the project from design, build, finance, operate, and maintain to just design, build, and finance.) Similarly, Colorado's FasTracks interviewees noted that because FasTracks served as a public transportation provider, the decision as to whether multiple modes should be included was made before the project was given to FasTracks.

Interviewees for two Colorado projects, i.e., the I-70 Mountain Corridor and the US 36 Express Lanes, noted the development of a policy with specific project development milestones for the inclusion or exclusion of alternative modes. At the time of the interviews, the plan was to consider multimodal alternatives—including transit—for each project and to have surplus user fee revenue be applied toward transit or other forms of multimodal transportation. That policy is now in place.

Expected Impacts of Projects on Land Development

For the 23 projects, there were 18 projects for which information on expected land development impacts was available. For these 18 projects, the type of expected impact varied in terms of specificity: no impact (4 projects); more intense development in a specific location identifiable on a map or otherwise quantifiable (5 projects); more intense development but not in a specific location per se (7 projects); and some type of value capture (2 projects). Table 8 provides the anticipated impacts: actual impacts will not be known until after the projects are completed.

No Impacts on Land Use

There were three projects for which specific land development impacts were not expected after construction. Florida's I-4 Ultimate P3 Project is in an established corridor with urban development already adjacent to the facility: although it should reduce congestion, the corridor has been in place for the past 30 years. Florida's I-595 Express Corridor had a similar rationale: the opening of the highway in 1989 led to an increase in residential development but additional land use impacts are not expected. In response to "What are the expected land use impacts?", an interviewee for Texas' SH 183 Managed Toll Lanes Concession stated "Not per se" noting that the corridor is already congested and that the focus of the project is to provide alternatives. That interviewee then noted that the entire corridor is heavily developed, but that some remote areas may redevelop, and that this development would occur with or without the roadway's construction, but that possibly redevelopment might occur quicker with construction.

Table 8. Expected Impacts of Projects on Land Development[a]

Type of Land Development Impact	Project
None: no land impact is expected (e.g., the project is an already developed area)	• SH 183 Managed Lanes Toll Concession, Texas • I-595 Express Corridor, Florida • I-4 Ultimate P3 Project, Florida
Specific: more intense development in a well-defined location (e.g., 20 million square feet of commercial development)	• US 36 Express Lanes, Colorado (Transit-Oriented Development) • Miami Intermodal Center, Florida (Joint Development) • InterLink, Rhode Island[b] • 54 Express, Florida (Transit-Oriented Development)[c] • Atlanta BeltLine, Georgia (Transit-Oriented Development)[b,c]
General: more intense development in an amorphous location (e.g., near new access points for a given freeway)	• Northwest I-75/575 HOV/BRT, Georgia • High Desert Corridor, California • Washington D.C. Streetcar PPP project, Washington, D.C.[c] • Katy Freeway Reconstruction, Texas[c] • Anaheim Regional Transportation Intermodal Center, California[c] • Anton Anderson Memorial Tunnel, Alaska • Maryland Light Rail Purple Line P3, Maryland • Chicago Region Environmental and Transportation Efficiency Program, Illinois
Value capture (e.g., land near the facility is sold to developers)	• FasTracks, Colorado • Atlanta Downtown Multi-Modal Passenger Terminal, Georgia
Impacts not known or not discussed	• I-70 Mountain Corridor, Colorado • Riverwalk Expansion/Wacker Drive Reconstruction Project, Illinois • CTA 95th Street Terminal Improvement Project, Illinois • Chicago O'Hare International Airport, Illinois • Crenshaw/LAX Transit Corridor Project, California

HOV = high-occupancy vehicle; BRT = bus rapid transit; CTA = Chicago Transit Authority.
[a] Project titles used in the table were those the researchers had obtained from various websites and then subsequently used in communications with interviewees (unless interviewees changed the project title in which case the new project title is used). Interview information is current as of the time the interview was conducted.
[b] The fact that transit-oriented development is an expected impact for this project was obtained from planning documents (Atlanta BeltLine, Inc., 2010; City Centre Warwick, 2015), not from the interviews.
[c] This project was initially believed to be a P3; however, the interview, or communications after the interview, showed it was no longer a P3.

Interviewees associated with one of these three projects--Florida's I-4 Ultimate P3 Project--noted that a separate companion project, a commuter rail line, might indeed influence land development near the stations. Consistent with the literature (Meyer and Miller, 2013), such projects illustrate the view that incremental capacity improvements have a lesser land use impact than improvements that provide brand new access.

Specific Impacts on Land Use

One land impact is more intense development at a specific location. The interviewee noted that in contrast to the aforementioned I-595 and I-4 projects, which are in already-developed corridors, Florida's Miami Intermodal Center is expected to attract retail establishments, hotels, and businesses near the facility. The interviewee clarified that such land use impacts result from the nature of the project (e.g., in this case it is zoned for mixed-use) rather than the project being a P3 (or not P3) per se. Florida's 54 Express is expected to help support 15 large-scale developments that have been approved but not built (and subsequent to the initial interview, interviewees noted that some of this anticipated growth is now occurring). Further, the interviewee noted that a key impact is transit-oriented development around the stations, where the county has established an urban service area in its comprehensive plan that includes reduced impact feeds for higher density development in the corridor. The interviewee noted that the combination of transit and managed lanes may encourage land development patterns similar to what was observed in Arlington (Virginia) where TOD is near heavy rail stations. (In addition, the interviewee noted the importance of preserving right of way near ramps in order to retain modal options.) Rhode Island's InterLink supports a transit-oriented development; interviewees reported that the master plan includes a rezoning and the elimination of setbacks, and examination of the master plan (suggested to the interviewers by the interviewees) shows up to 2 million square feet of additional development centered on the InterLink (City Centre Warwick, 2015). Georgia's Atlanta BeltLine interviewees cited examples of investment (e.g., almost $2.7 billion of development occurring near the facility), with the various subarea plans (e.g., Atlanta BeltLine, Inc., 2010) showing locations of high-intensity development near transit stops. Finally, the interviewee with the US 36 Express Lanes noted all development is either close to transit facilities or facilities that provide access to transit.

General Impacts on Land Use

For some projects, land development impacts were defined as additional land development, but these impacts were not necessarily quantified.

For California's High Desert Corridor, population growth—and additional economic development—is expected at both ends of the corridor (where proposed High Speed Rail stations will be situated) and near highway-on/off ramps. While noting that a toll project in an undeveloped area would have a larger impact on land use, the interviewee for Georgia's Northwest I-75/575 HOV/BRT noted that because it is a retrofit, growth is expected at the new access points where the facility connects with local arterials, such as a new development near an interchange. (However, the interviewee noted that on a separate project, when the state had forecast last development impacts prior to construction, the forecast had the effect of increasing land prices prior to the state's acquisition of right of way.) For California's Anaheim Regional Transportation Intermodal Center, interviewees noted that investors have periodically expressed interest in development opportunities; however, there has not been a formal solicitation for interest since the initial request for expressions of interest (after which the city could not find one entity willing to serve as a master developer that could commit to financing, operating, and maintaining the facility over a long period of time). Illinois' Chicago Region Environmental and Transportation Efficiency Program does not expect direct land use impacts according to the interviewees (e.g., transit-oriented development); however, the investments in rail and interchange capacity should stimulate two types of commercial growth: logistics industry employment (given Chicago's role as a rail hub), and land development in the suburbs and the central business district (given the better connections provided by faster commuter rail service). Based on the interview, the Washington D.C. Streetcar PPP project would expand "premium" transportation, and hence economic growth, to areas not currently connected to the existing subway system. The Katy Freeway interviewee noted that the area is already developed but that during construction some right-of-way acquisition affected existing property owners and that after construction there will be improvement in both "mobility and economics."

Interviewees with the Maryland Light Rail Purple Line noted that there is already substantial development along the line, however, the land in the corridor has the potential to become more developed in the future, recognizing that this land is privately owned and thus development decisions rest with the private sector. Interviewees referred to the Record of Decision (Federal Transit Administration, 2014), which notes that the line will support "higher density in developed areas" including "mixed-use redevelopment" near the stations. A map (Maryland Transit Administration, undated) also noted by the interviewee shows examples of planned residential and commercial developments near the stations.

Finally, interviewees with the Anton Anderson Memorial Tunnel have had an opportunity to observe some land use impacts in that once the tunnel allowed high operations (rather than trains transporting vehicles only), there was a 12-fold increase in vehicular traffic into Whittier [a community located in Prince William Sound], which prior to the construction of the highway was only accessible by driving vehicles onto flatcars that were then transported by rail. However, interviewees noted that an even larger increase did not materialize because there was not additional land development to increase the "draw" of the tunnel. (Moses and Brown [2014] clarify that the tunnel provides the only way to access the community of Whittier by highway, with the increase in number of vehicles transported rising from 240 per day to between 3,060 and 3,825 per day following construction of the project.)

Potential Value Capture Examples

Interviewees for two projects (FasTracks and the Atlanta Downtown Multi-Modal Passenger Terminal) suggested some form of value capture where the facility will increase the worth of adjacent land, which may help finance the facility's operation or construction.

- For Colorado's FasTracks, interviewees noted that generally, there are two ways to use real estate to help fund infrastructure improvements: one way is to sell land to developers and the other way is through a tax increment financing district. A review of a piece of literature separate from the interview illustrates how the increased real estate values near the facility will help pay back the federal loans: a TIFIA program loan and a railroad rehabilitation and improvement financing loan; they, along with land sales, account for 70% of the project cost (Nichols, 2012). Nichols (2012) clarified that the portion of property taxes attributed to increased land values—the "tax increment"—is thus used to pay back the federal debt.

- For another potential P3 project (Georgia' Atlanta Downtown Multi-Modal Passenger Terminal), the response from interviewees suggested to the researchers the possibility of additional land development and air rights. Interviewees noted there are 4 acres of green space above the center that could attract residential and office development. Interviewees noted that the master developer had found that it was possible to create an additional 12 million square feet of retail, office, and residential space. (The topic of air rights was not mentioned in that interview but was mentioned in another interview as a possibility: interviewees with the Northwest I-75/575 HOV/BRT in Georgia noted that it was conceivable that, for a different project [the Miami Intermodal Center]), possibly office and residential areas above a terminal owned by the state could be leased to a P3 entity.)

A related technique was used in Virginia with the Route 28 project where landowners along Route 28 agreed to pay for improvements to the corridor in 1988 through a special tax district (Route 28 Corridor Improvements, LLC, 2014). The revenue bonds backed by proceeds from the Route 28 Tax District will be used to finance this project with VDOT funds (Route 28 Corridor Improvements, LLC, 2014).

Virginia Case Study: Application of the Value Capture Methodology Developed in This Study

Overview

Comments from interviewees for at least 2 of the 23 projects suggest potential private sector interest in participating in a variety of P3s. First, interviewees for Florida's I-595 Express Corridor explained how different payment structures could be implemented for multiple modes (e.g., a true toll where the concessionaire takes all the risk, a shadow toll where the DOT pays the concessionaire for each user of the facility, and an availability payment where the DOT pays the concessionaire a fixed amount regardless of traffic). Second, interviewees for the Maryland Light Rail Purple Line P3 stated that the private sector is more concerned with ensuring the existence of a strong P3 process and contractual structure, regardless of transportation mode or technology. Such a process appears promising for three reasons.

1. *P3 projects are diverse.* The private component of Rhode Island's InterLink and Florida's Miami Intermodal Center included consolidation of rental car companies. This is a fundamentally different form of private sector participation than what had been proposed for Florida's 54 Express for which the private sector would provide financing for what had traditionally been a public sector operation. Even the allocation of risk can differ: in the case of Florida's Miami Intermodal Center, the initial loan was taken by the Florida DOT rather than the concessionaire.

2. *P3 projects have diverse measures of success.* Contrary to the traditional view of a P3 in which the private sector assumes the risk (Dochia and Parker, 2009), interviewees for two projects, i.e., Florida's I-595 Express Corridor, I-4, and Colorado's FasTracks, noted the use of availability payments, as defined by the FHWA (2010), that are made to the concessionaire regardless of demand. These payments include a requirement that a certain level of service be attained. For example, in the case of Colorado's FasTracks, if certain transit performance standards are not met, the payment may be reduced up to 25% (and if standards are exceeded, a financial incentive is provided). Future measures of success are also evident: incorporating green energy transmission

lines for solar and wind farms in the right of way of the project (noted by the interviewee for California's High Desert Corridor), it is conceivable that some future P3s might use a related performance measure such as ability of the corridor to supply energy needs for a given project.

3. *Public acceptance is occasionally a problem for P3s.* Just like other transportation infrastructure projects, P3s can incur public objection. For Florida's 54 Express, there was some perception by the public that lanes were being taken away (which was not the case); further, although construction was not imminent, the receipt of an unsolicited proposal may have contributed to that perception.

These reasons suggest that the point at which multiple modes become part of the project may differ by project. The inclusion of multiple modes may be early in the life cycle when the project is defined, or modes may be added later when some unique aspect of the project, such as an ability to share costs or take advantage of potential land impacts, becomes better understood. Value capture—e.g., the increase in the value of the land as a result of the multimodal P3 project—is thus one potential element of such a process.

A process for considering P3s already exists in Virginia (Commonwealth of Virginia, 2014). To augment such a process, land development impacts can be considered. That is, the projects noted in the interviews also seem to suggest that in some cases, even if a project is not defined as a P3 per se, there can be utility in examining how the project may influence land development and using that analysis as a way of providing funding for the project.

For example, although the possibility of pursuing Georgia's Atlanta BeltLine as a P3 was raised but not resolved, this uncertainty did not prevent the project from benefitting from a form of value capture: tax increment financing, which accounts for about one-third of the expected revenue (Atlanta BeltLine Inc., 2013). In this case, a roughly 10 square mile "tax allocation district" was established, with increases in property taxes above the amount collected in 2005, for a 25-year period being used to fund Atlanta BeltLine Projects (Atlanta BeltLine Inc., 2013). In reference to Atlanta but not explicitly the BeltLine, DeLoach (2013) noted that tax allocation districts also have the advantage of being useful at sites with "persistent" problems such as environmental remediation. Accordingly, a value capture case study was performed as a way of showing how to support a process for considering multimodal impacts of P3s.

I-495 (the Capital Beltway) plays an important transportation role as a circumferential highway serving the metropolitan Washington, D.C., area. Fluor Daniel (2003) noted: "Travel demand on the Capital Beltway routinely exceeds capacity during peak periods," which leads to heavy congestion. For a 14-mile section (Fluor Daniel, 2003), this problem prompted the 2012 construction (Transurban Operations, Inc., 2015) of four new HOT lanes, which are now known as the I-495 Express Lanes, designed to expand capacity and deliver new travel options, such as express bus services and carpool lanes. Two express bus services (Fairfax County's Express Connector [Fairfax County Virginia, 2015] and OmniRide Tysons Express [Potomac and Rappahannock Transportation Commission, 2015]) are currently using the I-495 Express Lanes. The I-495 Express Lanes project is a good site for applying a value capture methodology, as the necessary data sets are available from the local government. The value capture case study has three components:

1. application of the value capture methodology for Virginia
2. results of the residential hedonic price model
3. results of the commercial hedonic price model.

Application of the Value Capture Methodology for Virginia

Because the value capture methodology developed for this study requires four major steps, the application in Virginia followed those steps: (1) develop the hedonic price model, (2) construct the multimodal transportation network, (3) establish the impact boundary, and (4) select study variables.

Step 1. Develop the Hedonic Price Model

The generalized hedonic function implemented in this report is Equation 1. Although previous studies focused on residential properties given difficulties with analyzing commercial properties (Ko and Cao, 2013), both residential and commercial properties were considered herein. The study periods for the hedonic price model are the 2 years before (2006 and 2007) and the 2 years after (2013 and 2014) the construction of the project. Equation 1 presumes the change in the parcel value is based on a change in transportation characteristics T, and P_k refers to properties within the impact boundary defined in this study.

$$\ln(P_k) = \beta_0 + \beta_1 T + \beta_2 T \times I(After) + \beta_3 A_k + \beta_4 S + \beta_5 \times I(After) + \beta_6 I(After) + \varepsilon \qquad \text{[Eq. 1]}$$

where

P_k = property assessed value in dollars (k = 1 for a residential property and k = 2 for a commercial property)

T = transportation characteristics reflecting the ease of travel

S = neighborhood socioeconomic characteristics

A_k = property attributes (k = 1 for a residential property and k = 2 for a commercial property)

$I(After)$ = indicator equal to 1 for after construction of a P3 project.

The indicator (I) reflects the effects after construction and that these effects are added to those before construction. That is, before construction, Equation 1 is Equation 2; after construction, Equation 1 becomes Equation 3.

$$\ln(P_k) = \beta_0 + \beta_1 T + \beta_3 A_k + \beta_4 S + \varepsilon \qquad \text{[Eq. 2]}$$

$$\ln (P_k) = \beta_0 + \beta_1 T + \beta_2 T \times \beta_3 A_k + \beta_4 S + \beta_5 + \beta_6 + \varepsilon \qquad \text{[Eq. 3]}$$

The reason for using a nonlinear dependent variable (the natural logarithm of the property value P_k) is that property values are never negative. An alternative would have been to use a linear dependent variable, i.e., simply P_k. In fact, some authors (e.g., Boarnet and Chalermpong, 2001) choose the linear specification or log-linear specification (e.g., that shown in Equations 1 through 3) based on goodness of fit, such as the model with the highest adjusted R^2. However, such a criterion would not be appropriate unless the variances of the proposed dependent variables, i.e., Pk and $\ln(P_k)$, are similar.

Step 2. Construct the Multimodal Transportation Network

This study used the QGIS software package (previously known as Quantum GIS) (QGIS, 2016), through which OSM data (Open Street Map, 2016) were downloaded and then incorporated into ArcMap GIS in order to integrate GTFS data, which can be imported by the add-on toolbox provided by ArcMap GIS. However, GTFS does not always provide data on all transit services (GTFS Data Exchange, 2015). For example, two express bus providers use the I-495 Express Lanes in Fairfax County, but GTFS provides information for only one: Fairfax County's Express Connector. Accordingly, OmniRide Tysons Express information was obtained from the National Capital Region Transportation Planning Board (2015). Finally, a multimodal transportation network in GIS was created for the analysis.

Step 3. Establish the Impact Boundary

An impact boundary was established by setting a buffer from 0.2 mile to 1.0 mile along the I-495 Express Lanes. The smaller boundary of 0.2 mile was chosen based on Langley (1981) investigating house prices near the Capital Beltway around Washington, D.C., and the larger boundary of 1.0 mile was chosen based on Ko and Cao (2013) regarding the impact of transit on property values in Minneapolis. Parcel-level properties were selected when their centroids were located between the 0.2-mile and 1.0-mile impact boundary. Figure 1 shows properties between these two impact boundaries.

A total of 29,158 residential parcels and 1,418 commercial parcels were selected within the impact boundary. Figure 2 depicts express bus service routes from two providers using the I-495 Express Lanes.

Figure 1. Residential Properties (*left*) and Commercial Properties (*right*) Within Impact Boundary of I-495 Express Lanes

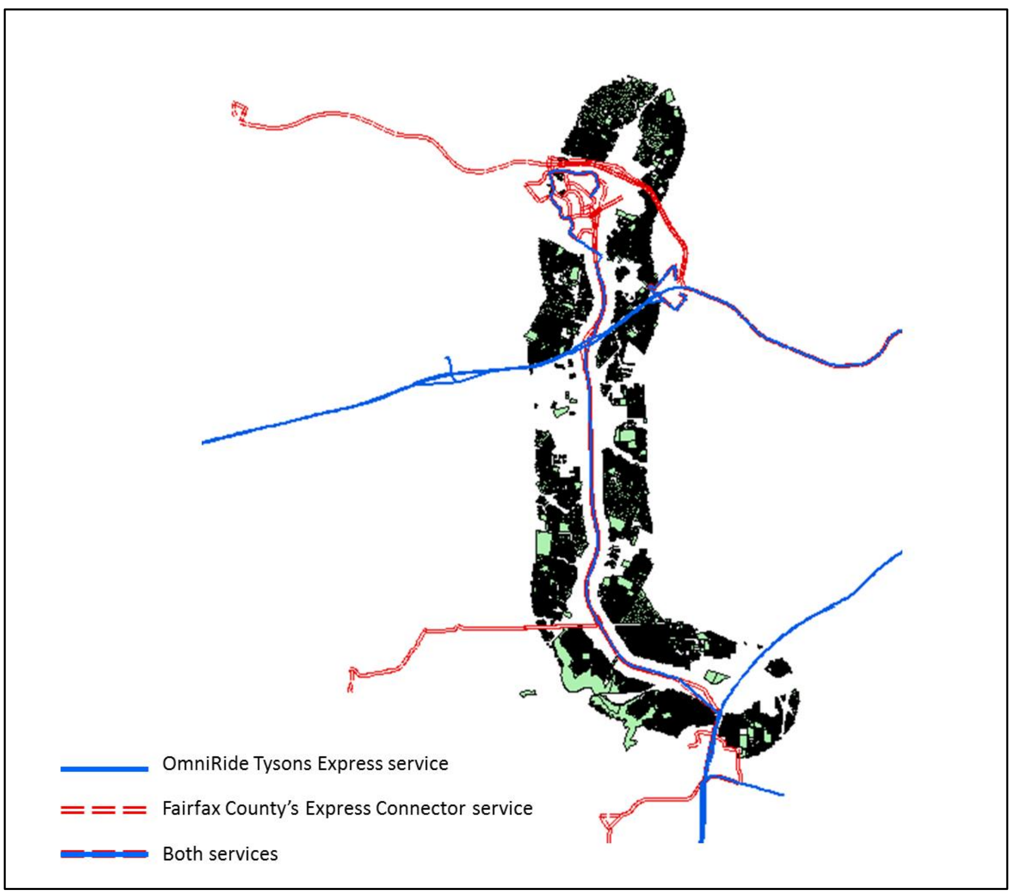


Figure 2. Routes for Fairfax County Express Connector (dashed, red) and OmniRide Tysons Express (solid, blue). These routes use I-495. Residential properties within the impact area are shown.

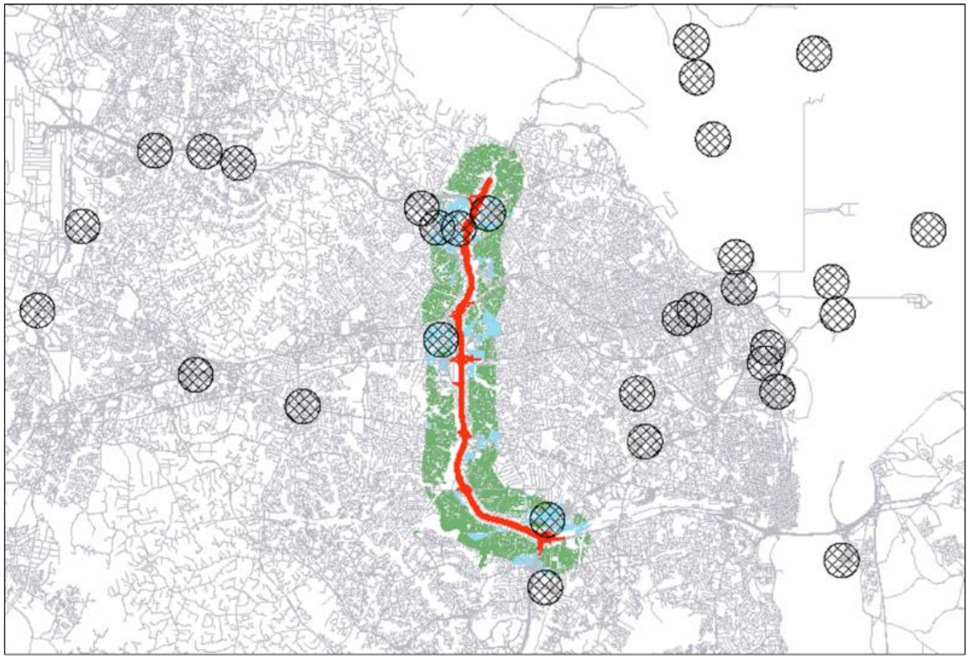
Step 4. Select Study Variables

Table 9 shows the dependent variable (the property assessed value) and the independent variables used in the study. Three types of proximity variables were incorporated to consider the features of the I-495 Express Lanes—the straight-line distance from each property to the nearest HOT lanes ramp (measuring the effect by HOT lanes); the straight-line distance from each property to the nearest express bus route that uses the HOT lanes (measuring the effect by multimodal component; the location of bus stops was not part of this analysis); and the straight-line distance from each property to the nearest regional activity center (measuring changed travel impedance for a person's activities). Impedance, i.e., the level of difficulty for traveling, can be measured in a number of ways, such as time, cost, distance, or some combination thereof. For this study, the researchers chose distance as the impedance measure. The single row in Table 9 indicating a variable "DistActCenter" signifies the distance of each parcel to the regional activity centers throughout the region. These regional activity centers are shown in Figure 3.

Table 9. Summary of Variables Used to Develop the Hedonic Price Model Shown in Equation 1

Category	Variable	Definition	Unit	Data Source
Dependent Variable				
Property Assessed Value	PropertyValue	Amount total property values assessed for property tax imposition	U.S. Dollar	Fairfax County Government (Stevens, 2015a,b)
Independent Variables				
Transportation Characteristics	DistHOT	Nearest distance calculated by geographic coordinates to HOT lanes ramps	Meter	(Open Street Map, 2016)
	DistBus	Nearest distance calculated by geographic coordinates to bus routes	Meter	(GTFS Data Exchange, 2015)
	DistActCenter	Nearest distance calculated by geographic coordinates to regional activity centers	Meter	MWCOG (2014)
Property Attributes	No.Story	Number of stories	Count	Fairfax County Government (Stevens, 2015c,d)
	No.Unit	Number of units	Count	
	FoundArea	Foundation area	Square Feet	
	BuildUse	Building use	-	
	TotBuildArea	Total area of the building	Square Feet	
	BuildAge	Building age	Year	
	No.Bed	Number of bedrooms	Count	
	No.Bath	Number of full baths	Count	
	LivArea	Livable area	Square Feet	
	RemoYear	Year remodeled	Year	
Socioeconomic Characteristics	No.Job	Number of jobs within 1 mile radius	Count	U.S. Census Bureau (2015)

MWCOG = Metropolitan Washington Council of Governments.



1. Downtown Washington	27. Dulles Corner
2. Georgetown	28. Dulles East
3. Monumental Core	29. Dulles West
4. New York Avenue	30. Fairfax Center
5. Ballston/Virginia Square	31. I-95 Corridor/ Engineer Proving Ground
6. Clarendon/Court House	32. Springfield
7. Crystal City	33. City of Fairfax—GMU
8. Pentagon City	34. Downtown Leesburg
9. Rosslyn	35. Corporate Dulles
10. Friendship Heights	36. Germantown
11. Bailey's Crossroads/Skyline	37. North Frederick Avenue
12. Bethesda CBD	38. Rockville Town Center
13. Silver Spring CBD	39 Shady Grove/King Farm/Life Sciences Ctr
14. White Flint	40. White Oak
15. Twinbrook	41. Greenbelt
16. The Pentagon	42. New Carrollton
17. Herndon	43. Konterra
18. Merrifield/Dunn Loring	44. Potomac Mills
19. Reston East	45. Airport/Monocacy Blvd.
20. Reston West	46. Urbana
21. Tysons Corner	47. Route 28 North
22. National Institutes of Health	48. Largo Center
23. Rock Spring Park	49. National Harbor
24. Beauregard Street	50. Innovation
25. Waldorf Commercial	51. Gainesville
26. Beltway South	52. Woodbridge

Figure 3. Regional Activity Centers Used to Compute Distance for Each Parcel From Nearest Regional Activity Center. (This distance is thus the value for the variable "DistActCenter" for each parcel as shown in Table 9.)

Although transportation was the key item of interest, the property attribute variables (such as the number of stories), number of jobs, and year dummy variables helped control for confounding factors, such as changes in the real estate cycle. The property attribute–related variables and socioeconomic characteristics were similar to those used in other hedonic price model studies (e.g., Ko and Cao, 2013; Vadali, 2008). The total number of jobs within a 1-mile radius from each property was computed with Longitudinal Employer-Household Dynamics (LEHD) data. Figure 4 shows the changes in workplace locations, where the number of workplaces shrank from 5,604 (before construction) to 4,514 (after construction). However, Figure 4 shows only changes in employment locations: it does not show the change in the number of jobs in that portion of Fairfax, which increased from 585,152 (before construction) to 594,125 (after construction).

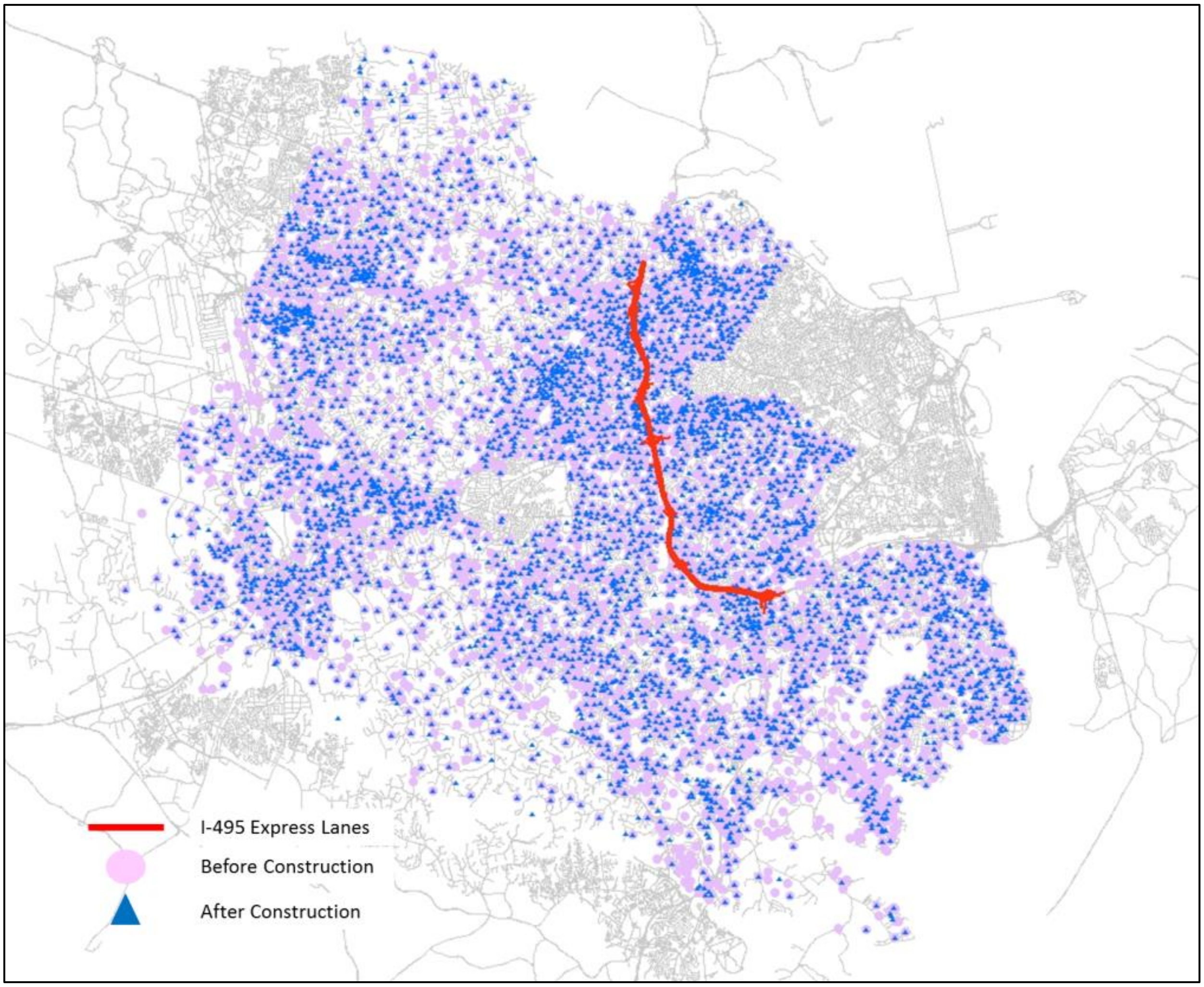


Figure 4. Employment Locations. Pink/light locations denote locations before construction, and blue/dark locations denote locations after construction. Although the number of employment locations decreased, the number of jobs in the figure increased.

In the selection process for study variables, parcels with errors such as a build year of 2100 were removed from the analysis. As shown in the data cleansing process in the Appendix, the removal of parcels with errors reduced the number of residential parcels by 11% and the number of commercial parcels by 39%.

Results of Residential Hedonic Price Model

Table 10 presents the residential hedonic price model. As suggested by Bartik (1988), the model retains those coefficients that are statistically significant at the 95% confidence level ($p < 0.05$); thus, the number of jobs was removed as it did not meet this threshold. The model shown in Table 10 includes only significant variables; variables that were not statistically significant were removed.

The model explains almost two-thirds (65%) of the variation in prices and appears to give reasonable results—with three surprises. Although the model suggests that increasing the number of stories increases the value of the parcel if the number of stories is increased to three or more, the model suggests that an increase from one to two stories decreases the value of the parcel. The model also suggests that increased age is associated with a lower parcel value but only up to a point: increasing the age beyond 61 years leads to an increased parcel value. Remodeling residential properties during the period 2000-2005 is associated with a negative value.

Table 10. Residential Hedonic Price Model

Variable	Coefficient	Standard Error	*t*-value
(Intercept)	1.22e+01	2.00e-02	613.306
Distance to Express Bus Routes (before construction)	-3.23e-06	9.07e-07	-3.559
Distance to Express Bus Routes (after construction)	-1.20e-05	1.25e-06	-9.619
Distance to HOT Lanes Ramps (before construction)	1.97e-05	1.02e-06	19.311
Distance to HOT Lanes Ramps (after construction)	2.59e-05	1.41e-06	18.32
Distance to Regional Activity Centers (before construction)	-5.50e-06	2.72e-07	-20.272
Distance to Regional Activity Centers (after construction)	-5.78e-06	3.70e-07	-15.613
Number of Stories	-1.50e-01	2.94e-02	-5.088
Number of Stories^2	5.28e-02	9.68e-03	5.461
Number of Bedroom	4.23e-02	7.92e-04	53.453
Number of Full Bath	1.42e-01	1.33e-03	106.874
Building Age	-7.93e-03	2.29e-04	-34.667
Building Age^2	1.28e-04	2.93e-06	43.635
Livable area (in 100 scale)	3.22e-02	1.96e-04	164.323
Year Remodeled (≥2010)	2.18e-02	4.66e-03	4.679
Year Remodeled (≥2005 and <2010)	3.77e-02	4.56e-03	8.28
Year Remodeled (≥2000 and <2005)	-9.20e-03	4.06e-03	-2.263[a]
Year Remodeled (≥1995 and <2000)	7.92e-02	9.12e-03	8.689
Indicator for after construction	-1.57e-01	4.24e-03	-37.061
F-statistic	1.066e+04		
Adjusted R-squared	0.652		

[a] The *p*-values for all variables are less than 0.001 except for Year Remodeled (≥2000 and <2005), for which the *p*-value is 0.02.

Finally, Peng (1993) suggested that a large intercept and a low adjusted R square can comprise a sign that substantial variation is not explained by the model. Although the intercept in Table 10 is relatively large, the adjusted R-squared (0.65) is considerably larger than that noted when Peng (1993) raised the concern (0.39), which, along with the statistically significant variables, suggests the model does explain some variation. However, the large intercept in Table 10 may be a sign that site-specific calibration of the model is necessary—that is, this model may not be directly transferable from one site to another.

Because the model in Table 10 has six proximity-related variables, the coefficients alone do not fully explain the relationship between proximity and residential property values. Accordingly, Figure 5 shows the relationship between proximity and residential values while other characteristics are held constant, as noted in the Appendix. In addition, as described in the Appendix, Figures 5 through 9 were created after adjustment of the property values before construction based on the market change rate; that is, because residential prices countywide dropped by 20.9% from the before period to the after period, in Figures 5 through 9 the before prices were reduced by 20.9% to account for this market trend.

Proximity to express bus routes that use the I-495 Express Lanes influenced residential property values. Figure 5 suggests that, after accounting for the market value change rate, residential properties located at zero distance from the bus routes increased in value after construction, from $335,408 to $370,518. That is, without the positive impacts of the I-495 Express Lanes, residential property values would have remained at $335,408. This gap suggests a premium rendered by the proximity of express bus routes using the I-495 Express Lanes. However, because of the steeper slope after construction (with respect to the negative impacts of a parcel moving from the bus routes), the premium offered by proximity to express bus routes vanishes rapidly as the distance increases and disappears completely at approximately 8,000 meters (about 5 miles) away from the bus routes.

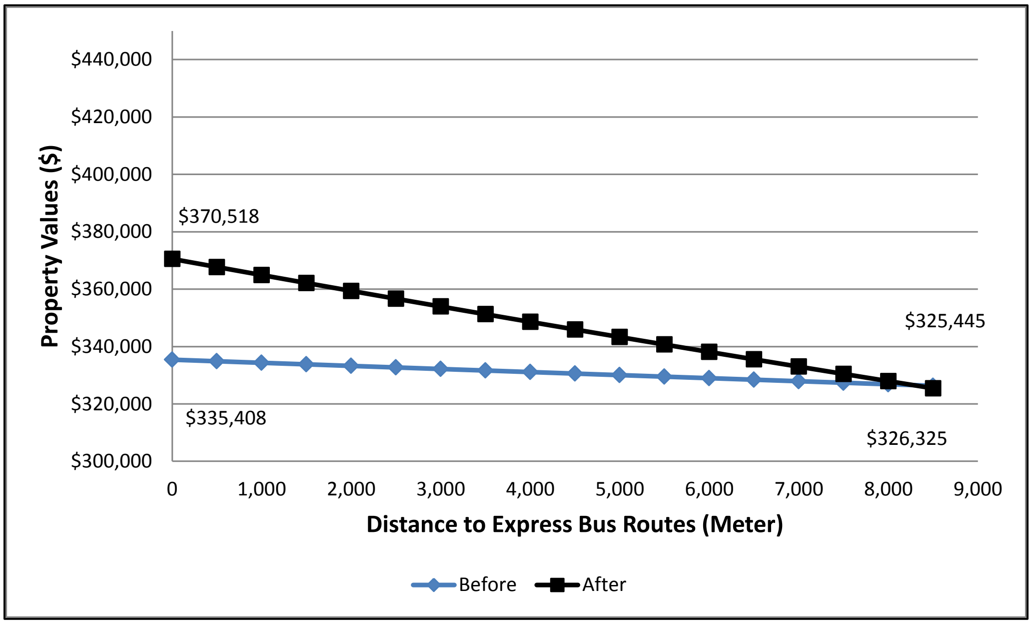


Figure 5. Property Values as Function of Distance to Express Bus Routes

Similarly, the proximity to regional activity centers after construction affects residential property values. After the market value change rate was applied, the gap between $378,750 and $342,559 (Figure 6) suggests a premium attributed to the proximity of regional activity centers (with the I-495 Express Lanes serving to increase this access).

Unlike the two previous results that concerned bus travel and regional activity centers, proximity to HOT lanes ramps had a relatively small impact on property values. As shown in Figure 7, after the market value change rate was considered, the model suggested that a parcel located near a regional activity center has a value of $330,765 rather than $315,081, attributable in part to the construction of the HOT lanes.

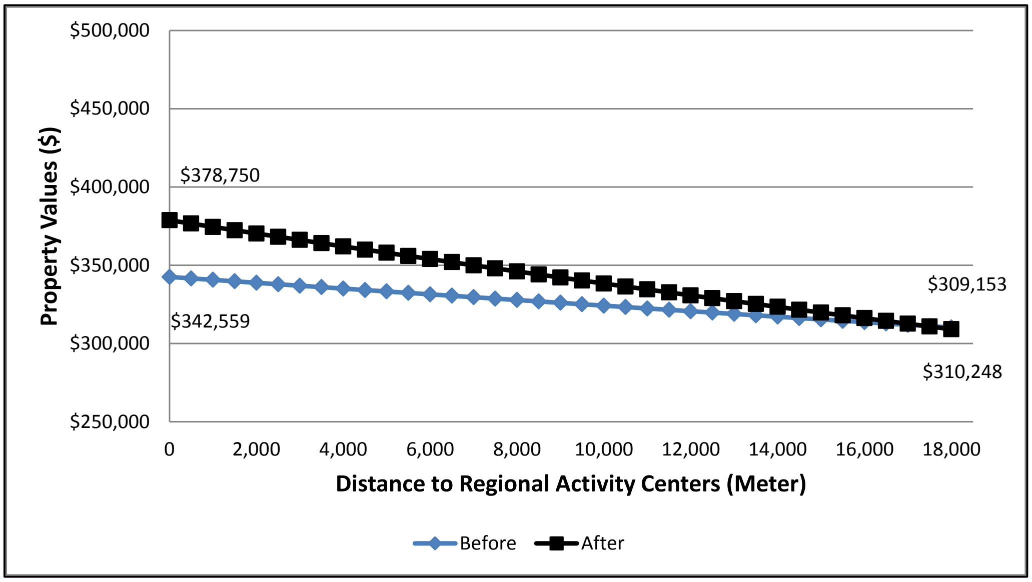


Figure 6. Property Values As a Function of Distance to Regional Activity Centers

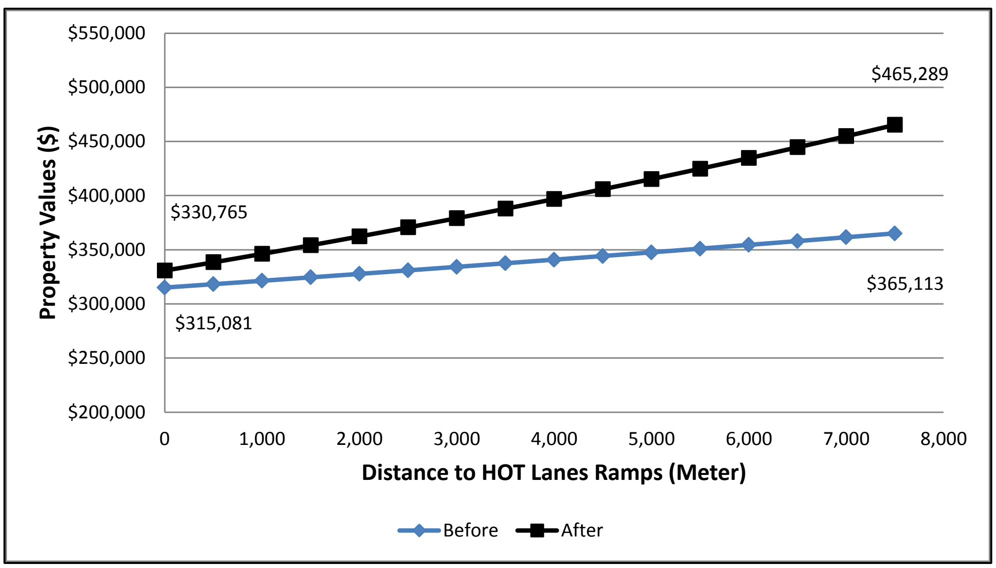


Figure 7. Property Values as Function of Distance to HOT Lanes Ramps

However, unlike with Figures 5 and 6, an increase in distance showed higher residential property values. Before construction, an increase in distance also increased residential property values; however, the slope was steeper after construction than before construction. It is possible that, as suggested by Cervero and Duncan (2002), impacts such as noise, fumes, or vibration from the highway could result in lower values near HOT lanes.

Results of Commercial Hedonic Price Model

The second hedonic price model reflects how proximity to a P3 project affects commercial property values. All coefficients are statistically significant with a *p*-value of 0.05 or less and show reasonable signs. Because of their high *p*-values, coefficients for the distance to regional activity centers and the number of jobs were omitted in the final model shown in Table 11. The adjusted R-squared is 0.462, which is near the average value of a toll road–related study with a hedonic price model (Boarnet and Chalermpong, 2001).

Table 11. Commercial Hedonic Price Model

Variable	Coefficient	Standard Error	*t*-value
(Intercept)	1.53e+01	1.59e-01	96.003
Distance to Express Bus Routes (before construction)	-1.34e-04	3.85e-05	-3.468
Distance to Express Bus Routes (after construction)	1.14e-04	4.79e-05	2.381 [a]
Distance to HOT Lanes Ramps (after construction)	-1.10e-04	3.76e-05	-2.92 [a]
Number of Stories	2.20e-01	1.87e-02	11.746
Number of Units	1.53e-03	4.56e-04	3.357
Foundation Area (in 100 scale)	1.08e-03	1.24e-04	8.704
Property Type: Industrial Building	-1.05e+00	1.20e-01	-8.764
Property Type: Office	-5.90e-01	1.28e-01	-4.606
Property Type: Office Condominiums	-2.06e+00	1.25e-01	-16.533
Property Type: Shopping Center	1.03e+00	1.80e-01	5.695
Total Area of the Building (in 100 scale)	4.19e-04	4.19e-05	9.997
Building Age	-1.74e-02	3.15e-03	-5.532
F-statistic	208.1		
Adjusted R-squared	0.462		

[a] The *p*-values for all variables are less than 0.001 except for Distance to Express Bus Routes (after construction), for which the *p*-value is 0.02, and Distance to HOT Lanes Ramps (after construction), for which the *p*-value is 0.004.

There are two key interpretations of the variables.

1. *Being close to a bus route commands less of a premium after construction than before construction.* Industrial properties have higher property values (all other things being equal) for parcels located closer to stops serving express bus routes than for parcels located further from such stops. However, as shown in Figure 8, the negative impact of increasing this distance is not as severe following construction as it was before construction.

2. *The proximity to HOT lanes ramps increases commercial property values, which is in contrast to the residential model.* A possible reason for this may be that while "disamenities" such as increased noise may cause such properties to lose value,

commercial properties' preference for locations where transportation is easily accessible is so important that it offsets such a reduction. However, the steeper slope shown in Figure 9 means this premium diminishes rapidly as distance increases and disappears completely at approximately 3,000 meters (about 2 miles) away from the HOT lanes ramps.

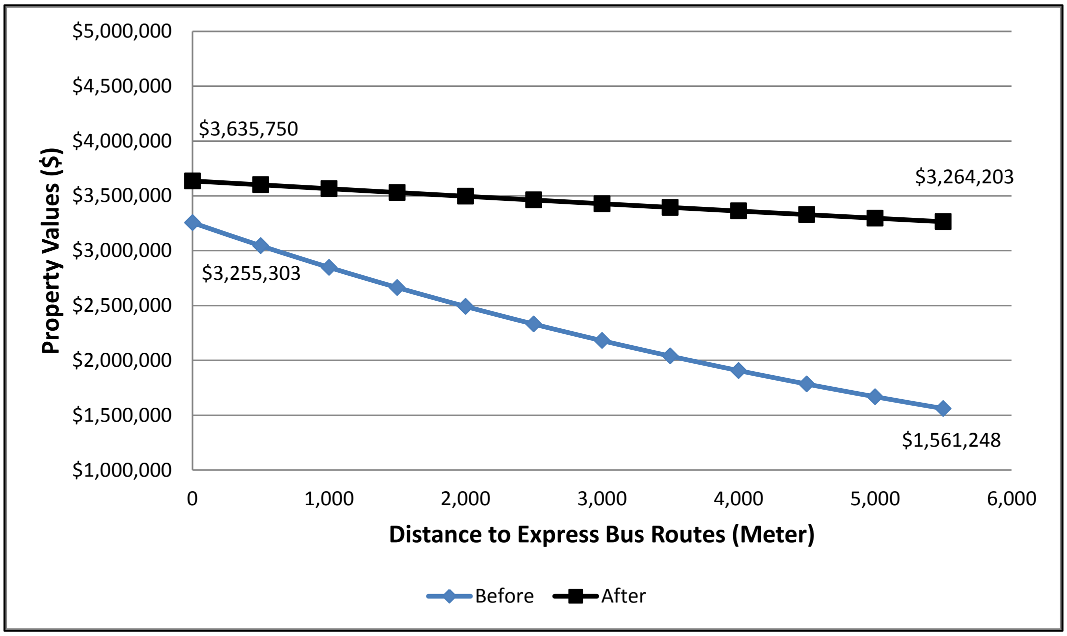


Figure 8. Property Values as Function of Distance to Express Bus Routes

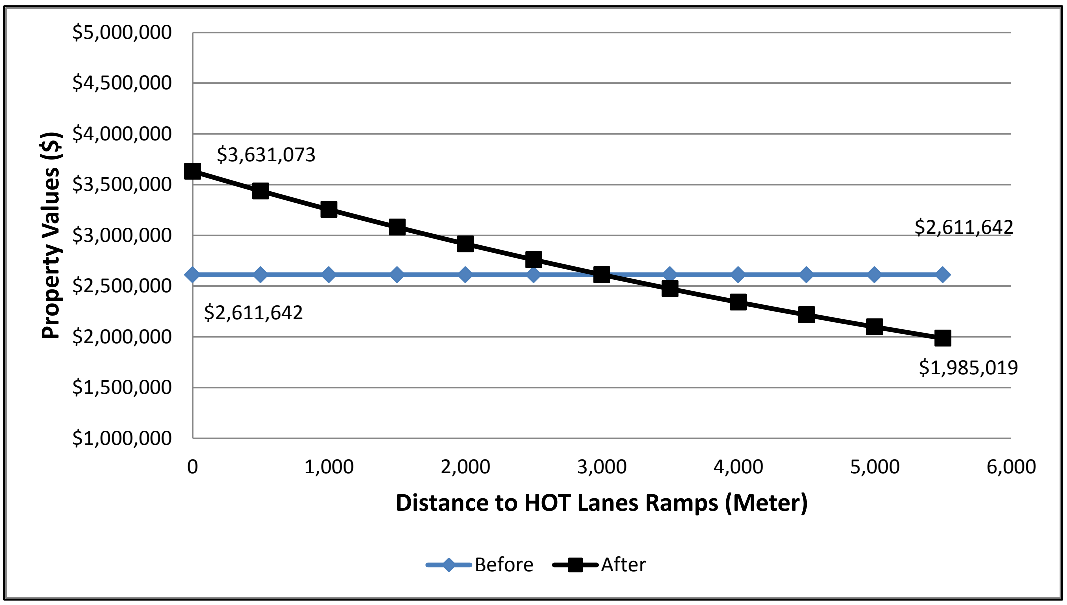


Figure 9. Property Values as Function of Distance to HOT Lanes Ramps

In Table 11, even though the coefficient for the variable Distance to Express Bus Routes (after construction) has a positive value (1.14e-04), the “After” line in Figure 8 shows that property values decrease as distance (to express bus routes) increases. The reason for this is that the slope of this line in Figure 8 is based on three variables: the Distance to Express Bus Routes (after construction), the Distance to Express Bus Routes (before construction), and the Distance to HOT Lanes Ramps (after construction). The net effect of these variables is that an increased distance from the HOT lanes reduces property values, albeit not as much as before construction.

CONCLUSIONS

Lessons Learned From the Interviews

- *It is not unusual for a project’s status to change from P3 to non-P3.* This transition occurred for roughly two-fifths of the projects studied: (e.g., 10 of the 23 projects for which interviews were conducted were found not to be P3s and of the initial list of 35 candidate projects, 16 were found not to be P3s). Reasons for transitioning to non-P3 status included a lack of financial viability, an unanticipated conflict with state statutes, and potential design conflicts; in addition, some of the projects may never have been a P3.

- *Obtaining additional funds is not the sole reason for pursuing a P3.* Although this reason was cited as the motivating factor for most (10 of 13) projects pursued as a P3, additional reasons cited were improved service quality, additional construction expertise, and shortened time to build projects. In total, such one or more of these additional reasons applied to 9 of the 13 projects pursued as a P3.

- *Milestones for considering multiple modes in P3s are not generally used beyond existing processes.* For the 15 projects where data were available, specific milestones (unique to P3 projects) did not exist for including or excluding multiple modes. Interviewees pointed out that such decisions are part of the environmental review process (6 projects) and that conditions are so fluid that milestones are infeasible (7 projects); however, for 2 projects, formal policies for considering multiple modes in P3s are under consideration.

- *Land development impacts were considered in most (at least 18 of 23) of the projects, but the level of specificity varied by project.* Although interviewees expected 3 projects to have no identifiable land use impacts, for 5 projects more intense development was expected in a specific location, and for 2 additional projects, some form of value capture from the increase in land value was anticipated. For an additional 8 projects, land development impacts were not attributed to an exact location but were anticipated—e.g., for Illinois’ Chicago Region Environmental and Transportation Efficiency Program, the rail switching impacts were expected to facilitate additional development in the central business district and the suburbs and support the logistics industry throughout the region.

- *The conditions supporting a multimodal P3 are diverse.* Although some multimodal P3s comprise the implementation of a region's long-term vision, others resulted from public pressure, a unique opportunity to bring together stakeholders to create a project that was otherwise infeasible or to solve a specific problem (notably Alaska's Anton Anderson Memorial Tunnel). Given that success for multimodal P3s is measured in different ways—financial viability always matters but other metrics have included transit performance and the potential impact on land development—and given that P3s are sufficiently new so that a role for new participants is not always clear—there may be merit to agencies considering multiple modes at multiple decision points as P3s are developed.

Value Capture Opportunity From the Virginia Case Study

- *For residential properties, the P3 project may have resulted in a greater premium being placed on proximity to transit.* This is suggested by the fact that after construction of the I-495 Express Lanes, there was a greater negative coefficient for the variable indicating distance to transit. The model suggests that after construction a parcel's value drops by approximately $500 for each additional 100 meters the parcel is located away from the express bus routes.

- *For commercial properties only, the model suggests the better proximity to HOT lanes may have increased parcel values.* This premium is large enough to cancel out the disamenity effects for residential properties. After construction, a commercial property's value decreases by approximately $30,000 for each additional 100 meters the parcel is located away from the HOT lanes ramps. Commercial properties have larger values than residential properties, which is why the $30,000 noted here is so much larger than the $500 noted for the 100 meters.

- *The initial question of interest was whether a multimodal P3 project's impact on travel impedance (i.e., ease or difficulty of travel) could be reflected in new property values.* Given that changes in property values have been empirically detected, capturing those values could enhance the financial viability of multimodal P3s. Because residential and commercial properties showed different impacts on property values, and because these impacts varied as a function of location and travel impedance, site-specific modeling to determine value capture is necessary.

RECOMMENDATION

1. *VDOT's Office of Public-Private Partnerships should share the results of the interviews and the value capture case study, or excerpts thereof, as appropriate, with local, regional, and VDOT planners.* There are opportunities during the project development process to consider multimodal components of P3 projects. For example, other states' practices collectively suggest that in a few (but not all) cases, explicit consideration of land development impacts can be one factor in implementing a P3 project. In a few other cases in other states, factors other than financial viability, such as improved service quality, were important for implementing a P3 project. Raising awareness of P3 practices in other states may lead to insights that are applicable to a given Virginia P3 project. The high level screening reports

and the detail level screening reports prepared for potential P3 projects comprise one instance where local transportation plans can be integrated into P3 projects (as was done in Table 6).

BENEFITS AND IMPLEMENTATION

Benefits

To be clear, sharing these results would not guarantee any change in practice. The interviews in other states showed that public-private partnerships are the product of detailed, and often-changing, negotiations between a variety of partners and multimodality is just one of several considerations. For example, Virginia's Pocahontas Parkway (Route 895) P3 project was a "financial failure" on two occasions because observed volume was not as large as forecast volume, rendering toll revenue insufficient to pay off the debt (Grymes, 2014).

Further some funding sources may be restricted in terms of the types of modes they can support. An example is the Hampton Roads Transportation Fund, which is managed by the Hampton Roads Transportation Accountability Commission. Language in HB 1253 from the 2014 General Assembly Session states that the fund may be used "solely for new construction projects on new or existing roads, highways, bridges, and tunnels" (Hampton Roads Transportation Accountability Commission, 2014). Although text later in the bill notes that the Hampton Roads Transportation Accountability Commission has the power to enter into leases with various entities to operate transit and rail facilities, the quoted language restricts how new construction monies can be used.

That said, consideration of multimodal solutions is a prominent portion of the VDOT 2016 Business Plan (VDOT, 2015d). For example, Action Item 1.4.1 notes the use of "multi-modal best practices" when reviewing land development plans. One potential practice noted in this report may be to consider how multimodal investments can positively affect property values, as was done with the I-495 Express Lanes where closeness to bus routes had a positive impact on property values. Given that public-private partnerships are likely to continue, it is possible that some of these other projects (e.g., the expansion of I-66 west of the Capital Beltway [Office of Transportation Public-Private Partnerships, 2014]) may offer potential for the use of value capture, where positive effects may be expected based on the reduction of travel impedance.

Tables 6 and 8 show ways in which P3 projects have been used to support transportation plans. For example, California's Anaheim Regional Transportation Intermodal Center and Georgia's Northwest I-75/575 HOV/BRT were done in part because the region had a long-term vision for a multimodal network. Other projects, such as Colorado's US 36 Express Lanes, supported specific types of land uses. Thus, Tables 6 and 8 show how projects can potentially support local or regional transportation plans. This support can be based on the project itself (e.g., as per Table 6, a project might have multiple modes that is desired by the community) or this support can be based on the secondary effects of the project (e.g., how the project affects land development as shown in Table 8; congestion as noted in the literature review (e.g., Nichols and Belfield, 2016); or other impacts.

Implementation

The most effective way to share the information provided in this report, as per Recommendation 1, is to place a hyperlink for the report in the "Resources" section of the website of Virginia's Office of Public-Private Partnerships (2014). The hyperlink for this report will be added as noted upon the publication of this report.

The website already provides a link to a manual titled *Implementation Manual and Guidelines for the Public-Private Transportation Act of 1995 (As Amended)* (Commonwealth of Virginia, 2014). The manual outlines the process to evaluate potential P3 projects with several high-level project screening criteria. The "transportation priorities" associated with the criteria include three questions, one of which is noted here: "Is the project consistent with priorities identified by the appropriate transportation plans and programs, such as SYIP, STIP, and [metropolitan planning organization] plans and programs?"

ACKNOWLEDGMENTS

This research could not have been conducted without the assistance of staff who contributed time and expertise. A technical review panel (Angela Biney, Jacqueline Cromwell, Robin Grier, Amy O'Leary, Ivan Rucker, and Eric Stringfield) provided guidance at critical points. Staff from other state DOTs, metropolitan planning organizations, localities, and other entities provided insights regarding projects discussed in this report: Julie Adamson (Florida), Kwadwo Atta (Georgia), Loreen Bobo (Florida), Gordon Burton (Alaska), Derrick Cameron (Georgia), Oswaldo Chaves (Illinois), Nate Cruz (Washington, D.C.), Stephen Devine (Rhode Island), Brittany Dyra (Illinois), James Edwards (Florida), Roger Driskell (Illinois), Nicholas Farber (Colorado), Richard Gehring (Florida), John Hancock (Georgia), Kalieh Honish (California), Eugene Kim (California), Jamie Lai (California), Paul Lampley (Florida), Ben Limmer (Georgia), Robert Machuca (California), Patrick McLaughlin (Colorado), Jodie Misiak (Maryland), Craig Newton (North Carolina), Frank O'Dea (Florida), Eliza Paul (Texas), Tim Pimental (Rhode Island), Randy Redmond (Texas), Greg Schiess (Florida), Jeffrey Sriver (Illinois), LaShunda Walker (Georgia), and Brian Welch (Colorado). Data for Fairfax County that could not be obtained from other sources were provided to the authors by Robert Josef, Richard Lambert, and Dan Stevens. Interviews were led by Roger Howe with assistance from Linda DeGrasse, PilJin Chun, Kayleigh Roy, and Thomas Hamed. Linda Evans provided editing. The authors alone are responsible for any errors herein.

REFERENCES

AECOM Consult, Inc. *Synthesis of Public-Private Partnership Projects for Roads, Bridges and Tunnels from Around the World, 1985-2004.* Federal Highway Administration, Washington, DC, 2005.

AECOM Consult, Inc. *User Guidebook on Implementing Public-Private Partnerships for Transportation Infrastructure Projects in the United States.* Federal Highway Administration, Washington, DC, 2007.

AEM Consult Team. *Case Studies of Transportation Public-Private Partnerships in the United States.* 2007. http://www.fhwa.dot.gov/ipd/pdfs/us_ppp_case_studies_final_report_7-7-07.pdf. Accessed October 27, 2016.

Ankner, W.D. *Road Pricing, Tolling, Mega-Projects, and Other Multi-Modal Opportunities: Strategically Positioning Public Transportation.* American Public Transportation Association, Washington, DC, 2008.

Atta, K. Email to Changju Lee. July 20, 2015.

Atlanta BeltLine, Inc. *Master Plan, Subarea 1: Plan Recommendations Report.* Atlanta, 2010.

Atlanta BeltLine, Inc. *2030 Strategic Implementation Plan*: *Final Report.* Atlanta, 2013.

Atlanta Beltline, Inc. The Atlanta Beltline. 2017. http://beltline.org/about/atlanta-beltline-inc/. Accessed January 2, 2017.

Arnold, R., Ankner, W.D., and DeCorla-Souza, P. Generating Revenue to Fund Public-Private Partnerships for Reconstruction of Freeway Systems in Metropolitan Areas. In *Transportation Research Record: Journal of the Transportation Research Board,* No. 2297. Transportation Research Board of the National Academies, Washington, DC, 2012, pp. 112-120.

Bartik, T. Measuring the Benefits of Amenity Improvements on Hedonic Models. *Land Economics,* Vol. 64, No. 2, 1988, pp. 172-183.

Bielli, M., Boulmakoul, A., and Mouncif, H. Object Modelling and Path Computation for Multimodal Travel Systems. *European Journal of Operational Research,* Vol. 175, No. 3, 2006, pp. 1705-1730.

Boarnet, M.G., and Chalermpong, S. New Highways, House Prices, and Urban Development: A Case Study of Toll Roads in Orange County, CA. *Housing Policy Debate,* Vol. 12, Issue 3, 2001, pp. 575-605.

Bureau of Labor Statistics. CPI Inflation Calculator. 2016. http://www.bls.gov/data/inflation_calculator.htm. Accessed August 29, 2016.

Center for Transportation Public-Private Partnership Policy. *Public-Private Partnerships Case Studies.* George Mason University, Fairfax, VA, 2014.

Cervero, R., and Duncan, M. *Land Value Impacts of Rail Transit Services in San Diego County.* Urban Land Institute, Washington, DC, 2002.

Chen, S., Tan, J., Claramunt, C., and Ray, C. Multi-Scale and Multi-Modal GIS-T Data Model. *Journal of Transport Geography,* Vol. 19, No. 1, 2011, pp. 147-161.

City of Atlanta. Press Release: Mayor Kasim Reed Commits to Continuing Public/Private Investments for the Atlanta BeltLine. June 13, 2013. http://www.atlantaga.gov/index.aspx?page=672&recordid=2031. Accessed August 27, 2015.

City Centre Warwick. *Master Plan.* Warwick, RI, 2015.

Commonwealth of Virginia. *Implementation Manual and Guidelines for the Public-Private Transportation Act of 1995 (As Amended).* Richmond, 2014. http://www.virginiadot.org/office_of_transportation_public-private_partnerships/resources/UPDATED_PPTA_Implementation_Manual_11-07-14_FOR_POSTING_TO_WEBSITE_-_changes_accepted.pdf. Accessed June 8, 2016.

Congressional Budget Office. *Using Public-Private Partnerships to Carry Out Highway Projects.* Publication No. 4041. Washington, DC, 2012. https://www.cbo.gov/sites/default/files/112th-congress-2011-2012/reports/01-09-PublicPrivatePartnerships.pdf. Accessed August 28, 2016.

Crawford, D. U.S. Tunnels Go for Smarter Management (Abstract Only). *ITS International,* Vol. 19, No. 4, 2013. https://trid.trb.org/view/2013/C/1262808. Accessed August 28, 2016.

Cromwell, J. Email to J.S. Miller, August 26, 2016.

DC. gov. Mayor Bowser Launches Office of Public-Private Partnerships with Key Leadership Announcements. 2015. http://mayor.dc.gov/release/mayor-bowser-launches-office-public-private-partnerships-key-leadership-announcements. Accessed January 2, 2017.

DC.gov. Office of Public-Private Partnerships. 2016. http://op3.dc.gov/. Accessed January 2, 2017.

DeLoach, D. P3s Foster New Redevelopment Opportunities. *Atlanta Business Chronicle,* August 2, 2013. http://www.bizjournals.com/atlanta/print-edition/2013/08/02/p3s-foster-new-redevelopment.html?page=all. Accessed August 27, 2015.

Dochia, S., and Parker, M. *Introduction to Public-Private Partnerships With Availability Payments.* Jeffrey A. Parker & Associates, Inc., Philadelphia, 2009.

Dotson, A.E., Jr. Public-Private Partnerships (P3) Legislation a Hot Topic at the Florida Logistics & Trade Conference. *National Law Review*, May 23, 2014. http://www.natlawreview.com/article/public-private-partnerships-p3-legislation-hot-topic-florida-logistics-trade. Accessed January 6, 2017.

Elizabeth River Crossings. Regional Economic Development. 2016a. https://www.driveert.com/wp-content/uploads/2012/12/ERT_factsheets_EconomicalDev_WEB.pdf . Accessed May 16, 2016.

Elizabeth River Crossings. Understanding Public-Private Partnership. 2016b. https://www.driveert.com/wp-content/uploads/2012/12/ERT_factsheets_PublicPrivatePartner_WEB.pdf. Accessed May 16, 2016.

Fairfax County, Department of Systems Management for Human Services. *Demographic Reports 2005-2006.* Fairfax, VA, 2006. http://www.fairfaxcounty.gov/demogrph/demrpts/archives/fullrpt2005_6.pdf. Accessed October 27, 2016.

Fairfax County, Department of Systems Management for Human Services. D*emographic Reports 2007.* Fairfax, VA, 2007. http://www.fairfaxcounty.gov/demogrph/demrpts/archives/fullrpt2007.pdf. Accessed October 27, 2016.

Fairfax County, Department of Neighborhood and Community Services. *Demographic Reports 2013.* Fairfax, VA, 2013. http://www.fairfaxcounty.gov/demogrph/demrpts/archives/fullrpt2013.pdf. Accessed October 27, 2016.

Fairfax County, Department of Neighborhood and Community Services. *Demographic Reports 2014.* Fairfax, VA, 2014. http://www.fairfaxcounty.gov/demogrph/demrpts/archives/fullrpt2014.pdf. Accessed October 27, 2016.

Fairfax County Virginia. 495 Express (formerly HOT) Lanes in Fairfax County. 2015. http://www.fairfaxcounty.gov/fcdot/expresslanes/. Accessed December 2, 2015.

Forster, D. McAuliffe Rips Toll Deal, Announces Relief for Portsmouth Motorists. *The Virginian-Pilot*, July 11, 2015. http://pilotonline.com/news/local/transportation/mcauliffe-rips-toll-deal-announces-relief-for-portsmouth-motorists/article_130c62be-9959-5dd7-960e-7da629ff15a7.html. Accessed August 28, 2016.

Federal Highway Administration. Innovative Finance Support: P3 Defined. Undated a. http://www.fhwa.dot.gov/ipd/p3/defined/. Accessed November 10, 2014.

Federal Highway Administration. Innovative Finance Support: State P3 Legislation. Undated b. http://www.fhwa.dot.gov/ipd/p3/state_legislation/#main_content. Accessed November 10, 2014.

Federal Highway Administration. Innovative Finance Support: Project Profiles: Chicago Region Environmental and Transportation Efficiency Program (CREATE). Undated c. http://www.fhwa.dot.gov/ipd/project_profiles/il_create.aspx. Accessed January 3, 2017.

Federal Highway Administration. Innovative Finance Support: Project Profiles: I-4 Ultimate. Undated d. http://www.fhwa.dot.gov/ipd/project_profiles/fl_i4ultimate.aspx. Accessed January 4, 2017.

Federal Highway Administration. *Public-Private Partnership Concessions for Highway Projects: A Primer*. FHWA-OIPD-10-005. Washington, DC, 2010.

Federal Highway Administration. Innovative Finance Support: Project Profiles: New Build Facilities. 2014. http://www.fhwa.dot.gov/ipd/p3/project_profiles/. Accessed February 10, 2014.

Federal Highway Administrations. Innovative Finance Support: P3 Concessions in the U.S. October 11, 2016. http://www.fhwa.dot.gov/ipd/p3/resources/p3_concessions_map_newbuild.aspx. Accessed January 4, 2017.

Federal Transit Administration. *Record of Decision: Purple Line Project, Montgomery County and Prince George's County, Maryland*. Washington, DC, 2014. http://www.purplelinemd.com/en/about-the-project/studies-reports/record-of-decision. Accessed January 26, 2017.

Florida Department of Transportation. I-4 Ultimate Improvement Project: FAQs, undated. http://i4ultimate.com/project-info/faqs/. Accessed January 19, 2017.

Fluor Daniel. *Capital Beltway HOT Lanes: Detailed Proposal*. Virginia Department of Transportation, Richmond, 2003.

Gilroy, L. *Reviewing the First Year of the I-495 Express Lanes*. The Reason Foundation, Los Angeles, December 3, 2013. http://reason.org/news/show/1013646.html. Accessed August 24, 2015.

Grymes, C.A. Pocahontas Parkway (Route 895)—The Toll Road That Failed. Virginia Places, Fairfax, 2014. http://www.virginiaplaces.org/transportation/pocaparkway.html. Accessed May 17, 2015.

GTFS Data Exchange. Transit Agencies Providing GTFS Data. 2015. http://www.gtfs-data-exchange.com/agencies. Accessed December 6, 2015.

Hampton Roads Transportation Accountability Commission. Legislative Items. 2014. http://www.hrtac.org/page/legislative-items/. Accessed May 25, 2016.

Iacono, M., and Levinson, D. Methods for Estimating the Economic Impact of Transportation Improvements: An Interpretive Review. In *An International Handbook on Transport and Development*, Hickman, R., Bonilla, D., Givoni, M., and Banister, D., Eds. University of Oxford Press, Oxford, UK, 2013.

InfraPPP. Projects—Projects in USA. 2013. http://infrapppworld.com/pipeline-html/projects-in-usa. http://infrapppworld.com/. May 29, 2014.

InfraPPP World S.L. Projects in USA. Malaga, Spain, 2014. http://infrapppworld.com/pipeline-html/projects-in-usa. Accessed May 27, 2014.

Istrate, E., and Puentes, R. *Moving Forward on Public Private Partnerships: U.S. and International Experience With PPP Units.* Brookings Institution, Washington, DC, 2011.

Kimley-Horn and CH2M. *Tier 2 Environmental Assessment: I-66 Transit and TDM Technical Report: Draft.* May 12, 2015. http://www.transform66.org/documents/tier_2_environmental_assessment_technical_reports/Transit_TDM_Technical_Report.pdf. Accessed August 25, 2015.

Ko, K., and Cao, X. J. The Impact of Hiawatha Light Rail on Commercial and Industrial Property Values in Minneapolis. *Journal of Public Transportation*, Vol. 16, No. 1, 2013, pp. 47-66.

Kozel, S. Route VA-288 Construction—Western Section. *Roads to the Future*, 2005. http://www.roadstothefuture.com/VA288_Construction_Western.html#top. Accessed May 17, 2016.

Langley, C.J. Highways and Property Values: The Washington Beltway Revisited. In *Transportation Research Record: Journal of the Transportation Research Board*, No. 812. Transportation Research Board of the National Academies, Washington, DC, 1981, pp. 16-20.

Layne, A. Fixing Virginia's Public-Private Process. *The Virginian-Pilot*, March 15, 2015. http://pilotonline.com/opinion/columnist/guest/layne-fixing-virginia-s-public-private-process/article_f11bb6b0-222f-5b3c-9ca5-f6f0afa3429c.html. Accessed August 28, 2016.

Lee, J. *Five Myths About the TIFIA Credit Program.* Eno Center for Transportation, Washington, DC, November 2012. https://www.enotrans.org/eno-brief/five-myths-about-the-tifia-credit-program. Accessed November 10, 2014.

Litman, T. *Introduction to Multi-Modal Transportation Planning.* Victoria Transport Policy Institute, Victoria, BC, Canada, 2012.

Los Angeles County Metropolitan Transportation Authority. High Desert Corridor. Los Angeles, 2017. https://www.metro.net/projects/high-desert-corridor/. Accessed January 3, 2017.

Maloof, A. P3 Projects Fill Gaps in Budget Holes. *Mass Transit*, April 21, 2014. http://www.masstransitmag.com/article/11231825/p3-projects-overcome-budget-cuts. Accessed July 16, 2015.

Maryland Transit Administration. Economic Development Near the Purple Line, Baltimore, undated. http://www.purplelinemd.com/images/maps_graphics/Development%20Map2014%20final.pdf. Accessed January 26, 2017.

McCabe, R. Groundbreaking Set Today at Port for Transportation Projects. *The Virginian-Pilot*, July 22, 2015. http://hamptonroads.com/2015/07/groundbreaking-set-today-port-transportation-projects. Accessed August 24, 2015.

Metropolitan Washington Council of Governments. Place + Opportunity: Strategies for Creating Great Communities and a Stronger Region, Washington, DC, 2014. Accessed December 3, 2015.

Meyer, M.D., and Miller, E.J. *Transportation Planning: A Decision-Oriented Approach,* 3rd edition. Modern Transport Solutions, Atlanta, GA, 2013.

Michael Baker Inc., CDM Smith Inc., and Renaissance Planning Group. *Norfolk International Terminals: Intermodal Accessibility Measure Study Technical Report.* Office of Intermodal Planning and Investment, Richmond, 2013. http://www.vtrans.org/resources/reports/NorfolkInternationalTerminals_Tech_Report_FINAL_042513.pdf. Accessed August 24, 2015.

Moses, T.M. and Brown, J. Evaluation of the Train Signal and Rail Systems for the Anton Anderson Memorial Tunnel, Alaska Department of Transportation and Public Facilities, Fairbanks, 2014.

National Capital Region Transportation Planning Board. TPB Regional Transportation Data Clearinghouse. Washington, DC, 2015. http://rtdc.mwcog.opendata.arcgis.com/. Accessed by May 26, 2016.

Newton, C.M. Email to R.W. Howe, October 7, 2014.

Nichols, M.C. *Value Capture Case Studies: Denver's Historic Union Station.* Metropolitan Planning Council, Chicago, 2012. http://www.metroplanning.org/news/article/6392. Accessed July 16, 2015.

Nichols, K.M., and Belfield, S.S. Analyzing the Impact of Implementing New Tolls on Existing Roadway Facilities – The Hampton Roads Experience. Transportation Research Board of the National Academies, Washington, DC, 2016. http://docs.trb.org/prp/16-3944.pdf. Accessed August 28, 2016.

O'Leary, A.A. Email to J.S. Miller, August 17, 2016.

Office of Transportation Public-Private Partnerships. Projects. 2014. http://www.p3virginia.org/p3-projects/. Accessed May 5, 2016.

OpenStreetMap. About. Undated. https://www.openstreetmap.org/about. Accessed May 26, 2016.

Orr, R. The Privatization Paradigm: Jumping Onto the Infrastructure Bandwagon. *Infrastructure Journal*, 2006. https://gpc.stanford.edu/sites/default/files/j004-2_0.pdf. Accessed January 6, 2016.

Parsons, J., and Rubin, D.K. When Toll Road Traffic Flows Fall Short. *Engineering News Record,* August 24, 2016. http://www.enr.com/articles/40096-when-traffic-flows-fall-short. Accessed August 29, 2016.

Parsons Brinckerhoff, Nossaman LLP, and HS Public Affairs. *The Effect of Public-Private Partnerships and Non-Traditional Procurement Processes on Highway Planning, Environmental Review, and Collaborative Decision Making.* SHRP 2 Report S2-C12-RW-1. Transportation Research Board, Washington, DC, 2015.

Peng, R. *Housing Market Behavior with Restrictive Land Supply.* Ph.D., Dissertation. Massachusetts Institute of Technology, Cambridge, 1993. https://dspace.mit.edu/bitstream/handle/1721.1/69320/30692663-MIT.pdf?sequence=2. Accessed August 31, 2016.

Potomac and Rappahannock Transportation Commission. OmniRide Tysons Corner AM Map. 2015. http://www.prtctransit.org/commuter-bus/schedules/tysonscorner-am-map.html. Accessed December 2, 2015.

QGIS. A Free and Open Source Geographic Information System. 2016. http://www.qgis.org/en/site/. Accessed May 26, 2016.

Rall, J. *Public-Private Partnerships for Transportation: A Toolkit for Legislators—February 2014 Updates and Corrections.* National Conference of State Legislatures, Washington, DC, 2014.

Regional Transportation District of Denver. FasTracks: Project Fact Sheets. 2014. http://www.rtd-denver.com/FF-FasTracks.shtml. Accessed December 30, 2016.

Reinhardt, W. *The Role of Private Investment in Meeting U.S. Transportation Infrastructure Needs.* The American Road and Transportation Builders Association Transportation Development Foundation, Washington, DC, 2011. http://www.pwfinance.net/document/research_reports/0%20artba.pdf . Accessed January 6, 2017.

Route 28 Corridor Improvements, LLC. Welcome to 28FREEWAY.COM. 2014. http://www.28freeway.com/. Accessed May 18, 2016.

Smalkoski, B., and Levinson, D. Value of Time for Commercial Vehicle Operators. *Journal of the Transportation Research Forum,* Vol. 44, No. 1, Spring 2005, pp. 89-102.

Stevens, Daniel C. Email to Changju Lee and John S. Miller. February 10, 2015a.

Stevens, Daniel C. Email to Changju Lee and John S. Miller. February 11, 2015b.

Stevens, Daniel C. Email to Changju Lee and John S. Miller. March 2, 2015c.

Stevens, Daniel C. Email to Changju Lee and John S. Miller. March 3, 2015d.

The Louis Berger Group, Inc. *Sketch Level I-70 Mountain Corridor Traffic and Revenue Study.* Colorado Department of Transportation, Denver, 2014.

Transurban Operations Inc. Project Background—Express Lanes Development. 2015. https://www.expresslanes.com/project-background. Accessed December 2, 2015.

Trottenberg, P. *Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis. Memorandum to Secretarial Officers and Modal Administrators.* U.S. Department of Transportation, Washington, DC, September 28, 2011. https://www.transportation.gov/sites/dot.gov/files/docs/vot_guidance_092811c_0.pdf. Accessed August 29, 2016.

U.S. Census Bureau. LEHD Origin-Destination Employment Statistics (LODES) Dataset Structure Format Version 7.1, Washington, DC, 2015.

U.S. Department of Transportation. Projects Financed by TIFIA. Undated. http://www.transportation.gov/tifia/projects-financed. Accessed October 10, 2013.

U.S. Department of Transportation. TIFIA Credit Program Overview. Updated on May 29, 2015. http://www.dot.gov/tifia/tifia-credit-program-overview. Accessed May 10, 2015.

U.S. P3 Deal Flow Suffers From Delays, Attrition. *Public Works Financing Newsletter,* May 2015. http://pwfinance.net/u-s-deal-flow-suffers-from-delays-attrition/. Accessed October 27, 2016.

Vadali, S. Toll Roads and Economic Development: Exploring Effects on Property Values. *Annals of Regional Science*, Vol. 42, 2008, pp. 591-620.

Virginia Department of Transportation. Coming Soon: I-564 Intermodal Connector. Richmond, 2015a. http://www.virginiadot.org/projects/hamptonroads/i-564_intermodal_connector.asp. Accessed August 24, 2015.

Virginia Department of Transportation. Under Construction: Hampton Boulevard Grade Separation. Richmond, 2015b. http://www.virginiadot.org/projects/hamptonroads/hampton_boulevard_grade_separation.asp. Accessed August 24, 2015.

Virginia Department of Transportation. I-66 Transform 66–Outside the Beltway: Multimodal Solutions, I-95 to Haymarket. Richmond, 2015c. http://outside.transform66.org/. Accessed August 25, 2015.

Virginia Department of Transportation. Business Plan Update: Fiscal Year 2016. Richmond, 2015d. http://www.virginiadot.org/about/resources/FY2016_Business_Plan.pdf. Accessed May 25, 2016.

Virginia Department of Transportation. Gov. McAuliffe Announces Deal Ensuring No Tolls on the MLK Freeway Extension in Portsmouth. Richmond, July 10, 2015e. http://www.virginiadot.org/newsroom/statewide/2015/gov._mcauliffe_announces_deal84307.asp. Accessed August 28, 2016.

Virginia Department of Transportation and Department of Rail and Public Transportation. Virginia Megaprojects—About Megaprojects. Richmond, 2015. http://www.vamegaprojects.com/about-megaprojects/. Accessed May 5, 2016.

Virginia Transportation Research Council, Transportation Planning Research Advisory Committee. *Research Needs.* Charlottesville, November, 2012. http://onlinepubs.trb.org/onlinepubs/shrp2/SHRP2prepubC12.pdf. Accessed October 27, 2016.

Virginia's Office of Public-Private Partnerships. P3: Virginia Public-Private Partnerships. 2014. www.P3virginia.org. Accessed February 7, 2017.

Vock, D.C. Virginia Discovers P3 Projects Might Not Always Save Money. *Governing: The States and Localities.* 2015. http://www.governing.com/topics/finance/gov-virginia-public-private-partnership-setbacks.html. Accessed August 26, 2016.

Watts, J. Virginia Transportation Board Adopts Tighter P3 Rules. *The Bond Buyer*, November 13, 2014. http://www.bondbuyer.com/news/washington-infrastructure/virginia-transportation-board-adopts-tighter-p3-rules-1067923-1.html. Accessed August 28, 2016.

APPENDIX

DATA PREPARATION PROCESS

Because this study concerned both residential and commercial property values in multiple years, it was necessary to develop a formal process for preparing the data for analysis.

Removal of Errors

A first step was to check for abnormal values. This check required the following steps.

1. Unreasonably built years such as 0 or 2100 were deleted, and only properties that had been constructed within 100 years were considered.

2. Only properties remodeled after 1995 were considered as an effective variable. (No effects were assumed for properties remodeled before 1994.)

3. Residential properties with no bathroom were deleted.

4. Zero values of livable area for residential properties and foundation area and total area of the building for commercial properties were removed.

5. Only livable areas more than 0 square feet and below the 95% percentile (3,698 square feet) of residential properties were used.

6. The property values over $0 and below the 95th percentile ($924,978 for residential, $52,193,883 for commercial) were used.

7. Only industrial buildings (39.5%), offices (5.1%), office condominiums (23.6%), and shopping centers (4.4%) were considered based on their majority of proportions among 19 commercial building uses.

After the data cleaning process, observations of residential and commercial parcels were reduced to 102,209 and 3,373 from 115,209 and 5,492, respectively.

Examination of Proximity Effects

The development of Figures 5 through 9 required that certain variables in the hedonic price models be held constant while the proximity variable was changed. The general approach was to pick either the most common value or the average value. For example, consider the residential model where properties could be remodeled during four periods: 1995-1999; 2000-2004; 2005-2009; and 2010-present. Because the percent of properties remodeled during 2000-2004 (37.4%) was largest for that time period than for the other three time periods, Figure 5 was created based on properties being remodeled during 2000-2004. Because the average number of bedrooms for all residential properties was three, Figure 5 was created based on properties with three bedrooms. Table A1 shows the average values used to create Figure 5.

Table A1. Average Values for Interpretation (Residential Property)

Variable	Average Value
Distance to Express Bus Routes (before construction) (meters)	2333
Distance to Express Bus Routes (after construction) (meters)	1184
Distance to HOT Lanes Ramps (before construction) (meters)	2798
Distance to HOT Lanes Ramps (after construction) (meters)	1421
Distance to Regional Activity Centers (before construction) (meters)	5202
Distance to Regional Activity Centers (after construction) (meters)	2618
Number of Stories	1
Number of Bedroom	3
Number of Full Baths	2
Building Age (year)	43
Livable Area (in 100 scale) (square feet)	15

A similar approach was applied for the commercial hedonic price model. Industrial buildings (39.5%) were chosen because of its largest proportion among property types, and all other variables were set at conditions near the average values of the data (Table A2). These were used to create Figures 8 and 9.

Table A2. Average Values for Interpretation (Commercial Property)

Variable	Average Value
Distance to Express Bus Routes (before construction) (meters)	1649
Distance to Express Bus Routes (after construction) (meters)	829
Distance to HOT Lanes Ramps (after construction) (meters)	1134
Number of Stories	2
Number of Units	6
Foundation Area (in 100 scale) (square feet)	126
Total Area of the Building (in 100 scale) (square feet)	472
Building Age (year)	34

Accounting for the Market Change Rate

The market value change rate was applied to all property values before construction. This market change rate stems from the assumption that the values after construction (2013 and 2014) already reflected the market trend of property values. Fairfax County (2006, 2007, 2013, 2014) estimated the median and average market values of residential properties. Based on these data, the average residential market values within Fairfax County were \$619,680 (2006), \$626,237 (2007), \$490,659 (2013) and \$494,284 (2014), respectively. The average market value dropped from \$622,958 (2006 and 2007) to \$492,471 (2013 and 2014) by an average of 20.9%. Thus the before property values were reduced by 20.9% to account for this change in market conditions. Figure 5 was thus created by assuming that residential property values (where home remodeling was done between 2000 and 2005) had the same trend of a 20.9% reduction in value. A similar approach was used for Figures 6 through 9. For Figures 8 and 9, the residential rate used earlier (Fairfax County, 2006, 2007, 2013, 2014) was applied to commercial properties, as a commercial-based change rate was not available.

Figure A1 illustrates how the model interpretation would be affected if market change rates had not been used. The left side of Figure A1 does not use market value change rates, whereas the right side of Figure A1 repeats Figure 5 where before prices were reduced. The slope of the lines during the after period would not have been affected; for example, the increase in value suggested by proximity to bus routes would be retained. However, the magnitude of the parcel value during the before period would have been higher, reflecting the fact that throughout Fairfax County, residential prices were about 20.9% higher during the before period (2006 and 2007) than the after period (2013 and 2014).

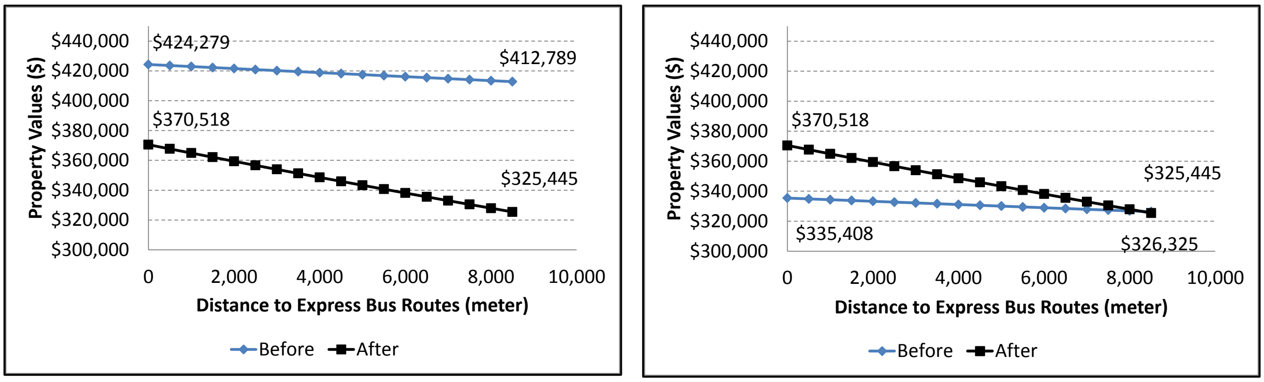


Figure A1. Property Values as a Function of Distance to Express Bus Routes. ***Left*: Market value change rates are not considered. *Right*: Market value change rates are considered.**.