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How to Make BTOD More Successful?

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Abstract

Transit-Oriented Development (TOD) is a recommended planning strategy of smart growth and New Urbanism. In the U.S., over 90% of TOD projects are rail TOD (RTOD) projects. In contrast, bus TOD (BTOD) is a minor player, and is therefore lightly researched. This paper summarizes the strengths and weaknesses of BTOD relative to RTOD, and proposes three categories of implementation strategies to make BTOD more successful: 1) adaptive transit strategies, which intend to make bus transit more conducive to BTOD in terms of improving bus transit operating performance, enhancing its external image, and better serving bus riders; 2) adaptive land use strategies, which call for better coordinating bus transit planning and land use planning to ensure that transit-supportive land uses are created in the vicinity of bus stations; 3) strong supports from government agencies and leaders.

In addition, this paper also concisely describes the TOD Best Practices by introducing the two prominent TOD projects in Arlington County, Virginia (the Columbia Pike Streetcar Project and the Rosslyn-Ballston Metro Corridor Project).

Key words: Transit-Oriented Development (TOD), adaptive transit strategies, adaptive land use strategies, Virginia

1. INTRODUCTION

Compared to rail transit-oriented development (RTOD), bus transit-oriented development (BTOD) remains as a minor player (Currie, 2006). Cervero et al. (2004) estimated that only 7.8% of the TOD initiatives in the U.S. were bus based and predominantly located in smaller communities. As of today, BTOD is still more of a concept than a reality.

This fact is not surprising due to existing bus transit's relative weaknesses in attracting development around its stations compared to rail transit. Bus transit's low investment results in its low performance. Because of that, bus transit usually has little influence on land use and urban form (Vuchic, 2007).

Although the above fact seems indisputable, the question is: how long will this situation last? will BTOD always be a second-class TOD? The answer is emphatically no. In fact, there are compelling reasons for us to make BTOD more successful in the future.

First, bus is the most important transit mode in the U.S. In 2005, 9.8 billion unlinked passenger trips were taken in the country, of which 59.7% were made by bus, 28.6% made by heavy rail, and 11.7% made by all other modes combined (American Public Transportation Association, 2007). For those U.S. cities that currently cannot afford or do not meet the eligibility requirements yet for building rail transit, bus remains the most important even the sole transit mode in the years to come.

Second, there exists a hierarchy of TODs corresponding to a hierarchy of transit modes (Dittmar and Poticha, 2004). This means that BTOD can possibly find its proper niche, especially in relatively low density, and/or suburban settings.

Third, it is becoming technically more feasible than ever before to overcome some bus-related weaknesses to make BTOD more competitive against RTOD.

Fourth, bus is not always a competitor of rail. When a bus line serves as a feeder to a rail line, BTOD on the feeder line and its neighboring RTOD on the trunk line could be mutually beneficial in terms of boosting each other's ridership. It is noteworthy that the collocation of bus services/terminals at some major rail stations has been found beneficial to RTOD (Porter, 1997).

The above reasons motivate this paper to further explore the BTOD-related issues. The paper first proposes a research methodology guiding the entire study. It then discusses BTOD in the context of the TOD system, and summarizes its strengths and weaknesses. The paper subsequently proposes and evaluates a set of improvement strategies, supported by both U.S. and international case examples. Furthermore, the paper briefly introduces two prominent TOD projects in Virginia and one Richmond TOD plan. A concluding section summarizes the research findings.

2. RESEARCH METHODOLOGY

2.1 TOD Roadmap

To guide this research, a TOD roadmap is created and shown in Figure 1.

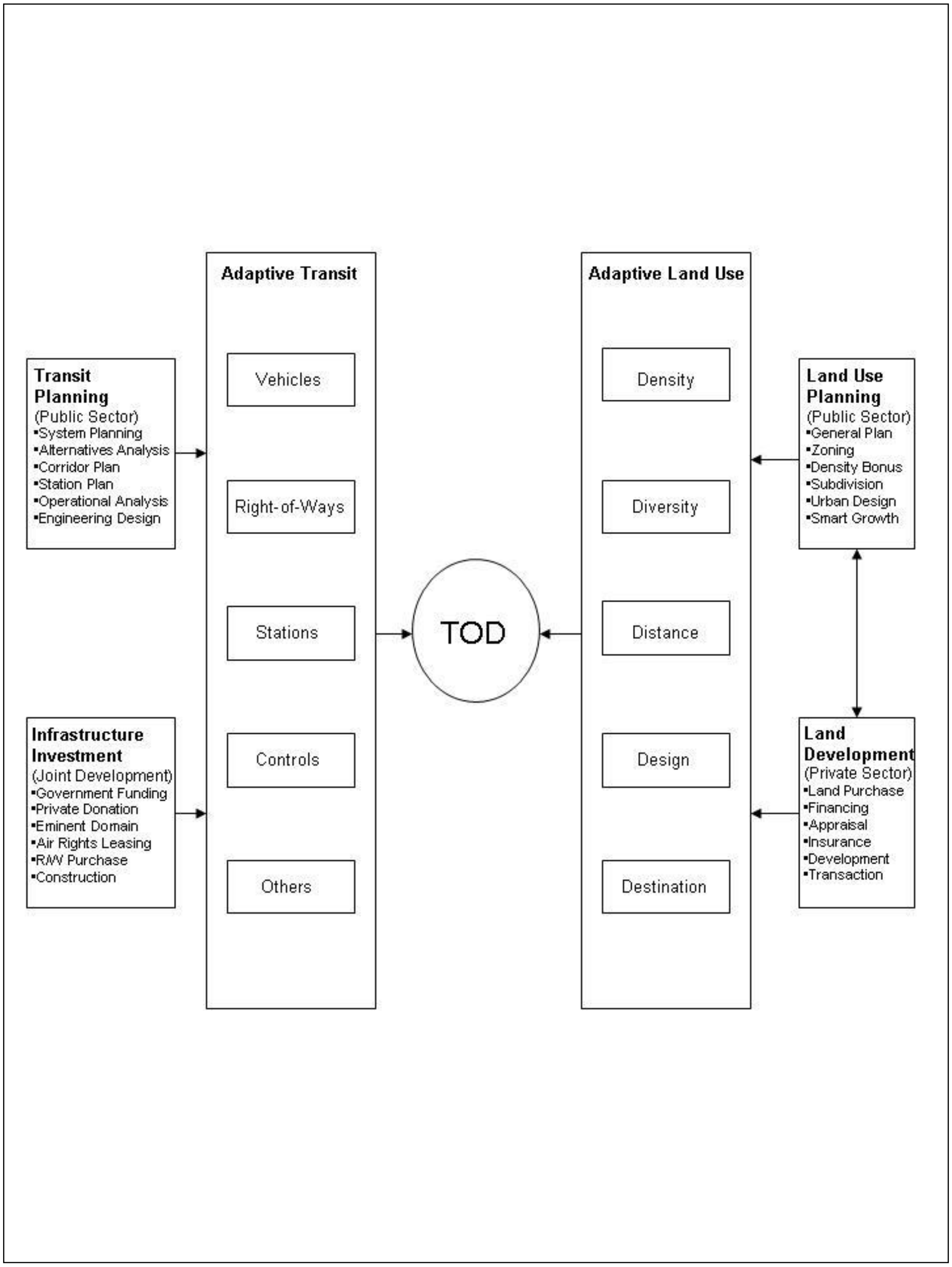

Figure 1 TOD Roadmap (Created by author)

Black (1995) recognized that there is a symbiotic relationship between transit and a particular urban form. Cervero (1998) devised the concepts of adaptive cities, adaptive transit, strong-core cities, and hybrids. He noted that the combination of flexible bus-based services and mixed-use development along busway corridors has resulted in high per capita transit ridership rates in both Ottawa and Curitiba.

Figure 1 indicates that the success of a TOD project is to find a harmonious fit between an adaptive transit and an adaptive land use. Both transit and land use are affected by many factors, including transit planning, infrastructure, land use planning, land development, and other intertwined factors.

Based on the understanding of this TOD roadmap, a research framework is outlined below.

2.2 Research Framework

This research includes the following tasks:

Task 1: Literature Review

The BTOD-related literature review will be embedded in the text. Therefore, there is no separate literature review section to be provided.

Task 2: Research Hypotheses

This paper proposes the following set of hypotheses pertaining to BTOD:

<u>Hypothesis #1</u>: To build an adaptive transit conducive to BTOD development, it is necessary to make at least three levels of improvements:

- Level 1: build a tiered, and hub-spoke type of transit system to minimize transfer times;
- Level 2: upgrade transit mode to bus rapid transit (BRT) if possible with exclusive busways and other advanced features; and
- Level 3: optimize transit station design to encourage walk access and minimize pedestrian/vehicular movement conflicts within the station area.

<u>Hypothesis #2</u>: To build an adaptive land use conducive to BTOD development, it is also necessary to make at least three levels of improvements:

- Level 1: coordinate land use planning and bus transit planning processes;
- Level 2: encourage public/private partnership; and
- Level 3: strengthen public participation and community outreach.

Hypothesis #3: To integrate an adaptive transit and an adaptive land use together also requires other supporting strategies to be implemented concurrently in a systematic way so potential implementation barriers could be reduced or eliminated.

Hypothesis #4: It is possible to make BTOD more successful, especially in the low-density, and/or suburban settings, but the process takes time because the land use pattern change is a rather slow process.

Task 3: Data Collection

Research data are collected from the following sources:

- Journal articles and books;
- Empirical case studies;
- Planning reports, especially Transit Cooperative Research Program (TCRP) reports; and
- Local TOD data come from the Richmond Transit-Oriented Development Plans prepared by Virginia Commonwealth University (VCU) and the Comprehensive Operations Analysis conducted by Greater Richmond Transit Company (GRTC). The data collected from the recently completed "Transit and Land Use Best Practices" project, which was funded by the Virginia Transit Association, will also be utilized as much as possible.

Task 4: Technical Analysis

Based on literature review and data collection, this study conducts a technical analysis, proposes, and evaluates a set of BTOD implementation strategies.

Task 5: Conclusion

This section summarizes the entire paper.

3. BTOD IN THE TOD SYSTEM: A RECAP

Calthorpe Associates (1992) identified both an "Urban TOD" associated with rail stations and a "Neighbourhood TOD" associated with bus stations. Urban TODs are located on the Trunk Line Network at heavy or light rail stations or at express bus stops. Because they are adjacent to the major spines of the regional transit system, these TODs have a higher percentage of job creations and may be developed at higher commercial intensities and residential densities. Due to the presence of its large employment base, urban TODs tend to have higher trip attractions than trip productions.

In contrast, neighborhood TODs are located on high frequency bus routes or along feeder bus lines within 10-minute-travel time from light rail stops or bus transfer stations. This means that neighborhood TODs have frequent, high-capacity transit services to attract development. These TODs place a greater emphasis on residential uses and local-serving shopping uses. Therefore, neighborhood TODs may have higher trip productions than trip attractions. Calthorpe noted that not all transit stops will be TODs. Instead, some stops will be developed as park-and-ride lots or will be located in low-intensity industrial areas (Calthorpe Associates, 1992).

Calthorpe's classification of TODs into urban TODs and neighborhood TODs seems overly simplistic. Table 1 shows a refined typology of TODs proposed by Dittmar and Poticha (2004).

Table 1 Typology of TODs and Associated Transit Modes

TOD Type	Transit Mode	Frequency	Land Use Mix	Minimum Housing Density (units/hectare)	Housing Types
Urban Downtown	All Modes	<10 minutes	Primary office Entertainment Multifamily Housing	>60	Multifamily Loft
Urban Neighbourhood	Light rail Streetcar Rapid bus Local bus	10 minutes peak 20 minutes off-peak	Residential Retail Class B Commercial	>20	Multifamily Loft Townhome Single Family
Suburban Center	Rail Streetcar Rapid bus Local bus Paratransit	10 minutes peak 10-15 minutes off-peak	Primary office centre Entertainment Multi family housing Retail	>50	Multifamily Loft Townhouse
Suburban Neighbourhood	Light rail Rapid bus Local bus Paratransit	20 minutes peak 30 minutes off-peak	Residential neighbourhood Retail Local office	>12	Multifamily Townhome Single family
Neighbourhood Transit Zone	Local bus Paratransit	25-30 minutes Demand responsive	Residential Neighbourhood retail	>7	Multifamily Single family
Commuter Town Centre	Commuter rail Rapid bus	Peak service Demand responsive	Retail centre Residential	>12	Multifamily Townhome Single family

Source: Dittmar, H. and S. Poticha. 2004. "Defining Transit-Oriented Development: The New Regional Building Block." In Dittmar, H. and G. Ohland (eds.). *The New Transit Town: Best Practices in Transit-Oriented Development*. Washington, D.C.: Island Press.

Due to its relatively low density requirements, bus services can be provided at every level of development, including higher density development for sure. This means that BTODs can technically exist anywhere in the above TOD typology. However, rail-based modes are more closely related to higher density and larger scale development. Because of this, RTODs, especially heavy rail-related TODs, normally exist in more urban and higher density areas. Those areas that already have RTODs are less likely to build new BTODs due to its resource constraints (Currie, 2006).

A review of TOD residential density thresholds identified consistently lower density expectations for bus based schemes than light rail in San Diego, Washington, and Portland. BTOD is commonly associated with cities without rail. Table 2 shows the recommended densities for different modes of public transit.

Table 2 Minimum Densities for Different Transit Modes

Mode	Density (units/acre)
Intermediate Bus	7
Frequent Bus Service	15
Light Rail	9
Heavy Rail	12

Source: Dunphy, Robert T, Robert Cervero, and Frederick C. Dock. 2004. *Developing Around Transit: Strategies and Solutions That Work.* Washington, D.C.: Urban Land Institute.

4. BTOD STRENGTHS AND WEAKNESSES: A SUMMARY

In its California TOD study, Parsons Brinkerhoff (2002) compared BTOD advantages and disadvantages, which are recompiled in Table 3.

Table 3 Bus TOD and Rail TOD

Bus TOD	Rail TOD
Pros:	
Can increase ridership	Can increase ridership
More efficient service provision	More efficient service provision
More ubiquitous and flexible than rail	Fixed and better identity
Large number of bus stops along a transit corridor	Permanent stops provide less risks for investment
	More culturally accepted than bus
	Construction process provides more opportunities for joint development
	Requires less leadership than bus
	Proven track record
Neutral:	
Low-income riders	Higher income and choice riders
Urban & suburban service market	Urban service markets
Less influential constituencies	More influential constituencies
Cons:	
Lack of fixity decreases investment attraction	More expensive than bus
Stigmatized as second-rate transportation	Fewer stops along a transit corridor
Construction process provides fewer opportunities for joint development	
Requires more leadership than rail	
Few successful examples	

Source: Parsons Brinkerhoff. 2002. *Statewide Transit-Oriented Development: Factors for Success in California.*

Table 3 indicates that BTOD and RTOD have their respective strengths and weaknesses, but in opposite areas. For example, rail has a better identity (strength) but is more expensive (weakness). Bus is more flexible (strength) but has a poor image (weakness). These trade-offs are clear.

Largely based on his Australian empirical research, Currie (2006) also examined the strengths and weaknesses of BTOD relative to RTOD. His findings, which are largely consistent with those shown in Table 3, are summarized in Table 4.

Table 4 BTOD Strengths and Weaknesses

BTOD Strengths	Strength Rating	BTOD Weaknesses	Weakness Rating
Complementarity and Ubiquitousness	High	Permanence, Magnitude, Development Risk	High
Flexibility-Choice	Moderate	Newness	Low to Medium
Flexibility-Adaptiveness to Change	Moderate	Different Markets	Low to Questionable
Cost Effectiveness	High	Park and Ride	Unclear
Service Frequency	High	Industry TOD Capabilities	High
Transfers	Low to Medium	Pedestrian Access	Moderate
		Parking Restraint	High
		Urban Density	Moderate to High
		Scale Dilution	Unimportant to Low
		Noise and Pollution	Moderate to High
		Frequency and Speed	Moderate to High
		Bus Stigmatization	High
		Track Record	Moderate to High

Source: Currie, G. 2006. Bus Transit Oriented Development – Strengths and Challenges Relative to Rail. *Journal of Public Transportation*, 9 (4).

From Currie's perspective, the significant challenges for effective BTOD are: poor bus industry capabilities; noise/pollution impacts of buses; and poor track record. He concluded that BRT has more strengths than local bus. BRT with good design can lessen the significance of challenges. The well-designed BRT could have net advantages compared to rail in some circumstances. This paper supports his position.

At present, BTOD seems to have more weaknesses than strengths, and RTOD has more strengths than weaknesses. That explains why the number of RTODs greatly outnumbers that of BTODs in the U.S. and the rest of the world. However, this situation would change if we could implement more remedial improvement strategies to reverse the trend.

5. BTOD IMPLEMENTATION STRATEGIES

To make BTOD more successful, this paper proposes three sets of implementation strategies directly addressing the BTOD weaknesses identified: 1) adaptive transit strategies; 2) adaptive land use strategies; and 3) other supporting strategies.

5.1 Adaptive Transit Strategies

This set of adaptive transit strategies contains three levels (macro, intermediate to micro levels).

Level 1: Build a Tiered Transit System

First of all, this tiered transit system should apply the hub-spoke concept being used in airline industry.

Transit hubs (Central Business District, major population and employment centers) are connected by trunk lines (BRT routes and other high-capacity routes), and local bus lines serve as feeders to trunk lines. The three-tiered transit system in Los Angeles is a good example: Tier 1 services (Rail, Metro Rapid Bus, and Express Service) represent the highest level of transit services with largest carrying capacities; Tier 2 services (Inter-Community Transit Service) include all other fixed route/fixed schedule services operated on surface streets; and Tier 3 services (Neighborhood Circulator/Paratransit Service) include services operated in either a fixed route or demand responsive fashion with vans, sedans, or minibuses.

Second, this tiered transit system should have bus stations which are either built at transfer points among bus routes, such as a timed-transfer system in low-density areas, or between bus feeders and rail lines (Vuchic, 2007).

The Canadian timed-transfer system was first pioneered in Edmonton and Calgary, and subsequently in Ottawa. Tidewater, Virginia's "direct transfer" network, was modeled after Edmonton's, using shopping centers as bus transfer points (Cervero, 1998).

With regard to the effectiveness of the bus transfer center, successful examples abound. For example, the Staples Street Bus Transfer Center of Corpus Christi, Texas, serves up to 5,000 users daily. This center has gone beyond the typical transit center and is helping reshape the surrounding community, and giving bus transit a positive image in Corpus Christi. The Boulder Transit Village, Colorado, is also a multi-modal regional bus/bus rapid transit (BRT) station, and will be developed into a TOD with 200-300 or more affordable and market-rate residential housing units, supportive commercial uses and possibly a park-and-ride lot.

In order to make the above bus system improvement, it is necessary to conduct a comprehensive operations analysis (COA). Based on the recommendation of COA, any necessary bus route readjustment and transfer center identification can be undertaken.

Level 2: Upgrade Bus Transit Mode to Bus Rapid Transit if possible

Upgrading bus transit mode to bus rapid transit (BRT) is one of the most effective ways to make BTOD more successful. BRT is more rail-like than regular bus. Generally speaking, only when bus is more auto-like in terms of its operating performance and more rail-like in terms of its identity, will BTOD be more competitive relative to RTOD. Regular bus has shortcomings in both operating performance and identity.

BRT can at least fix the following list of BTOD weaknesses:

- BRT normally involves exclusive busways, which will improve BTOD fixity, identity, image, and permanence. In turn, it will attract more development and investment around stations;
- BRT has a brand new bus exterior design, color, and station design. This will give people a sense of newness, which will help boost transit ridership;
- BRT has a much better operating performance (faster speed, frequent service, no transfers between a feeder line and a trunk line, fewer stops, more comforts) than regular bus. This will make BRT more competitive than regular bus, even light rail when considering BRT's lower capital cost; and
- Since BRT has fewer stigmas than regular bus does, it will appeal to higher-income riders and help achieve modal shifts from auto to transit.

BRT can also adopt O-Bahn technology (track-guided bus) to further reduce its right-of-way requirement and achieve a higher speed (Cervero, 1998). A benefit and cost analysis for adopting O-Bahn technology for a specific corridor needs to be performed carefully.

Levinson et al. (2003) conducted a thorough BRT research published as TCRP Report 90. The BRT-related land development benefits for selected busways are tabulated in Table 5.

Table 5 Land Development Benefits of BRT Systems

System	Land Development Benefits
Pittsburgh East Busway (9.1 miles)	59 new developments within a 1500-ft radius of station. $302 million in land development benefits, of which $275 million was new construction. 80% is clustered at station.
Ottawa Transitway System (19.3 miles)	$1 billion in Canadian dollars ($C) in new construction at Transitway stations.
Adelaide Guided Busway (7.5 miles)	Tea Tree Gully area is becoming an urban village.
Brisbane South East Busway (10.25 miles)	Up to 20% gain in property values near Busway. Property values in areas within 6 miles of station grew 2 to 3 times faster than those at greater distances.

Source: Levinson et al. 2003. *Bus Rapid Transit (TCRP Report 90)*. Washington, DC: Transportation Research Board.

The land development benefits of the above list of BRT systems reflect the BTOD benefits in those areas. BRT can be more cost-effective, and provide greater operating flexibility than rail transit. BRT can also extend rail transit lines at a reduced cost, just like Metro Orange Line (BRT) extends Metro Red Line (heavy rail) at North Hollywood Station in Los Angeles. BRT systems can provide sufficient capacity to meet peak-hour travel demands in most U.S. corridors (Levinson et al., 2003). Therefore, BRT technology can potentially help reduce the gap between BTOD and RTOD.

Level 3: Optimize Transit Station Design

This micro-level strategy intends to optimize transit station design to improve modes of access for passengers. In a station master plan, a good layout design for walk access and auto access is critical. Any potential conflicts between walk access and auto access should be reduced or eliminated.

Several concrete design measures are suggested:

- Build separate parking garages if funds permit. Having a separate parking garage will remove cars from the parking lot, which may potentially be converted into an in-fill development. This will also help reduce the conflicts between pedestrian flows and vehicular flows;
- Reduce the number of parking spaces and impose charges on those parking spaces adjacent to station, and implement other parking management strategies, e.g. designating long-term parking and short-term parking stalls with different colors;
- Properly design building orientation, building setbacks, and connections to stations. Make sure pedestrians and motorists use different building entrances to eliminate conflicts, which requires parking lot and walking area to be located on the opposite sides of the bus terminal building. It is essential to build comfortable sidewalks specifically for pedestrians to access station; and
- Create a grade-separated underpass or overpass for pedestrians. Figure 2 shows the Irvine Transportation Center Pedestrian Bridge in California as an example of pedestrian overpass.

Figure 2 The Irvine Transportation Center Pedestrian Bridge in California

5.2 Adaptive Land Use Strategies

This set of strategies includes the following three core planning measures:

Level 1: Coordinate Transportation and Land Use Planning Processes

It is essential to coordinate transportation and land use planning processes, especially in the vicinity of the TOD site. The following concrete measures are particularly important:

- As illustrated in Figure 3, bus transit and land use planning for the BRT station areas should be well coordinated and integrated at every level (planning, design, and construction). State, regional, and local cooperation is important in developing and implementing BRT projects. At local level, planning department and transportation department need to be well coordinated. The transportation planning and land use planning process should be streamlined. For example, city general plan of the Planning Department includes circulation element to address transportation concern. In the meantime, environmental impact assessment of the Transportation Department considers the effects of local land uses and zoning ordinances;

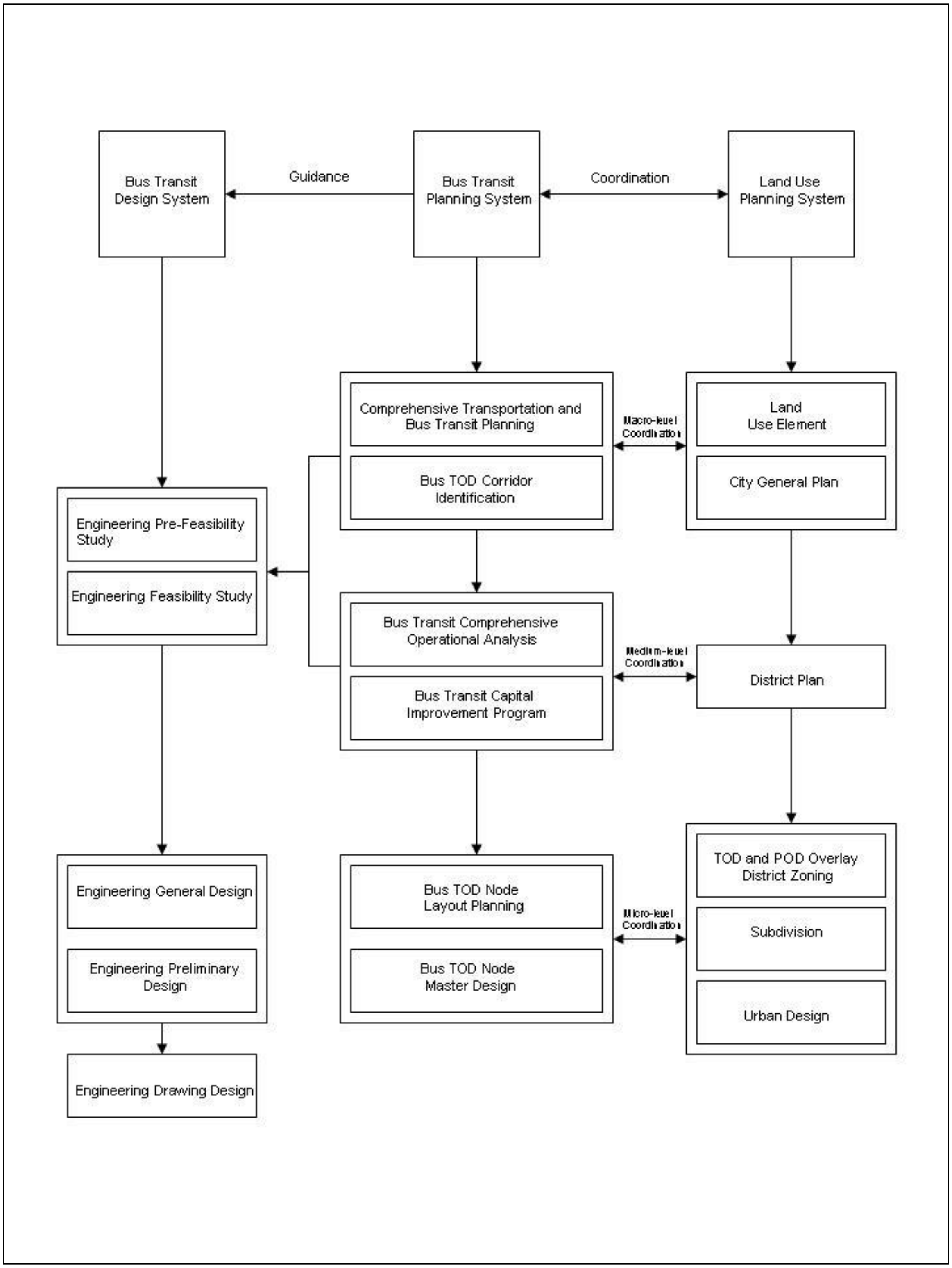

Figure 3 The TOD-Based Bus Transit Planning and Design System
(Source: Adapted from Lin, Qun, and Chuanling Zong. 2006. Practicing Transit-Oriented Development Planning in Shenzhen. *Urban Transport of China*, Vol. 4 and No. 3.)

- Create a TOD overlay district to encourage mixed-use and moderate to high-density development needed to support public transportation. This transit overlay zone includes all transit-supportive land uses;
- The Pedestrian Overlay District (POD) is established to preserve and encourage the pedestrian character of commercial areas and to promote street life and activity by regulating building orientation and design and accessory parking facilities, and by prohibiting certain high impact and automobile-oriented uses;
- Since land use regulation is almost completely within the purview of local governments, obtaining local government support is vital. In the case of Uptown District Project in San Diego, the bus TOD became an important community asset due to the strong city leadership. In the Boulder Transit Village Project of Colorado, the City's Housing and Human Services Department pays $4.5 million to fund the TOD project, demonstrating the City's strong initiatives;
- Density bonuses would also promote mixed land uses near transit stations;
- Build sidewalks and other pedestrian-friendly facilities; and
- BTOD design needs to take into consideration its impacts on 5-D: Density, Diversity, Design, Distance and Destination, which is vital to the success of BTOD.

Level 2: Encourage Public/Private Partnerships

- Even though it is unnecessary to passively wait for a private developer to kick off the TOD project, a close working relationship with major developers is essential for building a successful BTOD project;
- Private sectors play key roles in transit joint development projects through donation of lands, payment of in-lieu fees and development impact fees;
- Private consulting firms, land surveyor firms, design companies, real estate agents, lending institutions are absolutely important in BTOD projects. Take the NoHo Arts District for example. The NoHo Arts District is a new Los Angeles community. A Metro Rail station is located there, and the terminus of the Metro Orange Line busway is across the street. In this TOD project, the economic development leveraged by this project has encouraged businesses to fill previously vacant commercial spaces. Eight new businesses have moved into the immediate vicinity of the art park. One vacant property has become a Starbucks Coffee shop, and other vacant buildings are now occupied by small businesses. This project serves as a catalyst to achieve a community's vision. Therefore, private sector plays an instrumental role in this project.

Level 3: Strength Public Participation and Community Outreach

- Because community's willingness to support public transport, foster bus transit-oriented development and build bus lanes is essential, it is necessary to strengthen public participation and community outreach as early as possible. This will help correct the general public's modal biases towards the perceived undesirability of bus transit;
- Because successful BTOD implementation requires involvement of transit operators, highway agencies, and the general public, all of the related stakeholders should be

engaged as a formal part of the planning process. For example, the Curitiba BRT planning process is an integral part of a city with coordinated urban design and transportation policies that favor transit and a livable urban environment over domination of street and highway traffic;
- The costs and benefits of building a BTOD, along with other options, should be carefully evaluated; and
- Marketing TOD is very critical in attaining the following goals: increasing knowledge and understanding about TOD; attracting high-quality development to TOD areas; increasing ridership of mass transit modes; providing amenities and services to the public not currently available; and revitalizing the economy.

5.3 Other Supporting Strategies

The adaptive transit strategies (Section 5.1) and the adaptive land use strategies (Section 5.2) reflect the TOD roadmap shown in Figure 1.

The TOD roadmap assumes an ideal situation, free from different kinds of barriers. The real world is of course much more complicated than that, which requires a set of other supporting strategies to remove these barriers and to make BTOD projects more realistic and implementable.

Supporting Strategy 1: Require a Strong Political Leadership and Government Support

The BTOD planning cannot be only limited to the municipal departmental levels (transit department and planning department), it must be further elevated to a higher political level in order to be successful.

This requires a strong political support from municipal, county, and even higher-echelon leaders, which is necessary to marshalling resources (including government funding), building consensus, and resolving any potential disputes in the BTOD development process.

Meanwhile, a clearly articulated legislation from legislative side is also very important. A good legislation would empower transit agencies and other players to assemble land and make joint development deals (Cervero, 2004).

Supporting Strategy 2: Plan Once, but Implement Incrementally

BTOD planning and implementation takes a long time. This requires the ability to keep persistent and stay focused on a shared vision, regardless of various types of distractions and interruptions. Arlington County, Virginia, adopted the metaphor of a “bull’s-eye” to articulate its TOD future, and achieved a remarkable success in its TOD projects along the Rosslyn-Ballston corridor, as introduced below (Cervero, 2004).

In the meantime, Boarnet and Crane (2001) also recognized that the progress toward TOD goals is often made in incremental steps. For example, in San Diego, where local conditions are consistent with TOD, such as in La Mesa, progress can be rapid. But in other places, there are many barriers and competing local concerns which may not be consistent with TOD goals.

Supporting Strategy 3: Provide Incentives to Developers to Ensure that the TOD Development is a Mutually Beneficial Process

To reduce the potential risks for developers in investing in TOD projects, government needs to provide different types of incentives to them to ensure that the TOD development is a mutually beneficial process. Examples of incentives include:

- give developers more latitude in project design;
- allow mixing of uses;
- offer density bonuses;
- simplify and streamline development permit approval and traffic impact assessment processes;
- provide cost-sharing mechanism; and
- others.

The above three sets of remedial implementation strategies, though not exhaustive, reflect a hybrid approach to addressing BTOD issues.

6. TOD PROJECTS AND CASE STUDIES IN VIRGINIA

This section introduces two prominent TOD projects and one recently completed TOD plan in Virginia.

6.1 Columbia Pike Streetcar Project, Arlington County, Virginia

As shown in Figure 4, the Columbia Pike ("the Pike") is a major east-west corridor traversing through Arlington and Fairfax Counties, Virginia. The Pike is experiencing a rapid socioeconomic growth due in large part to its geographic adjacency to Washington, D.C. and other regional attractors.

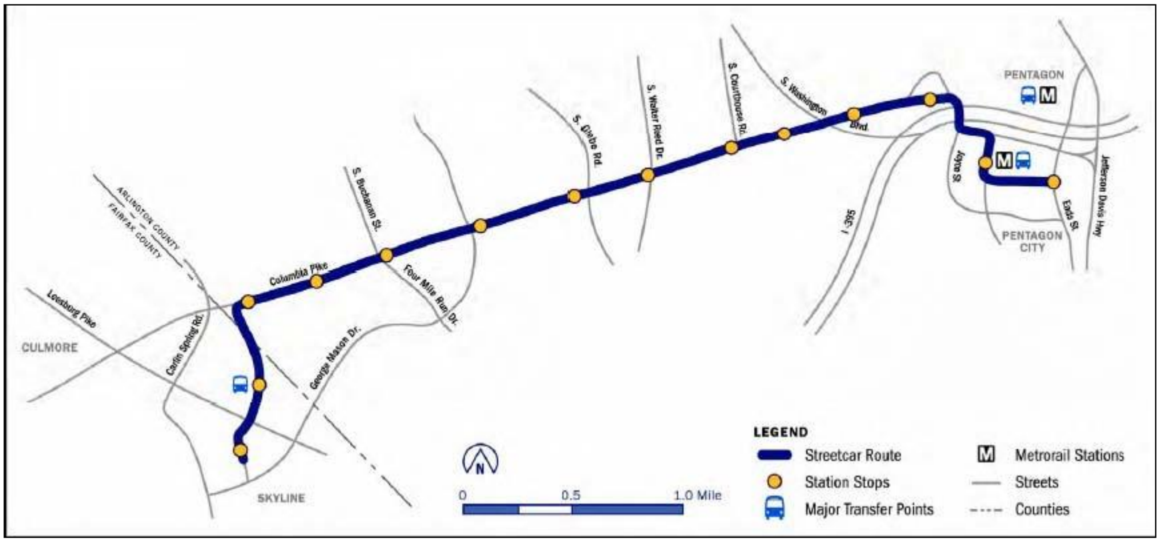

Figure 4 The Columbia Pike Streetcar Corridor Map

This project intends to develop an advanced transit system to serve the huge transit market between the Pentagon/Pentagon City area and Bailey's Crossroads, and to support the land use and redevelopment initiatives of both Arlington and Fairfax Counties. The project requires a close coordination between transportation planning and land use planning from the very beginning.

Based on the technical analysis of transit alternatives completed by the Washington Metropolitan Area Transit Authority (WMATA), in the spring of 2006, the Arlington County Board and the Fairfax County Board of Supervisors formally adopted the Modified Streetcar Alternative as the preferred alternative with the following features:

- Five mile connection between Skyline and Pentagon City;
- Six-minute headway service;
- Service augmented with Metro buses during peak periods.

Figure 5 shows a picture of Portland streetcar. The future project development steps include: financial planning and conceptual design; environmental assessment and preliminary engineering; engineering design; and construction.


Figure 5 Portland Streetcar

With respect to its TOD potentials, the Columbia Pike Streetcar Project would support corridor businesses and facilitate redevelopment for the Bailey's Crossroads area and the Columbia Pike Corridor.

In the Bailey's Crossroads of Fairfax County, the TOD project includes a mixture of community- and neighborhood-serving retail, office, residential, and recreational/cultural uses developed with a pedestrian scale and character. New mixed-use projects would create a distinct new identity for Bailey's Crossroads and provide future access to multi-modal transit options.

In the Columbia Pike Corridor of Arlington County, the TOD project would create an enhanced sense of place and community, and complement community goals to create a vibrant pedestrian-friendly "Main Street" environment in the corridor (Source: http://www.piketransit.com/).

6.2 Rosslyn-Ballston Corridor, Arlington County, Virginia

Arlington County has the nationally known successful TOD project, which places dense, mixed-use, infill development at five Metro stations along the Rosslyn-Ballston Corridor. See Figures 6 and 7 for details.

As of 2004, the Rosslyn-Ballston Corridor TOD project had over 21 million square feet of office, retail, and commercial space; more than 3,000 hotel rooms; and almost 25,000 residences, creating vibrant "urban villages" where people live, shop, work, and play using transit, pedestrian walkways, bicycles, or cars.

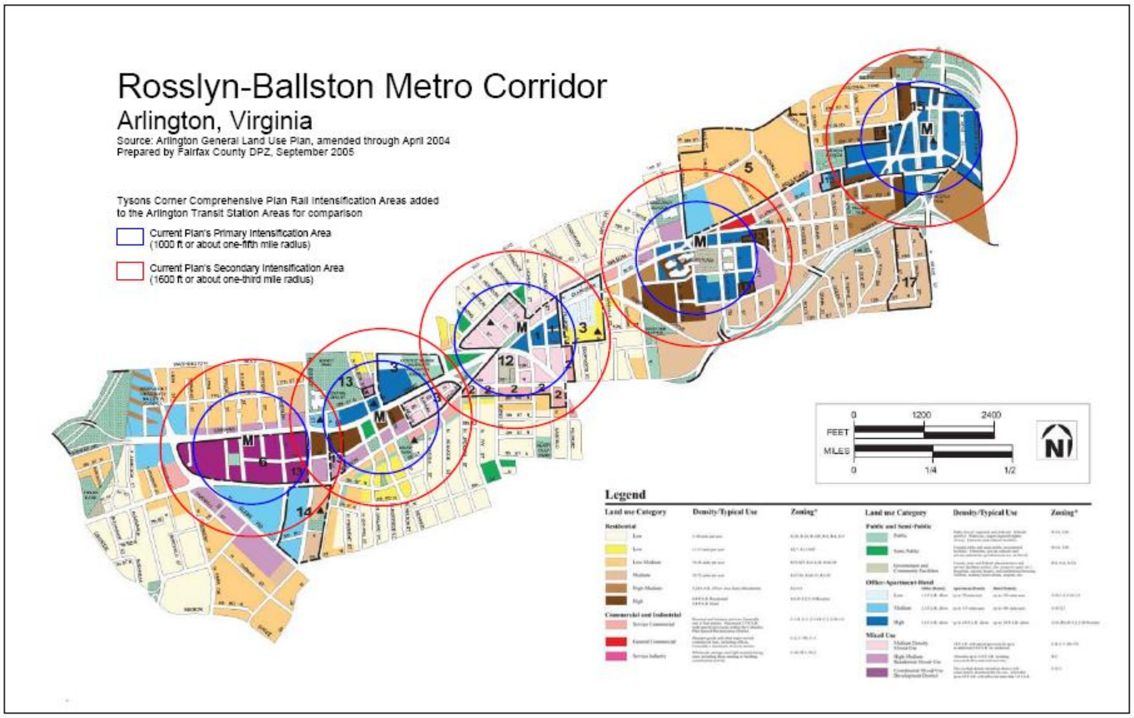

Figure 6 Rosslyn-Ballston Metro Corridor Map

Figure 7 Rosslyn-Ballston Metro Corridor Photo

At typical suburban densities, this project consumes over 14 square miles of open space, compared to the roughly two-square-mile Rosslyn-Ballston corridor. Arlington County adopted a General Land Use Plan to concentrate dense, mixed-use development at the stations and developed sector plans to ensure that each station maintained a distinct sense of community. Incentive zoning attracts private-sector transit-oriented development.

The corridor is so popular that preserving affordable housing is a challenge. In 2001, Arlington adopted an expanded bonus density provision for development of affordable housing, allowing up to 25 percent more density. As a result, the Metro ridership doubled in the corridor between 1991 and 2002. Nearly 50 percent of corridor residents commute by Transit (Source: http://www.epa.gov/piedpage/arlington.htm).

The Rosslyn-Ballston Corridor TOD Project has generated positive impacts on the modal splits for residential projects near Metrorail stations, see Table 6 for details.

Table 6 Modal Splits for Residential Projects Near Rosslyn Metrorail Station, 1987

Metrorail Station	Housing Project	Distance to Station (ft)	Percent of Commute Trips by:		
			Rail	Auto	Other
Rosslyn	River Place North	1,000	45.3	41.5	13.3
	River Place South	1,500	40.0	60.0	0.0
	Prospect House	2,200	18.2	81.9	0.0

Source: JHK and Associates. 1987. *Development-Related Survey I*. Washington, D.C.: Washington Metropolitan Area Transit Authority.

7. CONCLUSION

Compared to RTOD, BTOD remains as a minor player. However, BTOD can be made more successful if we implement adaptive transit, adaptive land use, and other supporting strategies in a concerted way.

Adaptive transit intends to make bus transit more conducive to BTOD in terms of improving bus transit operating performance, enhancing its external image, and better serving bus riders. This can be achieved through implementing a set of macro-, intermediate-, and micro-level bus transit planning measures. BRT technology is the hope for future BTOD.

On the land use side, it is essential to better coordinate bus transit planning and land use planning to ensure that transit-supportive land uses are created in the vicinity of bus stations. To engage more participation from private developers and the general public, public/private partnership and community outreach must be strengthened.

A successful BTOD project also needs strong supports from political leaders. Any government funding will help speed up the BTOD development process. Therefore, the other supporting strategies should also be implemented concurrently.

TOD is gaining its importance and popularity in Virginia right now. There are many TOD best practices and plans under development. This paper briefly introduces two prominent TOD projects in Arlington County: the Columbia Pike Streetcar Project and the Rosslyn-Ballston Metro Corridor Project.

BTOD has a good future in America, but it will take time for it to be realized because any change in land use pattern is a slow process. In this sense, the gap between BTOD and RTOD may be reduced in the near future, but will not be eliminated immediately.

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