

Door to Door: Combined Mobility and the Changing Transit Landscape

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Philly Bike Coalition (flickr)

It is self-evident: the more paying customers use a transit system, the better the return on investment for the transit provider. Yet exploiting this simple formula is anything but simple: adapting a transit system to a growing population spread over a growing geographic area while keeping costs in line with revenue is a major challenge for transit providers.

One way to increase the customer base is to extend the network, as long as there is a concentration of population and employment at the new stations. But this may not be enough, as the case of Singapore illustrates: As a result of Singapore's ongoing commitment to link land use and transportation, 80 percent of the population is within 400 meters (about a quarter of a mile) of a bus or metro line. Over the last decade, the Land Transport Authority has been steadily expanding its network and increasing service. Even so, as a result of rapid growth in wealth and population over the last decade (from 3.8 to 4.8 million persons), car ownership jumped from 26 percent to 47 percent, and the modal share captured by public transit actually decreased from 63 percent in 1997 to 58 percent in 2004.

The growing number of passenger servicing trips [car trips to mass transit stops] should raise a red flag to transport planners as they are usually first-and-last mile trips that could have been completed on the public transport network and thus avoided entirely... Commuters need to be persuaded to use alternative modes of transport such as public transit or cycling or walking, for short trips.¹

— Singapore Land Transport Authority

Thus, even in situations where the line-haul network can be expanded, transit providers need to focus on the first-and-last leg challenge if they hope to fully capitalize on their investments.

¹ Household Interview Surveys from 1997 to 2008 – A Decade of Changing Travel Behaviors, LTA, May 2010

“Combined mobility” – the addition of individual modes of transport to supplement mass transit systems – is a promising solution.

In many metropolitan areas, extending the transit network is becoming more expensive as capital and labor costs increase, and as it gets harder to secure the space for rights-of-way. In many developed economies such as Europe and the U.S., spending on infrastructure is predominantly directed at asset maintenance and repair, with few opportunities for new rail lines. Momentum behind infrastructure funding has dissipated in most European countries - at least for the time being - as the region copes with severe government debt by slashing budgets and postponing many infrastructure projects.²

All of this points to the importance of using as many modes as possible to “irrigate” transit access from the line-haul system into a larger geography where there is a huge reservoir of potential riders who would use the transit network if they did not live beyond walking or cycling distance, or if they had ready access to a connecting service or an alternative mode. While it is difficult to quantify the increases in ridership that might accrue by fixing the last-mile problem, there is nevertheless a convincing proxy for this in the well-established research linking transit use to distance from the service.³ Not surprisingly, the distance to the nearest transit stop and the number of transit stops near home are strongly related to transit travel.⁴ To the extent that transit trips offset vehicle trips, transit travel reduces vehicle miles traveled and increases walking to transit; the greatest effect is within one-quarter mile or less of a stop, declining by half between one-quarter and one-half miles, and becoming very small beyond that.⁵ This is supported by a Singapore Land Transport Authority study that found transit use declined by 1.6 percent for every 100 meters (about 330 feet) from the station, and explains LTA’s commitment to building a network of integrated transport hubs with seamless intermodal connections as well as a more extensive network of covered passageways to make walking more attractive.

Similarly, a 2011 study by the European Commission concludes that public transport quality and connections need to be greatly improved to reach the 71 percent of car users who feel that public transport is less convenient than the car. A similar proportion (72 percent) say they don’t use public transport because of a lack of connections (49 percent of “very important” responses). Sixty-four percent blame too few services.⁶

The objective is clear: by increasing access to transit services, by whatever means, ridership and revenues will increase.

The Context for Combined Mobility

Policies to increase non-auto mobility will need to confront several realities about the changing metropolitan landscape – realities that challenge established transportation planning practices and standard models for transit provision.

Sprawl continues. Despite the often stated reality that a greater proportion of people will be living in cities, these urbanizing areas are not necessarily configured in ways that make line-haul access (between terminals) possible. Although efforts to curtail sprawl and promote more centered development have taken hold over the last several decades, many mature metropolitan regions are permanently settled in ways that do not meet the density thresholds to support conventional rail and bus services. While sprawl is typically associated with American urbanization, it is regarded as one of the major challenges in Europe as well, particularly in the southern, eastern and central areas that saw rapid growth from EU regional policies. These places have seen a lot of auto-dependent suburban development; over the past 20 years, built-up areas in many western and eastern European countries have increased by 20 percent while the population has increased by only 6 percent.⁷ In Madrid, the Consorcio Transporta Madrid describes the settlement pattern in terms of Madrid City, the metropolitan ring of established satellite cities, and the “rest of the region.” Although the trend has slowed since the mid-1990s, growth in the metropolitan ring and the rest of the region has been at the expense of the center city, “giving rise to radical changes in mobility in the region, with a significant increase in metropolitan journeys.” In fact, mobility between municipalities that are not in the metropolitan ring has been increasing, with more than two-thirds of these journeys made by private vehicle (69.4 percent).⁸

In some emerging market cities, such as Santiago de Chile, transit planning cannot keep up with rapid metropolitan expansion. For reasons of both equity and environment, combined mobility can help extend transit access to these sprawling landscapes.

² Infrastructure 2013: Global Priorities, Global Insights Urban Land Institute and Ernst & Young 2013

³ Tools For Estimating VMT Reductions from Built Environment Changes, Anne Vernez Moudon, et al, State of Washington DOT 2013

⁴ Ewing and Cervero 2010; Khan, Kockelman, and Xiong 2013

⁵ Besser and Dannenberg 2005; Dill 2006; Ewing 1998; Guo 2009; O’Sullivan and Morall 1996; Schlossberg et al. 2007

⁶ Future of Transport, European Commission, March 2011

⁷ Urban Sprawl in Europe: The ignored challenge, EEA Report No 10/2006

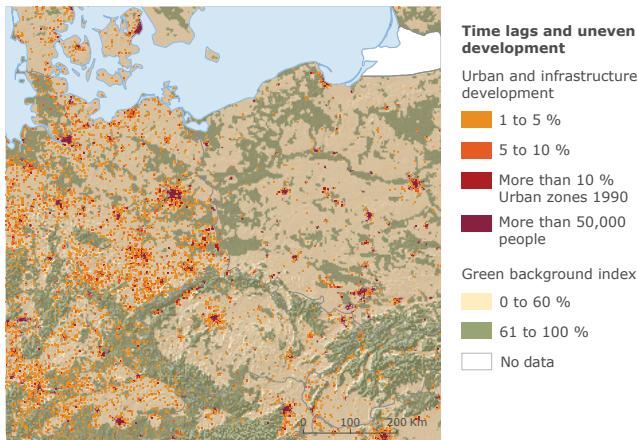
⁸ Madrid interview, CRTM

Figure 1: A rural district to the north of Santiago where intercity services have not yet reached.



Source: Transantiago.

Figure 2: Urban sprawl in Germany, Poland and Czech Republic (1990 to 2000).



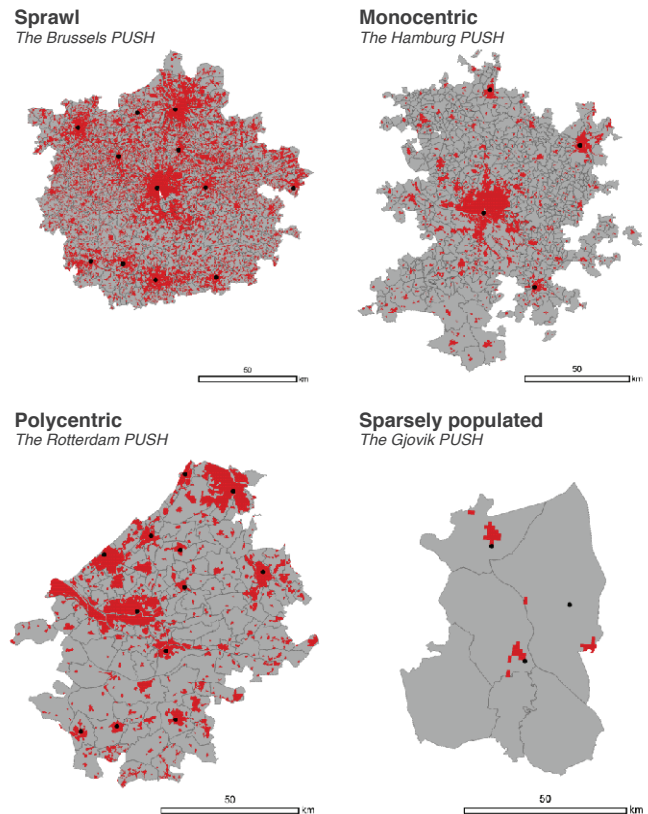
Source: EEA Report, October 2006.

The foundation of most transit networks is still the “solar” model of transportation and land use, in which the majority of transit trips are on commuter lines that emanate in a radial pattern from a single central business district. But as concentrations of employment and housing in the larger region start to become true centers in their own right, a much more complex “constellation” of destinations emerges, generating an equally complex pattern of transit trips not served by existing transit networks. In Europe, the emerging urban agglomerations are called “Functional Urban Areas,” and are considered the building blocks of a successful polycentric region. The concept of polycentric development supports the idea that there are specialized regional competencies – networks of specialists, resources, supplies and workforce – that are difficult to reproduce elsewhere. Improving the economic performance of an urban region depends on creating linkages – physical as well as economic – between centers with complementary strengths.⁹

Vienna has witnessed this same phenomenon, where more and more smaller centers are emerging within a distance of about 50 kilometers (30 miles) from each other, often focused on a particular industry or service economy sector. In 2007, White Plains, one of the regional centers north of New York City, had nearly as many reverse commuters (2,600) as those destined for

work in Manhattan (3,460), and 23 percent of the total reverse commuters for the entire Metro North rail system. More than half of New York City’s jobs are located outside of Manhattan’s central business district. Approximately half of the workers living in each of the city’s four other boroughs also work in their own borough. Regional mobility depends on finding ways to accommodate these more complex movement patterns within and among these multiple centers. Combined mobility is an essential part of this strategy.

Figure 3: Polycentric Europe.



Source: Potentials for Polycentric Development in Europe, ESPON 111, European Commission.

Patterns of urban activity are becoming more complex. The emergence of the “24/7 city” has generated demand for more trips of different kinds throughout the day.¹⁰ While weekday morning and evening peak periods continue to exist, rush hour durations are expanding, and demand on weekends and non-work hours is increasing. A 2010 study by Singapore’s LTA found that individuals were making more discretionary trips for social and leisure activities. The same study found that a combination of flexible work arrangements and road pricing strategies had shifted the morning rush period earlier, and made it longer. In the New York region, ridership in the off-peak and overnight periods, in particular, is where the majority of the increased ridership has occurred in recent years. From 2007 to 2011, average weekday off-peak and overnight ridership increased by 7.4 percent while peak ridership increased by 2.2 percent. Average weekend ridership increased by 7.2 percent from 2007 to 2011 compared to 4.8 percent on an average weekday.

¹⁰ Madrid, A World Reference, Consorcio Transporta Madrid, November 2013

⁹ Potentials for Polycentric Development in Europe, ESPON 111, European Commission

In the Madrid region, non-mandatory travel accounts for almost 43 percent of the total, suggesting purposes for making journeys are increasingly varied. “The issue of mobility is, therefore, gradually becoming more complex.”¹¹

City dwellers now make more frequent, unpredictable and varied trips that cannot be served efficiently by conventional transport, driving the demand for complementary services and demand-responsive modes. Meanwhile, heightened expectations surrounding information technology put pressure on transit providers to make real-time information available to riders, and to offer unified fare collections using open payment technologies to pay for any mode with a swipe of a contactless credit card or cell phone.

The idea of intermodal connectivity is not new. What has changed are the diversity of modes that are now considered part of this new extended network and the role played by both technology and new institutional arrangements and partnerships in facilitating these connections. A new set of practices is now referred to as “combined mobility” or “integrated mobility services.”

Car sharing, taxis and shared taxis, bicycle and bike sharing, carpooling, demand-responsive transport, car rental, etc. are services that can complement the classic fixed line, timetable-bound public transport services, and, together with walking, they form a complete and coherent mobility solution. The combined mobility framework considers the complete trip, from door to desk, and from first mile to last mile.

This paper discusses several major dimensions of this phenomenon:

- New methods, including new institutional arrangements and new levels of cooperation between the transit agencies and the providers of other modes.
- New modes, including especially shared cars and bicycles, but also new models for taxi service and shuttle buses.
- New spaces, including the kinds of physical accommodations needed to facilitate intermodal connections and to store different kinds of vehicles.

New Methods, New Modes, New Spaces

New Methods

At the center of combined mobility is coordination among transit agencies and providers of other modes. The degree of integration varies: it may be primarily information-sharing about timetables and the availability of other modes, such as bicycles and cars, or it can extend to actual shared control or public ownership of the alternative mode. For example, some transit providers have decided to launch their own car sharing programs, including

Bologna, Munich, Wuppertal and Dresden: German Rail has launched its own program - DBCarsharing. In some cities, bike share programs are privately initiated and operated, such as New York City's Citibike, but several of the established bicycle sharing programs were started by and continue to be owned by transit agencies, including Call A Bike, owned by Deutsche Bahn, and Barclays Cycle Hire, owned by Transport for London.

On the motorized front, Japan is a case study in the role that feeder buses can serve in supporting the transit system. Thirty percent of ridership there arrives by feeder bus, much of it on Japan's Green Mini Bus service, which carries 1,526,000 passengers a day. Some of these services are free. Others have significant discounts through prepaid IC¹² cards.

While service integration can take many forms, there are several strategies that most programs share:

- Unified payment systems
- Media and information sharing
- Institutional integration

Unified payment systems

Unified payment systems, which enable the use of the same ticket or monthly pass for multiple services, are an essential first step toward a more comprehensive system integration. For example, even though Santiago's transit authority, Transantiago, is only a decade old and is just starting to think about combined mobility, one of its first steps was to create a unified fare structure and payment system for the buses and metro. This move has had the positive effects of rationalizing and making more efficient Santiago's transit service, and establishes a solid foundation for Transantiago to build on. For cities that are further along in implementing combined mobility, riders may use a single ticket or monthly pass not just for buses and subways, but for car share, bike share and even taxi services as well. Many cities have introduced single card payment systems and flexible options for purchasing and adding value to the cards. Examples include the Bremer Karte plus Autocard in Bremen, which is a combined transit and car share ticket, and the Zurimobil chip card in Zurich, which provides access to cars, taxis and public transport.

One of the most ambitious initiatives is Hannover's HANNOVERmobil, a joint ticket that integrates public transport, car-sharing, taxis, German rail services, bicycle and other services. HANNOVERmobil provides customers hassle-free, one-stop mobility. Instead of spending time on choosing the right solution and signing up with a multitude of providers, the customer has instant access to a comprehensive “mobility menu” from which he can choose the most appropriate service at any time by using his “all-in-one” access card. In this case, the public transit provider has become a comprehensive mobility provider, improving transit customer service, increasing the number of customers and building customer loyalty.

This program integrates four services: Public transport, public car, taxi and long distance rail. The integration of public transit and car sharing forms the core of HANNOVERmobil. Residents can pick up one of the cars in their neighborhood and pay by the

¹¹ Ibid.

¹² Integrated circuit

hour and mile. More than 2,000 customers are using car sharing in Hanover today, with more than 110 cars and vans located in 70 spots all over the city and in parts of the surrounding area.

Figure 4: Mobile devices with HANNOVERmobil.



Source: heidelberg-mobil.com.

Finally, a significant advantage of unified payment systems is the possibility for the transit authority to monitor the entire network, and thus to influence travel patterns through measures such as congestion pricing. Singapore, which was one of the earliest adopters of a single card payment system, uses differential pricing, as well as cash awards and discounts, to distribute trips outside of peak hours, in particular the morning peak. The flexibility of the unified payment system allows for this dynamic pricing structure, which would have been prohibitively cumbersome without this technology.

Open payment systems can take this flexibility a step further by changing the role of the transit provider to a vendor – similar to a local convenience store. The rider no longer purchases fare media from the provider's ticket machine or station clerk to access the system, but instead, “purchases” access directly at the turnstile using a contactless credit card or near field communication-enabled mobile phone. The benefits of this are numerous:¹³

- Passenger convenience and throughput are increased.
- Differentiated fare structures, such as congestion pricing, are easier to implement.
- Capital and operational costs are reduced because ticket vending media and infrastructure do not have to be installed or maintained.
- Data collection enables both real-time intelligence and longer term management benefits.

Media and information sharing

Combined mobility initiatives rely on the near-ubiquitous access to cell phones, the internet and forms of social media. These initiatives include everything from using a computer, cell phone or other mobile device to get real-time information about schedules, service and bike share/car share availability; to making reservations for rentals, taxis and transit; to arranging in real time passenger rides with drivers in exchange for payment, using apps like Lyft, Uber and Sidecar.

The Deutsche Bahn Call A Bike system uses electronic locks controlled by embedded microcontrollers activated from one's cell phone. In Zurich, the “urban mobility information system” Mobil includes a map at all transit stops that has status information not only about all of the transit lines, but about pedestrian areas, bicycle paths and car parks.

In Vienna, the Wiener Modellregion's “e-mobility on demand” research project aims to integrate various e-mobility options – electric vehicles, the charging infrastructure, the optimal combination of types of transport and access to them by means of a multi-modal mobility ticket for users – into a new paradigm of intermodal urban mobility. These alternatives aim to extend mobility when walking, cycling or public transport is not practical. In May 2009 the City of Vienna launched its Intelligent Transport System with the goals of improving traffic management and providing regional travelers an accessible trip- or route-planning tool. More recently, as a next generation effort for ITS, the City of Vienna, with funding from the Climate and Energy Fund, released its project SMILE (Smart Mobility Information and ticketing system Leading the way for Effective e-mobility services). This personal mobility assistance app represents a prototype of a comprehensive multimodal mobility platform for all of Austria. Through the SMILE app on their smartphone, travelers will be able to view real-time travel alternatives for getting to their destinations, and can reserve and pay for their trips as well. SMILE is currently working with 20 vendors and providers ranging from local and long distance train operators to car sharing and taxi companies. The research project is in testing phases and will run until March 2015.¹⁴

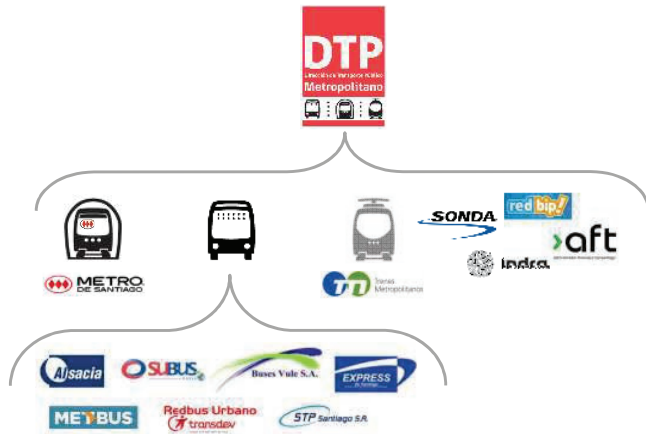
Institutional Integration

The combined mobility paradigm depends on close coordination among the providers of the different modes, and between public and private actors. Santiago offers a case study in how institutional integration was a necessary although not sufficient condition for creating a rational transit system. Transantiago emerged in reaction to the chaos that ensued after embracing the principle of “freedom to work,” which allowed private providers within the city to operate independently and without coordination. The system remains somewhat hindered by an incoherent, suboptimal pattern of urban development, the result of a fragmented governance structure in the city. However, when considering incremental, manageable steps an institution can take towards greater service integration, Transantiago is a success story.

¹³ Perrotta, Zupan, Barone et al, Transit Leadership Summit white paper, March 2013

¹⁴ Arthur D. Little 2014, 20

Figure 5: DTP organization chart.



Source: DTP.

Consolidation of administrative power would seem to be the antidote to the balkanization that handicaps coordinated transportation planning in many U.S. cities. In Singapore, coordinated planning of land use and transport is achieved not through administrative and legal consolidation of institutions and governance, but instead through the use of interagency committees that ensure the “integration of planning and implementation.” These committees serve to link various city functions and enable the city to manage a hierarchy of integrated short, medium and long term plans.

This model of close coordination and cooperation is one that other cities have followed to successfully expand regional mobility. Vienna has long enjoyed an integrated transport master-planning process that covers all modes plus parking policy, pedestrians, and cycling as well as safety.¹⁵ Vienna’s consensus-based, integrated planning relies heavily on the “Social Partnership,” a voluntary co-operation among employers, employees and the city to promote public transport access and parking policies that restrict car use in the city. At the core of shaping this process, starting in the late 1960s, was the Integrated Traffic Management Team, a group that included independent experts, academics and public officials who set out to perform key policy evaluation studies and help determine an integrated holistic plan for the Vienna urban area.

Successful institutional integration commonly operates at the regional level rather than being limited to the metropolitan. In Vienna, for example, the regional transit authority called VOR (Eastern Austria region) coordinates service and fares and distributes all subsidies based on local and regional policies. All of the stakeholders work together based on a regional master plan.

In Madrid, the transit authority CRTM is responsible for coordinating transit throughout the region, both private and public operators. CRTM is responsible for uniform fare collection across the modes, coordination and approval of service plans (timing of transfers, coverage, hours of operation, etc.), and central monitoring of all services. CRTM’s new operations center gives the agency an overview in real time of all of the modes, public and private, which allows it to adjust services between different providers during incidents, provide customers with real-time information, and use centralized data collection for

service analysis and planning. Coordination and integrated planning is facilitated by the CRTM board, made up of regional transit stakeholders, including municipalities, private and public operators, unions, consumer associations and the central government.

New Modes

Changing technology and changing attitudes are enabling an expanded range of modes for cities when they consider combined mobility. The still evolving list already includes taxis, car shares, short-term car rental, bicycles, bicycle shares, bicycles on transit and shuttle buses. Southern California Association of Governments even includes what they call “Casual Carpool,” where ride-sharing is coordinated on the spot at pre-designated locations, often near transit or dense places.

Rethinking the car

Perhaps most surprising is the degree to which the automobile, generally considered the antithesis of transit, is being reconsidered. TLS Participants agreed that the car will continue to be an important part of mobility planning, but in new ways. Park-and-ride facilities have always played a role in bringing riders to the system, although two of the cities at this summit, Singapore and Montreal, acknowledged difficulty making the park-and-ride model effective. For this reason, the design and integration of these facilities is getting increased attention. In Tokyo, the design and location of park-and-ride facilities is carefully considered. Tokyo’s prepaid IC card can be used not just for transfers and discounts between the metro and the feeder bus network, but for payments and discounts at parking facilities. The parking fee structure is carefully calibrated to different kinds of users. Some of this is being driven by technology, such as the emergence of compact electric vehicles of different kinds. Still at the frontier, but now taken seriously, are self-driving automobiles.

At the center of this movement is car sharing, in which users forego owning their own car and instead have access to a shared pool of vehicles, either as members of car clubs or as retail customers. In recent years, car sharing has expanded hugely, with operations in 27 countries across five continents, counting almost 1.8 million members and more than 43,550 vehicles, with near term expansion into seven additional countries around the world. This expansion is due to a softening in the demand for car ownership among affluent urban professionals who are increasingly cost- and environment-conscious. It is also spurred by the technological innovations that make transactions fast and easy. Car sharing recently has begun to integrate with public transit offerings to provide travelers a seamless door-to-door trip. The heightened accessibility and popularization of car sharing also has led to the development of alternative formats, most notably in personal vehicle sharing (also referred to as peer-to-peer car sharing), as well as station car programs—in which dedicated vehicles stand at transit stations for the express purpose of last mile mobility to riders’ final destinations—and vehicle and corporate innovations, for example, branding cars with third-party advertising. Similarly, car sharing fleets are an ideal platform for experimentation with specialized technologies

¹⁵ Siemens 2009, 33

such as electric-powered and autonomous self-driving cars. Car sharing organizations may be private, for-profit companies or they may organize as a nonprofit organization, a member-owned cooperative, a subsidiary of a transit agency, or an experimental or research based effort.¹⁶ An example of the next generation of car sharing formats would be the autonomous vehicle – e.g., BMW's DriveNow electric vehicles, and a test program in Australia between the University of New South Wales and car sharing company GoGet to build the first fleet of autonomous vehicles in the country. One element of the e-mobility project of Wiener Modellregion, described above, proposes the adoption of shared electric vehicles.

All of the successful car share arrangements rely on information technology to facilitate transactions.

- In Zurich, through the ZVV Annual Travelcard + Mobility, the Swiss rail operator offers travelers access to the car sharing company Mobility Switzerland's 2,600 vehicles in 435 locations across the country, 24 hours a day, seven days a week. For travelers who use a Mobility Switzerland vehicle more than three hours a week or 165 hours a year, an enhanced card allows savings over Mobility's standard hourly rate. Users can purchase a P+Rail Pass that enables them to pick up a car at any one of 550 P+Rail stations and then get on a train, or travel by bicycle to the station and leave it at a staffed cycle park.
- In Germany, holders of the Deutsche Bahn Card receive special incentives when they use Flinkster, their car-sharing service. DB both owns its own fleet and has agreements with private car-sharing companies to allow access to additional cars, an arrangement that is invisible to holders of the DB card. Flinkster has started rolling out electric cars at the same rate as conventional vehicles. Flinkster is also starting to experiment with tiny, folding electric vehicles to cover the final legs of trips: the "Hiriko" is more compact than a Smart Car, can be charged in 15 to 20 minutes, and, using an app, can be located instantly.

Figure 6: An Autolib Bluecar parked and charging on the streets of Paris.



Source: Francisco Gonzalez (flickr)

- Paris has launched Autolib' Bluecars, the car share equivalent of its successful bike share program Velib'. This program allows point-to-point car sharing of small electric vehicles. There are currently 33 stations, but by next year there will 1,120 rental and recharging stations for a fleet of 2,000 electric cars. The stations will have their own distinctive architecture.
- Madrid is in the process of concluding agreements with two private car sharing companies that will offer discounts to transit users.
- The Uber smart device application enables the traveler to arrange for a driver of almost any kind, from taxis to limousines to private drivers. Uber is now available in over 70 cities around the world.

A variety of configurations have emerged for the integration of car sharing with transit. In Brussels, Taxistop-Cambio (founded in 1975) is a nonprofit organization with the mission of advancing projects that "do more with less" by leveraging existing goods and means. It now encompasses functions such as its carpool service that facilitates individuals and businesses organizing the sharing of rides to work; Schoolpool, which provides the same service for pupils and their families; and, most relevantly, Cambio, a partnership with a German car sharing company to provide Taxistop customers access to their fleet.

Taking mobility integration still further, Dutch company Mobility Mixx expanded from a car sharing provider to a full-range mobility service provider, including rental cars, public transport reservations, park-and-ride, trip scheduling and payment. In addition, Mobility Mixx incorporated a package of business travel options; besides the car pool and train at the location, it offers access to Mobility Mixx OV-bicycle taxi, park-and-ride parking lots, rental cars, the electronic processing of mileage claims and the management of personal mobility budgets. Travel advice from door to door - via Internet and call center - allows employees to choose and combine.

¹⁶ Shaheen 2009, 37

Bike and ride

The bicycle is increasingly seen as mode of choice for first-mile/last mile connections. There has been a huge proliferation of bicycle sharing programs across the globe. In May 2011 there were around 375 schemes comprising 236,000 bicycles. As of April 2013 there were around 535 bike-sharing programs around the world, making up an estimated fleet of 517,000 bicycles, a doubling of bicycle sharing programs in two years. Madrid is in the process of instituting an electric bike rental program that will offer discounts to transit users. Singapore is in the process of developing entire “bicycle towns,” where bicycle mobility is an organizing principle. In some cities, bicycle transit has become so popular that automated structures are being built (see discussion below). In Vienna, for example, Citybike Wien has 111 bicycle stations holding 1,300 bicycles around the city. Vienna’s Transport Master Plan notes that cycling has shifted from a “purely leisure and sporting activity to an everyday mode of transport. It is an alternative to motorized forms of transport, particularly in densely built-up urban areas for journeys of up to 5 km.”¹⁷ In Singapore, the Transport Plan promotes intra-town cycling by connecting cyclists from their homes to major transport hubs, such as MRT stations and bus interchanges, where they can continue their journeys on public transport.

As with the car sharing programs described above, bike sharing increasingly is seen as an essential aspect of combined mobility, and transit providers are creating the same kinds of cooperative arrangements as they have with car sharing initiatives. In Wallonia (Belgium), C-TEC folding bicycles are offered as part of a combined season ticket from the public transport operator TEC to expand the catchment area for bus service. Wuppertal (Germany) is host to Mo-bility, an innovative joint project of three organizations: the design firm LUNAR Europe, the environmental organization Green City e.V., and the University of Wuppertal. Mo subscribers can rent bicycles, cargo bicycles, e-bikes and cars or use public transportation with just one card. With the “mobikes,” users earn “momiles” that can be redeemed against the cost of transit and car rental. The more “momiles,” the lower the bill. For instance, if you ride bicycles, renting a car gets less expensive.

Paris, the fashion capital of the world, in the summer of 2007 introduced its “latest must-have accessory in the French capital”:¹⁸ a bicycle sharing system called Velib’—*velo* (bicycle) and *liberté* (liberty)—which rocketed to instant status-symbol. By January of 2014, Velib’ served as a global model for countless cities who had aspiring and nascent bicycle sharing systems of their own, and urban mobility experts hailed it as the third best in the world behind Wuhan and Brussels.¹⁹

Velib’ is the result of a ten-year, public-private partnership agreement between the City of Paris and advertising giant JCDecaux. The company took responsibility for providing the bicycles and building the stations, and also pays the city a fee of about \$4.3 million per year; in addition, the city receives all revenue collected from the program. In exchange, Paris gave JCDecaux exclusive control over 1,628 city-owned billboards.

The program set bicycle usage fees and annual membership prices very low to encourage initial adoption and use of the bicycles as a public transit alternative; today, a one-day ticket costs only 1.70 euro (or 2.19 dollars). Then Mayor of Paris Bertrand Delanoë reported his main motivation was to reduce traffic and pollution, and a spokesman explained, “We think it could change Paris’ image – make it quieter, less polluted, with a nicer atmosphere, a better way of life.”²⁰ Today Velib’ boasts it is the world’s largest bike sharing program. It has over 20,000 bicycles available 24 hours per day in 1,800 stations spread about every 300 meters (328 yards) around the city.

Combined mobility can be accomplished also by linking bicycles and cars. If downtowns are configured effectively for cycling and a city can offer strategically-located parking with a calculated fee structure, then it might have a formula for reducing downtown car traffic. The city of Calgary used exactly this approach, providing free parking about five miles from downtown, along a bicycle trail leading into the downtown.

Finally, when evaluating the feasibility of combined mobility strategies, it is important to consider the physical space required on line-haul vehicles for transporting alternative vehicles. More attention is being paid to bicycle racks on buses, both in terms of their capacity and ease of use. Light rail vehicles in Portland and elsewhere provide hangers for bicycles inside the cars. In more ambitious examples like the GO Train Bike Car in Niagara Falls, Ontario, entire rail carriages are dedicated for bicycle transport. In the U.K., on some tram lines, bicycle trailers are hitched to the back of the light rail vehicles.

Figure 7: New York City bike share docking station.



Source: Citibike.

Taxi as transit

Though taxis are a form of transportation, traditionally they have not been considered a mode of transit. The utility of on-demand service is outweighed by higher cost and the uncertainty of availability in more sparsely populated places. Combined mobility, however, makes taxi service more affordable for the user by promoting shared taxis, and makes taxi service more efficient for the provider by using information technology to rationalize trip requests. This rationalization may start out informally and then, by degrees, become more of a standardized approach. For example, in Santiago, shared taxis contribute to mobility by working certain routes at certain frequencies in a framework regulated by the city. The vehicles have distinctive signage and

¹⁷ Vienna 2003, 24

¹⁸ Kate Betts, TIME, October 1, 2007

¹⁹ Arthur D. Little, 17

²⁰ John Ward Anderson, Washington Post, March 24, 2007

travel between set destinations at each end of a route. Along the way, passengers may board or disembark at will. The transit authority coordinates with the agency that licenses the cabs, and the pickup and drop-off locations are often at metro stops or bus stops. At present, direct integration in terms of schedules, payment or information sharing by way of maps or online schedules does not exist, but this is easy to envision as a next step.

One of the best examples of taxi-as-transit comes from the Brussels region. Public transport operator STIB collaborated with a private taxi company, Taxis Verts, to create Collecto, a demand-responsive transport service offered at an affordable flat rate. Users request taxi service by phone from among 210 office pickup points to any destination in Brussels. Collecto departure points usually correspond with the STIB stops, which are marked with the Collecto logo. In other cases, the collection point just requires space for signage, indicating the logo and a waiting area for users. This point usually can be accommodated on street sidewalks or along the edge of pedestrian plazas, for example. The STIB-Taxis Verts public-private collaboration also worked to redesign the Brussels night bus service through optimizing schedules and enhancing cost efficiency of existing night bus lines.

Another prime example of taxi transit is Vienna's development of the ASTAX (Anruf sammeln) system, which was started in 1999 as a pilot project and currently runs seven routes in the city. ASTAX taxis use public bus stops marked with an additional ASTAX logo sticker, and the taxis drive like the bus, from stop to stop. However the ASTAX taxis serve areas of little demand – less densely populated areas—and riders call for the taxi by phone in advance to cover their trip. Public transit operator Wiener Linien contracted this service out to a private operator that is able, when feasible, to match requests and facilitate a many-to-one routing, while still recognizing passengers' needs for a seamless trip. Two years ago, Wiener Linien replaced a major night bus line with the ASTAX in order to avoid empty or nearly empty buses circulating through residential areas. Because the ASTAX drives only when it is called, it has reduced line operating costs and thus increased the mobility needs of the Viennese in-line network in a highly efficient fashion.

Figure 8: An example of taxi-as-transit in Brussels. Collecto operates seven days a week for 23 hours and covers the entire Region of Brussels-Capital.



Source: stib-mivb.be

New Spaces

The picture that emerges from these many combined mobility approaches is one of a multiplicity of fine-grained and dispersed connections among modes taking place across the region. However, the connection to the core network remains paramount in urban mobility, and so it is still within the larger central station areas that the best practices in station area design and the combined mobility paradigm intersect. The success of this station redevelopment strategy centers on making these intermodal connections as seamless as possible—overcoming the “disutility of transfers.”²¹ Beyond coordinated schedules and fare collection, physical space has to be provided for the vehicles, and—just as important—designed so as to make each transfer a convenient and pleasant part of the overall trip.

In Madrid, intermodal connections are a major design consideration, and over the last decade the city has engaged in a large-scale effort to rebuild outmoded stations to improve transfers, at times even realigning rights-of-way to make the connections. Whenever possible, transit is brought closer to grade, where it is easier for riders to get their bearings. To further facilitate easy transfers, new stations stack intersecting services vertically and typically perpendicular to one another. In Vienna, where most metro stations already have connections to multiple tram and bus routes, bright, often natural light combines with well-designed, colorful wayfinding signage to facilitate movement through and around the station. Well-designed public spaces are the heart of Madrid's and Vienna's new station areas, creating the space for passengers to move pleasantly between modes and to stay oriented. In both cities, several large, at-grade pedestrian plazas support dense development around the central station, further extending and integrating the travel experience into the urban fabric.

These anecdotes comport with a familiar and broadly accepted set of best-practice design and planning strategies, often collected under the banner of Transit Oriented Development. In the lower density environments where combined mobility strategies are filling the accessibility gap, some TOD practices are less in play, for example, that the station area should accommodate a diverse range of activities, including civic uses; or that development should favor uses that support transit ridership, particularly higher density residential uses. However, many TOD best practices apply regardless of the surrounding land-use mixes and densities. For example, it is always essential to create good pedestrian and bicycle connections from the station to the surrounding area to capture as many riders as possible, and to leverage the land development benefits of transit access.

Effective points of intermodal activity balance competing needs for space and access among modes – connecting transit services, taxis, car parking – but also favor pedestrians and bicycle connections to the surrounding neighborhoods. Singapore transit stations designate ample space for bus transfers and for taxi lines, ensuring that these functions do not prohibit traffic flow and movement of the other modes present. At the Bukit Panjang node, for example, the bus interchange takes place as part of an intermodal complex that includes metro and light rail stations as

21 Interview, Robert Cervero

well as car parking, bike parking and taxi pickup and drop-off. The intermodal facility is the base of a larger mixed-use development that includes residential towers.

Several Madrid stations demonstrate the role that well designed public spaces at the point of transfer play, not only creating the physical space needed, but orienting travelers and creating an identity for the station area. The public spaces are well appointed in terms of materials, landscaping, lighting and directional signage, and maximize passive surveillance with uninterrupted sight lines through the space. The Moncloa interchange is a good example. With a direct connection to a Bus/HOV lane on the A-6 highway corridor, it brings together two metro lines and 20 suburban bus routes. In terms of urban design, it also integrates the design of the Plaza del Arco de la Victoria above.²² Vienna, likewise, has invested a great deal in the design of maps and way-finding signage, as well as real-time information displays to provide orientation, especially as one moves between modes.

Room for the Car

Because driving continues to represent the primary method for getting from home to transit, parking is an essential aspect of successful station design. Many of the combined mobility strategies discussed here create the opportunity to reduce the total amount of land devoted to the automobile, because they substitute other modes for trips that traditionally were made by car. In addition, smaller vehicles help relieve some of the pressure on finding space. The Hiriko electric vehicle has set the bar in this arena because of its groundbreaking capability to fold up into a very compact configuration. But even as cars get more compact and combined mobility takes hold, there remains ongoing need, especially in the less central areas where combined mobility is most in play, to provide parking for rental cars and car sharing services. This necessity presents a design challenge in providing parking close enough to the station to facilitate smooth transfers, without allowing the parking to dominate and deaden the station area.

Figure 9: This model of the Hiriko electric car is capable of folding into a more compact form, runs off a 20 horsepower electric motor, and can reach a maximum speed of 50 kph (31 mph).



Source: designboom.com.

In many places, parking will have to be in surface lots. But well established strategies exist for managing and designing these lots in ways that do not impede mobility of pedestrians or the creation of inviting spaces. In terms of location, lots should not be sited along the edges of important connecting corridors or public spaces, but should be placed behind the buildings defining these public spaces. Lots should be broken up into sections to avoid a large and undifferentiated sea of parking. In terms of aesthetics, surface lots can be made attractive through careful selection of materials, landscaping and lighting; well-defined pedestrian paths make walking to the station or other modes clear and safe. To facilitate intermodal connections, dedicated spaces for rental cars or car shares should reside in the most visible and easy to access parts of parking lots.

Where economically feasible, parking structures, especially automated facilities, can be a very space efficient way to house large numbers of vehicles. Parking structures can be exciting pieces of architecture and can incorporate mixed use buildings, thereby contributing to the character of the station area. Regardless of how ambitious the building is, if structured parking is provided, the ground floor should be lined with pedestrian oriented activities that relate to those outside, and as with surface parking lots, the dedicated spaces for rental cars or car shares should be in the most visible and easy to access locations. In Vienna, large park-and-ride garages stand at several outlying metro stations (mostly terminals), and they are designed with good connections to the platforms.

Figure 10: Santa Monica, California Civic Center parking garage is the first LEED-certified parking structure in the world.



Source: John McStravick (flickr)

It is not as difficult to make space for “demand responsive” services such as taxi services or some of the more flexible “concierge” models for car sharing. Even so, taxis compete for space where they wait, and their movements through the station area need to be carefully designed so as not to interfere with pedestrians, bicyclists and buses. Vienna has several car sharing services, and some reserve curb space around stations next to the taxi stands. In Hannover, shared parking is either integrated within the existing large parking lots or assigned dedicated street parking spots. In other cases, parking space is allocated to accommodate 10 to 15 cars. In existing parking lots, few spots are reserved for these cars.

²² Madrid, A World Reference, Consorcio Transporta Madrid, November 2013

Room for the Bike

Bicycles may be low impact, but as biking achieves scale as a transit mode, cities need to account for the spatial demands of bicycle infrastructure: bicycle share stations, bicycle parking facilities and bicycle lanes all compete for space in the transit landscape. Bicycle facilities, especially in some very dense urban environments, may not be stand-alone facilities, instead built into buildings within the station area or within the stations themselves. In Vienna, for example, S-bahn stations have bicycle parking of various kinds, many with bicycle share stations. The new multi-modal central station in Vienna will have underground bicycle parking with spaces for over 1,000 bicycles.

Figure 11: Located in the Netherlands, the Bicycle Apple is a bike parking structure that can hold up to 970 bikes at a time.



Source: ecologicalurbanliving.blogspot.com.

In the Netherlands, where an estimated 27 percent of daily trips are made on bicycle, the outsized success of biking has gotten a lot of attention because of the overcrowded conditions at bicycle parking stations. The crowding exists despite generous provision of facilities: vast bicycle parking structures sit outside of or underneath Dutch railway stations in the major cities. In fact, parking is so readily available that many riders keep a bicycle at their origin and destination stations. In some areas, bicycle use has become so intense that cities have devised ambitious dedicated-structure parking solutions. Outside of Amsterdam's Central Station, a three-story structure holds about 9,000 bicycles, and in Groningen, a massive, covered and guarded facility holds 4,500 bicycles. In Tokyo, the Kasai Station houses a series of underground parking structures, capable of housing up to 9,000 bicycles that can be quickly retrieved through an automated system. In Zaragoza and several other Spanish cities, the "Biceberg" pavilion stores up to 92 bicycles in the space that four cars would take up.

Figure 12: "Biceberg" bike storage in Spain.



Source: Handig, December 2012.

Biking facilities need to be secure, protected from the weather and able to accommodate different user needs. The combined mobility objective presents several urban design considerations: from the connecting mode, bicycle facilities should be either visible by direct line-of-sight, or easy to find because of well-designed signage. They should also be an attractive and integral part of the overall design of the place, contributing to the overall liveliness of the urban space and benefiting from the passive security and visibility that result from successful place-making. Adequate space around racks, and routes that provide cyclists room to maneuver but that prevent conflicts with pedestrians or parked cars also contribute to successful facilities. Racks should not block access to building entrances or fire hydrants. Charging stations should be provided for electric or battery assisted bicycles.

Particularly successful programs to accommodate bicycling as a transit mode go a step beyond merely creating the space to park bicycles. Many cities have begun to also incorporate supporting services, including maintenance and repair, sales and education. "Radstation" in Münster (Germany) provides a bikewash. In the U.S., a company called Bikestation has developed "bike transit centers" in California and Washington, D.C. where cyclists not only get secure parking, but air for tires, Wi-Fi, showers and trip-planning information. Employers who provide a place to shower, change and store clothes can encourage bicycle commuting, and these facilities can also be used by those who are not necessarily bicycle commuters, but who want to exercise during the day. Where it is not possible for employers to provide these amenities in their own buildings, cooperative arrangements can be made with nearby facilities. Employers and other destinations should provide those amenities, as well as electric power supply to recharge bicycle batteries.

Figure 13: Radstation in Münster.



Source: Jens-Olaf Walter (flickr)

From “intermodal transit facilities” to “active mobility districts”

The idea of a single facility where the full range of intermodal transfers takes place seamlessly and under one roof is compelling, and in the densest urban environments, the high cost and low supply of land can encourage such functional solutions. Where conditions are less optimal, however, the “mobility district” represents an alternative design model. In the mobility district, the various modes are not within one structure, but rather constitute a single relatively compact and walkable neighborhood. In this model, the movement between modes is itself a part of the urban experience, and the development of an activated and attractive district centered around transit becomes a form of urban regeneration.

The mobility district concept has several advantages: it can be less expensive and more straightforward to plan and build than a single structure; it can be implemented incrementally in response to market forces; and, because of its smaller scale, it can be calibrated to the existing context rather than imposing itself onto and dominating the surrounding fabric.

Denver’s Union Station redevelopment project, now under construction, is based on this same approach. A series of urban spaces connect a variety of transit modes to a new neighborhood hosting eight tracks of commuter rail (with room for expansion), Amtrak corridor, a three-track corridor for light rail transit, and a 22-bay regional bus facility (16 regional, four downtown circulator, two commercial buses), in addition to bicycle share and car share facilities. The new neighborhood comprises an easily navigated grid of streets and blocks. The different transit services are separate, but all within walking distance by way of the grid, interspersed public spaces and an underground concourse providing access to the bus bays. The mobility district design focuses not just on getting to and from this neighborhood, but equally on the act of moving through it.

Figure 14: Union Station Redevelopment project in Denver, Colorado, which will connect local trains, bus, light rail, Amtrak, B-cycle, and future commuter rail.



Source: Parsons Brinckerhoff Place-Making Group, California High Speed Rail Authority; denverunionstation.org.

Financial Implications

For a transit provider, quantifying the net financial costs and benefits of a capital project is not a trivial exercise. With combined mobility strategies, the same valuation challenges apply. While the cost side of the equation can be broadly obvious—it will be less resource intensive to implement combined mobility than to build more fixed guideways—the benefit side of the equation is more complex. One might measure increased ridership and fare box revenue that results from bringing more people to the system, although as the findings from this summit suggest, fare box recovery is itself a complex metric which does not necessarily internalize a wide variety of hidden costs or subsidies. Beyond that, many of the benefits that combined mobility sets out to generate are indirect and difficult to measure. Participants at this summit suggested that social media could be used more to understand how riders value expanded mobility options.

Ideally, when cities are making a comprehensive analysis of their transport investment alternatives, they find ways to monetize the following outcomes of investment in more sustainable mobility:²³

- Improved safety and security
- Reduced air and noise pollution, greenhouse gas emissions and energy consumption
- Improved efficiency and cost-effectiveness of the transportation of persons and goods
- Contributions to enhancing the attractiveness and quality of the urban environment and urban design

If traditional economic evaluation tends to undervalue non-motorized transport benefits, a more comprehensive evaluation of these positive impacts would result in greater investment

²³ Eltis, a research organization

in these modes: “Many planning decisions affect walking and cycling decisions, and therefore the amount of active travel that occurs in a community. To the degree that a planning process undervalues active transport it will underinvest in these modes, reducing overall transport system diversity and efficiency.”²⁴ This is supported by the European Commission’s findings that most of the external costs of transport are not internalized, and the methodologies are consistent among member states.²⁵

While this suggests a strong case for combined mobility, at the moment there is little research that examines specifically the net impacts of one type of strategy compared to another.

Nevertheless, interest in quantifying the benefits of combined mobility and in capturing these planning objectives in transport investment analysis has grown in tandem with the popularity of these new approaches. In 2003, the U.K. Treasury adopted measures to appraise and evaluate projects that establish a much wider concept of measured benefits, namely that they incorporate economic, environmental, social and distributional parameters, along with the more conventional focus on reductions in travel time. They found outsized cost-benefit ratios for investments related to biking and walking.²⁶ The U.K. studies show that within transport, investment in walking and cycling are likely to provide low cost, high-value options for many local communities. Their study underscores how much value had been missed by traditional evaluation metrics.

The City of Vienna considers the collateral benefits of the investments in its world class cycling network and justifies its investments in those terms:²⁷

- Safe and comfortable cycling infrastructure enables young and elderly people to be mobile by using a healthy and environmentally friendly mode of transport.
- Cycling comes at much lower costs to society than individual motorized transport, largely due to reduced costs for healthcare and externalized factors such as pollution, noise and congestion.
- Integral cost calculations - including the health, environmental, social and economic costs and benefits - show a high return on investment for cycling infrastructure.

Madrid, similarly, is undertaking intermodal station improvements with the expectation of a return on investment that more fully incorporates planning objectives.

Scholars have endeavored to monetize cities’ combined mobility investments in somewhat of a piecemeal fashion, but results are solidly positive. Kjartan Sælensminde at Oslo’s Institute of Transport Economics presents cost-benefit analyses of non-motorized transport investments in three Norwegian cities, and estimates that the benefits of investments in cycle networks outweigh the costs by a magnitude of four to five times.

A number of other similar studies, such as one from the U.K.,²⁸ find an integrated program that increases walking in British towns provides benefits worth £2.59 for each £1.00 spent, considering just reduced mortality.²⁹ Including other benefits (reduced morbidity, congestion and pollution) would increase this value. Another study³⁰ estimated that in Portland, Oregon, investments in bicycle facilities over 40 years in the range of \$138 million to \$605 million will provide healthcare savings in the range of \$388 million to \$594 million, \$143 million to \$218 million in fuel savings, and \$7 billion to \$12 billion in longevity value, resulting in positive net benefits.³¹ This suggests that in North America, basic mobility is worth at least 30 cents per passenger-mile to society.³²

A study conducted hedonic price method testing to determine whether a market premium exists for real estate within pedestrian- and transit designed development, and found that people indeed are willing to pay for this way of life.³³ This finding suggests that transit providers should be able to capture the induced increases in real estate value from combined mobility.

In a similar vein, the City of Copenhagen’s Bicycle Strategy 2011-2025 compares the total costs of different kinds of trips: taking a bicycle trip results in a societal gain of €0.49 (63 cents), while a using a car for the same trip results in a societal net loss of €0.89 (\$1.14). The firm also finds annual health benefits of cycling in Copenhagen to be €228 million (\$293 million).

Pedestrian improvements have similar outcomes: one meta analysis of studies³⁴ finds net benefits to these investments, including two U.K. studies that take a comparative approach to other transport infrastructure. The return on investment in the walking environment is likely as high as and even higher than investments in other transport projects. As comparative research in this vein develops and includes larger sample sizes, certainty will develop surrounding results, but early research appears to support combined mobility as a sound financial investment choice for cities.

As far as the question of whether combined mobility has any implications for “value capture,” the research and discussion at the Transit Leadership Summit include the fact that points of intermodal connection create value. But as the research into value capture illustrates, these impacts may be difficult to quantify.³⁵ Location-based value capture makes sense when it is clear that transit will improve an area that is well-defined. Value capture is difficult to implement because it is difficult to separate the pure value of location from the value that is created by the efforts of the developer or property owner. It is also hard to disentangle the value added by one piece of infrastructure, such as a transit line, from the value of other intrinsic elements of a location. These challenges to implementing value capture are exacerbated when applied to the combined mobility paradigm, which by definition is about extending the benefits of transit access into a larger and less defined geography that may even change by time of day.

²⁸ Cavill, Cope and Kennedy 2009

²⁹ Litman 2013

³⁰ Gotschi 2011

³¹ Litman 2013, 22

³² Ibid.

³³ Ewing and Bartholomew 2011

³⁴ “Making the Case for Investment in the Walking Environment: A Review Of The Evidence” 2011

³⁵ See in this volume “Location ‘Value Capture’ For Urban Public Transport Finance” by Deborah Salo

²⁴ Litman 2013, 4

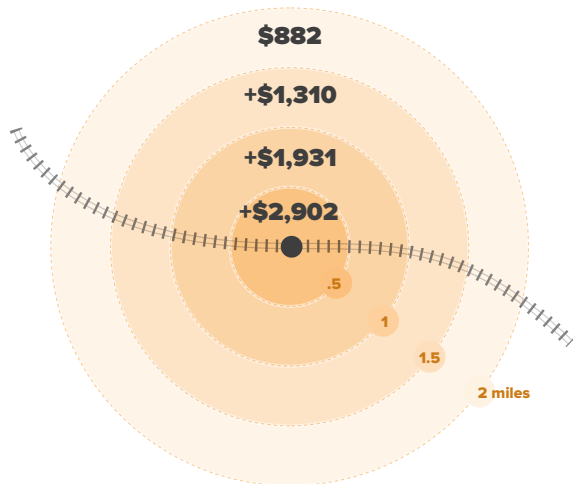
²⁵ Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system, European Commission staff working paper, 2011

²⁶ Davis 2010, 2

²⁷ Vienna 2013, 2

If it is difficult to quantify the sphere of influence of a transit investment even when talking about conventional fixed-guideway improvements, it will be even more difficult when talking about the kinds of flexible and multifaceted improvements that are the hallmark of combined mobility, even though these initiatives clearly create added property value.

Image 15: Value of time saved in travel.



Source: Regional Plan Association.

Conclusions

Combined mobility has an important role to play in extending mobility to larger geographies, and in providing more choice for more people. But it is important to note that early anecdotal evidence suggests that purchasers of “mobility packages” tend to be younger, well-educated and environmentally conscious urban workers for whom car ownership does not have high emotional value. That is a challenge to the equity objective of reaching less well-off populations in places that are poorly connected to the rest of the metropolis.

Institutional integration is essential

By definition, combined mobility depends on cooperation among the providers of the different modes. Close communication enables comprehensive planning, as in Vienna, so that capital investments can be prioritized and reinforce shared objectives rather than creating unwanted competition. Part of Transantiago’s agenda in managing their bus network is to insure that competing routes do not cannibalize one another. The efficiency and efficacy of the combined network depends on coordinated service plans. And unified fare collection, one of the central components of all combined mobility programs, depends on an integrated approach. Unified fare collection also creates the ability to incentivize ridership across the network by differential pricing.

While institutional integration is essential, the case of Singapore illustrates that it is not necessary to create a single consolidated entity, but rather, close coordination through inter-agency committees. Vienna’s integrated transport planning process covers all modes and relies heavily on its consensus-based “social partnership” –voluntary cooperation among employers, employees and the city to promote public transport access and parking policies that restrict car use in the city. In the U.S., where resistance to centralized planning is so entrenched, this kind of “civic infrastructure” may provide the way toward more coordinated planning.

The Madrid Consorcio suggests several threshold questions which should be considered when talking about regional integration of transport services: What modes should the authority take responsibility for? Over what geography? Over which infrastructure elements? And what responsibilities should the authority take on regarding complementary policies and investments that may not be part of their core competence?

Design matters

Best-practice design strategies from conventional Transit Oriented Development experience apply for the places where the new expanded range of intermodal transfers take place. Mitigating the “disutility of the transfer” depends on making the connection experience as comfortable and as seamless as possible. The Madrid and Vienna case studies illustrate the importance of design: aligning connecting services; making the transfers as close to the surface as possible for easier orientation; appointing the intermodal facilities with attractive materials that reinforce the identity of different spaces; and clear wayfinding signage and lighting. These same strategies apply in Singapore, which is a leader in building compact facilities that bring together multiple modes.

Flexibility will be needed

The experiences with combined mobility described above demonstrate the speed with which the transit landscape is changing. In this context, it is important for transit providers to be flexible. In part, this concerns the fare collection and communications technology: hardware components should be modular and enable the ready switching in and out of new components. Even more important, despite the fact that off-the-shelf technology is attractive, transit providers should be cautious about proprietary arrangements, which can inhibit flexibility and innovation.³⁶ As important, flexibility will be needed in the design of the station areas and the points of transfer. Best-practice station area design should anticipate that more space will be needed for car sharing, bicycle sharing, taxis and other connecting services.

³⁶ Perrotta, Zupan, Barone et al, TLS white paper, March 2013

Density and land use still matter

Combined mobility does increase the reach of transit systems into less dense places. But it is still true that “integrated mobility services” work best where there are agglomerations of activity and transit options; in other words, the implementation of integrated mobility is not immune from the density/transit paradigm. Even in cities such as Vienna that have comprehensive and multi-modal approaches to transit, the options for combined mobility are more robust where concentrations of employment and housing are greatest. And in Tokyo and Singapore, closely managing land uses and densities at transit stops has enabled line-haul networks to be extended.

Defining combined mobility

Combined mobility is a broad term for a relatively new, evolving and disparate set of practices. This paper describes many of the new modes and practices that seem to fall under this new term, as well as the changing spatial requirements for these new modes. But itemizing the characteristics of combined mobility is not the same thing as having a definition that is accepted across the industry; simply putting bike racks on buses is not the same thing as integrating fares and providing real-time information sharing so that new kinds of multi-modal trips are enabled. The reason this is important is because it will be difficult to agree upon and then to evaluate policies and investments if there is not a shared set of objectives and performance standards that would be part of this definition.

Implementing combined mobility

Private sector actors have overwhelmingly been responsible for developing the new modes discussed in this paper, particularly as regards bicycle sharing and car sharing, as well as rethinking taxi services as an accessible mode of transit. Even information platforms have been privately developed once public data became available. In most cases, the public sector has been as much the responder as the instigator of combined mobility innovations.

That said, the transit provider has the essential role in coordinating all of these efforts into an integrated network designed to serve the public interest. And it is the transit provider who has the resources to leverage these kinds of initiatives. For example, the transit provider can use its considerable purchasing power to incentivize cooperative agreements with other providers, initiate pilot demonstration projects and to insist on design excellence for intermodal facilities. The transit provider can support collateral investments and initiatives such as pedestrian and bike improvements, traffic-calming, and parking policies that discourage auto use.

The transit provider can also eliminate regulatory and operational barriers to experimentation, and can share data with other mobility entrepreneurs. The public transit provider is the only entity that can act as the convener for the disparate providers of alternative modes.

Finally, one of the striking aspects of the combined mobility phenomenon is the large role that changing attitudes have played in its acceptance. For example, car ownership, long considered an essential part of every lifestyle, even among city dwellers, is now seen by many as a discretionary investment. Users are willing to share access. Increased awareness of the environmental impacts of the automobile, as well as an increased appreciation of the health benefits of walking and biking, has also helped fuel this movement. The transit provider has an important role to play here in marketing and awareness campaigns, and in disseminating information about best practices.