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POLICY PAPER

Key considerations for integrated multi-modal transport planning

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CONTENTS

LIST OF CASE STUDIES

Introduction

From an environmental and financial sustainability perspective, a focus on car based transport for urban transportation is no longer feasible or desirable. Therefore, many cities are now looking to promoting public and non-motorised forms of transport as alternatives. To incentivise a modal switch, these alternative services have to be affordable, efficient and attractive, in terms of their quality. Integrated multimodal transport planning, which takes an approach to planning that incorporates both motorised and non-motorised transport as well as private and public systems, is one way to move towards this. These types of plans, take into account the whole city system and run in contrast to the traditional focus on the private vehicle. When these plans are well-designed and implemented, therefore, they become a potential way for cities to improve passengers' mobility across the transportation network and therefore connectivity in a city overall.

From an environmental and financial sustainability perspective, a focus on car based transport for urban transportation is no longer feasible or desirable

To understand why this is the case, this paper will start by outlining the limits of city transport policies and planning focused on road and car based infrastructure. It will then outline the main components of integrated multi modal transport plans. This type of planning is increasingly being adopted and to understand why, this paper will outline the potential benefits of such plans if they are well implemented. It will then focus on some of the components of how integrated multimodal transport planning needs to occur, including considerations on modal choice as well as integrating public transport with existing, often informal, private transportation sector. The final part of the paper will conclude with a summary the key success factors that need to be in place to realise the benefits of integrated multi modal transport planning.

Integrated multimodal transport planning

Limitations of transport planning focused on private vehicles

City transport policy across the globe has traditionally been more focused on private transportation, although city transportation planning has usually included some forms of public transportation. This has been as a result of a variety of causes, including economic growth and societal preferences that have, in many cases, translated into a political environment favouring car ownership[1]. This has resulted in a high level of resources for transportation being directed towards roads, flyovers, and other infrastructure targeted at private transport.

In many developing and middle income cities, the area of urban road coverage still needs to increase, as this is still below the efficient level for connectivity[2]. Evidence from Indian cities, for example, shows that poor road networks are responsible for most of the traffic[3]. However, at the same time, the limits of car-based transport have been reached in many other cities, for three major reasons:

— Cars are low capacity vehicles and therefore can only transport a relatively limited number of people at any given time, compared to other transport options, on the same amount of space. As such, transporting a given number of commuters by car is likely to result in significantly higher levels of congestion than by higher capacity vehicles.

— Evidence shows that the more road space is provided, the more cars will drive on those roads[4]. This is exacerbated by population and income growth , which lead to the overall increase in the number of cars. As such, though volumes of vehicles on roads can increase with road building, building roads cannot solve a city's congestion problem.

The more road space is provided, the more cars will drive on those roads. This is exacerbated by population and income growth

1 Jones, P. (2014) "The evolution of urban mobility: The interplay of academic and policy perspectives." *IATSS Research* Vol 38:1, pp. 7-13

2 Collier, P., Glaeser, E., Venables, T., Manwaring, P. and Blake, M. (2018) *Accessing Opportunities: Policy decision for enhancing urban mobility.* London: International Growth Centre.

3 Prottoy A. et al. (2017). *Accessibility and Mobility in Urban India*. Washington D.C.: World Bank.

4 Duranton, G. and Turner, M. (2011) "The Fundamental Law of Road Congestion." *American Economic Review* Vol 101:6, pp 2616-26512.

— Cars are reliant on fossil fuels. Therefore, as car ownership increases air pollution does as well. As Box 1[5] shows, single occupancy vehicles are right at the bottom of the overall green transport hierarchy. With climate change and the need to reduce fossil fuel consumption, more environmentally friendly modes of transport are required.

BOX 1: GREEN TRANSPORTATION HIERARCHY (FROM MOST TO LEAST GREEN TRANSPORT OPTION):

1. Pedestrians
2. Bicycles
3. Public transportation
4. Service and freight vehicles
5. Taxis
6. Multiple occupancy vehicles (e.g. carpooling)
7. Single occupancy vehicles

Source: Littman (2017)

Realms of integration

To overcome the challenges that arise as a result of disjointed planning, many countries have moved towards integrated transport planning across multiple different modes. Integration can occur to different degrees across four realms, as defined by the literature[6]:

— **Physical**: This usually refers to smaller hard-infrastructure integration, which allows for easy access and interchanges between different modes of transport, such as building stations that service multiple types of transport. Experience from different cities has shown that this is usually the easiest type of integration to undertake.

— **Network:** This refers to the larger hard-infrastructure investments that need to take place to ensure integration across modes of transport, such as rail and bus systems. It also includes aspects such as building or dedicating roads for feeder services for trunk routes and is therefore closely related to physical integration. It is usually the most expensive form of integration.

— **Operational**: This can include a number of different soft-infrastructure aspects, including routing alignment, aligning timetabling, ticketing and fares, and providing information to consumers on links between modes. All of these facilitate transfers between different modes of transport. This

5 Littman, T. (2017) Introduction to Multi-Modal Transportation Planning: Principles and Practices. Victoria: Victoria Transport Policy Institute.
6 Luk, J. and Olszewski, P. (2003) "Integrated public transport in Singapore and Hong Kong." *Road and Transport Research* 12:4

is a more complex form of integration but has been greatly facilitated by various technological innovations.

— **Institutional:** Perhaps the one of the most difficult forms of integration, based on different cities' experiences, is at the policy and institutional level. This includes coordination between or even merging different agencies responsible for transport at various levels of government as well as private providers. This also includes coordination between institutions responsible for transport and land-use planning. This type of integration usually takes the longest to achieve.

To be truly effective motorised transportation plans need to extend deeper to include non-motorised transportation and both the formal and informal private sector transport providers

Usually integration occurs between formal means of motorised transportation under the remit of government to regulate. However, to be truly effective these plans need to extend deeper to include non-motorised transportation and both the formal and informal private sector transport providers, which may be more complex to coordinate.

CASE STUDY: SINGAPORE'S SUCCESS WITH INTEGRATED MULTIMODAL TRANSPORT PLANNING[7]

Singapore has a long history of both planning and implementing integrated multimodal transport plans, starting with the 1996 Land Transport Plan. Singapore, which already has a high modal share of public transit use, has ambitions to increase it to at least 75%. These increases are happening; for example, in 2008 the modal share of public transport, for motorised transport trips, was 59%, and this proportion has increased to 67% by 2018[8]. This increase reflects the benefits that have been achieved through further integration of the system over time, including:

— **Physical**: Policies help integrate both transport and land-use planning. For example, one policy stipulates that all transit stations for the mass rapid transit system (MRT) have to be integrated with new commercial developments and be connected with at least one other transport mode. Furthermore, the stations have to be equipped with walkways and elevators so that they are accessible to the less physically abled population.

— **Network**: In addition to the MRT, Singapore also has a light rail train (LRT) system. Both these systems are integrated with the bus network, which provides the overall foundation of the transport system. Already in 2003, 90% of the population lived within 300m of a bus stop, which meant that through this they were also able to access the mass rapid transit system.

7 Ibid 6
8 TODAY (01 March 2018): "Proportion of peak hour trips made on public transport have gone up." Accessed from https://www.todayonline.com/singapore/proportion-peak-hour-trips-made-public-transport-have-gone on 02 November 2018

— **Operational**: A single fare card was first introduced in the 1990s and this allowed passengers to use both bus and rail. In 2002, this was upgraded to a so-called EZ card which can be used on all forms of public transport. Furthermore, in 1989, the government created a company called TransitLink that is tasked with coordinating information on routes, timetables and interchanges across all modes of transport.

— **Institutional**: Following TransitLink, the government then created the Land Transport Authority which is both the planning and regulatory agency covering both public and private transport. Even in Singapore institutional integration is incomplete with multiple bus and rail operators, which is managed by geographically separating their sphere of operation. Furthermore, it has its benefits as it keeps competition within the system.

Potential benefits of integration

If integrated multimodal transport plans are well-designed and implemented, then they should improve connectivity in a city overall. Additionally, with sufficient different public transport options that are efficient and affordable, as well as high quality non-motorised transportation routes that are well-designed and safe, it should mean that some commuters may be incentivised away from using private vehicles. In this case integrated multimodal transport planning may have the following potential benefits:

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— **Increased system efficiency**: By having sufficient information and options to choose different routes, passengers can increase the overall efficiency of their travel. This means both in terms of route choices as well as mode choices. Additionally, if transport planning and land-use planning are integrated, such as through transit oriented development (ToD), this means that they may be able to reduce the number of trips they need to take, or avoid them overall. Particular forms of integration can also have efficiency effects; for example, when the EZ card was piloted in Singapore, a study ways carried out that showed it decreased boarding time for buses by 62% compared to cash payments[9].

— **Reduction in congestion**: Although there is still sparse good quality data available for many developing and middle income cities on the cost of congestion, estimates from Britain, France, Germany and the US suggest that the total economy-wide cost across all four countries are about $200 billion in 2013[10]. The costs of congestion include time wasted, inflated transport costs and carbon emissions. If, therefore, through integrated multimodal transport planning, the density, affordability and attractiveness of public transport as well as non-motorised options

9 Ibid 6

10 Centre for Economics and Business Research/INRIX (2014). *The Future Economic and Environmental Costs of Gridlock in 2030: An Assessment of the Direct and Indirect Economic and Environmental Costs of Idling in Road Traffic Congestion to Households in the UK, France, Germany and the USA*. Washington D.C.: IBTTA

increase, this is likely to have people switch away from the use of cars thus reducing congestion.

- **Decreasing air pollution**: The reduction in CO_2 emissions is in itself a clear environmental benefit should transport planning lead to reductions in private vehicles. For example, there is cross-country evidence that the subway systems that were opened between 2000 and 2014[11], have been associated with a 5% reduction in air pollution in cities commuters have opted to use public transport instead of cars. These benefits can be compounded by additional investments in non-motorised transport options, which can improve greening in the city.

- **Improving affordability for low income users**: Potential efficiency gains from integrated multimodal transport planning may also have effects on fares. Currently, in many developing and middle-income cities, a 10km trip on public transport equates to about 30% of the income of the poorest quintile of the population[12]. Given the structure of many cities, where the poorest live on the outskirts where the rents are lower and thus have to commute long distances on a daily basis, ensuring that public transport is more affordable will have a direct effect on their lifestyles and potentially also the ability for them to access jobs.

Potential efficiency gains from integrated multimodal transport planning may also have effects on fares. Ensuring that public transport is more affordable will have a direct effect on low-income users' lifestyles and potentially also the ability for them to access jobs

- **Opening potential financing opportunities**: As highlighted, if transport planning is well integrated with land-use planning, this can have effects on land values. If the appropriate legislative and policy instruments are in place such the city can capture some of these increases in value, they can be used to finance the investments that will take place as part of the overall plan.

- **Enhancing social cohesion**: Currently one of the struggles for public transport systems in middle income countries is how to incentivise higher income users to switch away from private vehicles. If the system, therefore, is made more efficient and attractive, compared to the congestion that plagues many of these cities, some of these commuters may switch to public transport. In this way public transport will provide a meeting space for different members of society and can improve social cohesion. This was one of the aims behind expanding the urban railway system in Mexico City[13].

11 Gendron-Carrier, N. et al (2017). "Subways and Urban Air Pollution." *NBER Working Paper 24813*.

12 Carruthers, R., Dick, M. and Saurkar, A. (2005) *Affordability of Public Transport in Developing Countries*. Washington, DC: World Bank

13 Metropolis (2006). *Mobility and Social Cohesion*. Background Paper in Preparation of the Metropolis Conference in Toronto

Considerations on optimal modal choices

Integrated multimodal transport planning needs to occur both for the transport that already exist in the city and for future needs, particularly for rapidly urbanising developing and middle income cities. Therefore, assessing which modes of transport will be most suitable for meeting the needs of the current and future populations – and will be financially sustainable for cities - is key. Ideally, the overall steps in transportation planning should include the following:

— Monitoring and understanding existing conditions;

— Forecasting future population growth, including where people will be living and working, and thus where transport demand will be and which corridors will be affected;

— Develop, evaluate and ultimately prioritise potential investments, programmes and projects to carry out along these corridors. This includes financial forecasting and understanding which ones are feasible within current budget constraints, where financing will be found and how the financing will ultimately be funded;

— Ensuring the investments, programmes and projects that have been prioritised correspond to existing long run plans.

For cities that want to incentivise commuters to move from cars to public transport options, they need to provide a service that is convenient and affordable. Some areas that users of public transport assess services on are availability, frequency, speed, reliability, affordability, comfort and safety. Taking these into account from the outset in a planning process will be important. This will also include thinking on incorporating non-motorised transportation options. As noted, this is particularly important for more vulnerable groups, such as those who are poorer and cannot afford transport or the disabled and elderly who may require varied access options. Here key considerations for users are along the how continuous options are for movement, such as the availability of pavements, protection from motorised forms of transport as well as the geography of the space, such as topography.

Areas that users of public transport assess services on are availability, frequency, speed, reliability, affordability, comfort and safety. Taking these into account from the outset in a planning process will be important

BOX 3

Mode	Time and location serviced	Approx. avg. speed	Carrying capacity	User costs	Non-drivers	Poor	Disabled	Other factors
Walking	Nearly universal	2-5 mph	Small	Low	Yes	Yes	Limited	Limited distance covered and may be difficult or unsafe depending on the options. But it is environmentally friendly and healthy. Has particular benefits for women.
Bicycle	Feasible on most roads and paths, where quality is good enough	5-15 mph	Small	Low	Yes	Yes	Limited	Requirement for bicycle and appropriate area to cycle. Relatively limited distance. But environmentally friendly and healthy.
Taxi	Most urban areas	20-60 mph	Medium	High	Yes	Limited	Yes	High cost and limited availability.
Fixed Route Transit (e.g. bus or rail)	Limited – more developed urban areas	20-40 mph	High	Medium	Yes	Yes	Yes	Depending on city, there may be limited availability.
Paratransit	Moderate to wide	10-30 mph	Medium	Low to medium	Yes	Yes	Yes	Regulatory issues in terms of fares and safety.
Private vehicle	Nearly universal	20-60 mph	Medium	High	No	Limited	Limited	Environmentally unfriendly, costly, relatively low capacity.
Ridesharing	Suited for some trips	20-60 mph	Medium	High	Yes	Yes	Yes	Environmentally unfriendly, relatively costly.
Carsharing (i.e. vehicle rentals=	Limited to where services exist	20-60 mph	Medium	High	No	Limited	Yes	Not always available, costly.
Motorcycle	Nearly universal	20-60 mph	Small	Medium to high	No	Limited	Limited Limited	Relatively costly, safety issues.

Source: Adapted from Littman (2017)

Public transport

Each transport mode has different benefits and associated challenges, making them more relevant for different environments (see summary in **Box 3**[14]). For example, many middle-income cities are currently deciding between bus rapid transit (BRT) and light rail trains (LRTs), for particularly high congested areas, which are both high capacity transport options, in order to fulfil their public transit needs. **Box 4**[15] highlights some of the associated considerations that will need to be made between these options.

BOX 4: DECIDING BETWEEN BRTs, LRTs AND MRTs[16]

BRTs and LRTs have a wide range of carrying capacities and costs. BRT systems can range from being able to transport around **2,500 – 20,000 people/hour/lane**[17]. LRT systems can have higher capacities but generally fall somewhere in this range.

	BRT	Light Rail	Metrorail
Construction time	1-2 years	2-3 years	4 – 10 years
Maximum capacity (passengers/vehicle unit)	160 – 270	170 – 280	240 - 320
Line capacity (passengers/ direction/hour/lane)	2,500-22,500[18]	12,000 – 27,000	24,000[19] – 72,000
Maximum speed (kph)	60 -70	60 – 80	70 – 100
Average capital costs^ (US$million/km)	8.4	21.5	104.5
Average operating costs^ (US$ / vehicle revenue km)	2.94	7.58	5.30

Adapted from Cervero (2013). ^Capital and operating costs calculated from US case studies, using 2000 $USD Consumer Price Index average

MRTs, on the other hand, usually have higher carrying capacities than bus-based systems, at **over 30,000 passengers** per hour per direction[20]. As such, investments in these systems can be transformative for rapidly growing cities.

14 Ibid 5

15 Ibid 1

16 Taken from: Collier, P., Glaeser, E., Venables, T. and Manwaring, P. (2018) *Access to opportunity: urban mobility for prosperous cities*. London: International Growth Centre.

17 World Bank (2014). Bus Rapid Transit for Greater Kampala Final Report. Washington D.C: World Bank; Robert Cervero, R. (2013) "Bus Rapid Transit (BRT): An Efficient and Competitive Mode of Public Transport" *Working Paper Berkeley Institute of Urban and Regional Development*

18 Number of lanes (2) and carrying capacity for maximum based on Bogota's TransMillenio, from Venkat Pindiprolu, "Applicability of Bogotá's TransMilenio BRT System to the United States: Final Report" (NBRTI, 2006).

19 Minimum line capacity based on projections for Jakarta's MRT from Raditya Margi, "LRT to Move 24,000 Passengers per Hour," *The Jakarta Post*, 2015

20 UN-HABITAT, "Metro, Light Rail and BRT," 2013.

In very high-density areas where hourly passenger volumes are in excess of 30,000, both BRTs and LRTs are unlikely to meet capacity requirements. They are also likely to take up prime real estate in high density areas, which comes at a heavy opportunity cost. MRT systems where trains travel either above or beneath the ground, tend to be better options in such contexts, but can require up to five times the capital costs of LRTs.[21]

Non-financial benefits of BRT systems

— **Faster to construct**. Compared to other high capacity public transit services, BRT systems, particularly BRT Lite systems, are relatively quick to build and expand, and can begin operations before an entire system is completed, making these systems well suited for rapidly expanding urban areas.

— **Easier to re-route**. It is often easier to change the routes of a BRT system, relative to an LRT system in case mistakes are made, or in case the changing structure of the city requires the transport system to change.

Non-financial benefits of rail based systems

— **Environmental sustainability**. As LRT and MRT systems run on electricity and do not generate tailpipe emissions, they also have lower greenhouse gas emissions than buses and private vehicles[22]. To some extent, however, this can be mitigated if low-emission buses are used in BRTs. A study of the impact of the low sulphur diesel run, dedicated lane Rea Vaya BRT system in Johannesburg suggests that it has saved South Africa up to USD$890 million as a result of improvements in travel time, road safety and carbon emissions[23]. This is over three times the total construction budget for the project which in 2010 stood at $233 million for a line length of 59km[24].

— **Limited need for enforcement of use**. In cities such as Bogota, Accra, Lagos and Yangon, the inability of officials to fully enforce regulations on the use of BRT lanes means that private vehicles often use these lanes, significantly impairing the BRT system as a means of rapid connectivity. LRTs do not face a similar magnitude of problem in enforcement.

— **Limited resistance from existing road users**. The introduction of a BRT system, particularly one that encroaches on existing roads, is likely to face significant resistance from private vehicle users and other existing bus providers.

21 Ibid 17

22 UN-HABITAT, "Metro, Light Rail and BRT."

23 Gouldson, A. et al. (2015). "Accelerating Low-Carbon Development in the World's Cities (Working Paper)," Supporting Document for the 2015 Report of the Global Commission on the Economy and Climate, Seizing the Global Opportunity: Partnerships for Better Growth and a Better Climate (The New Climate Economy, 2015).

24 Rea Vaya Johannesburg (2010). *Rea Vaya: Comprehensive Project Update*

Non-motorised transport

As noted, in considering transport options for integrated multi-modal plans, it will be critical to take into account non-motorised transport as well. Specifically, in many developing and middle income cities a large part of modal share is from walking. For example, in Mumbai the modal share from walking is 33% and in Shanghai it is 27%[25].

It is critical to take into account non-motorised transport as well; in many developing and middle income cities a large part of modal share is from walking

As a sole method of transport, walking does not necessarily have large connectivity benefits for a city as it can take time to get to a destination and there are limits to the distances that can be walked. This can be partially alleviated with good urban planning and design, i.e. the better planned the street system, the larger the distance walkers can reach[26]. However, given the limitations overall, particularly poorer people in society, who rely solely on walking, will not be able to access as many jobs if they are traveling just on foot. Walking is also generally perceived as more onerous, both in time taken and safety for the individuals. In some cities this is indeed the case; in Nairobi, Kenya, for example, 70% of the road traffic fatalities in 2014 involved pedestrians[27].

However, walking is both an environmentally friendly and healthy form of transport that uses scarce road space more efficiently than other forms of transport: it is estimated that the capital cost for a pedestrian walkway for 4,500 people/hour/direction is about 100,000 USD. This is 50 times less than an urban road that can only carry 800 people per hour[28]. Furthermore, there is evidence that pedestrianizing in Germany and UK has had a positive effect on retail, with shops located in newly pedestrianised zones reporting higher turnover[29]. Therefore, it is imperative that non-motorised transport options are integrated within the overall public transport planning. This includes considerations for overall improvements in terms of quality and safety. These improvements will have particularly large benefits for poorer users who rely more heavily on walking due to affordability as well as women[30] and elderly passengers[31].

The capital cost for a pedestrian walkway for 4,500 people/hour/direction is about 100,000 USD; this is 50 times less than an urban road that can only carry 800 people/hour

25 OECD (2017) *Integrating Urban Public Transport Systems and Cycling: Summary and Conclusions*. Paris: OECD

26 UNHabitat (2018) *Streets for walking and cyciling: Desigining for safety, accessibility, and comfort in African cities*. Nairobi: UNHabitat.

27 FIA Foundation (2016) *Fact Sheet: Non-Motorised Transport*. London: FIA Foundation

28 Rode, P. et al. (2014). *Accessibility in Cities: Transport and Urban Form*. London: New Climate Economy Cities

29 Hass-Klau, C. (1993) "Impact of Pedestrianization and Traffic Calming on Retailing. A Review of Evidence from Germany and the UK," *Transport Policy* 1, no. 1.

30 Thynell, M. (2016) "The Quest for Gender-Sensitive and Inclusive Transport Policies in Growing Asian Cities." *Social Inclusion* Vol 4:3, pp. 72-82.

31 Ibid 6

Informal private paratransit

In many developing and middle income cities that lack sufficient public transport, a thriving but informal paratransit sector has emerged. This takes the form of minibuses, shared vans or rickshaws. However, due to the fact that they often fall out of the formal regulatory sector, many urban transport plans, and their subsequent implementation, ignore them. The fact that they do not appear in these plans and are thus remain unregulated, usually results in poor quality of their service and a deterioration of the overall transport network. For example, the lack of regulation may lead to an oversupply that can contribute greatly to congestion[32].

Failing to incorporate informal transport operations into formal integrated multimodal transport plans can be a costly mistake

Yet in some cities, these are often the predominant form of transport used by residents and play a key role for the transport sector.[33] Therefore, failing to incorporate informal transport operations into formal integrated multimodal transport plans can be a costly mistake. In some cases, the political outcomes of this is turning what could be a useful partner into a powerful opposition group. Effective integrated planning that incorporates informal transport can be a complement to larger-scale formal public transportation systems, such as BRTs or LRTs. This can happen with the view of ultimately formalising, and therefore regulating them, or phasing them out completely when the public transport sector has sufficient capacity. Three ways the informal paratransit sector can be incorporated include[34]:

— **Using shared lanes:** particularly in the initial phases of a BRT project, for example, or to improve transport options during peak times, authorities can phase in reform by permitting informal transport operators to use dedicated bus lanes. This has been done successfully in Gauteng, South Africa[35]. This has the additional benefit that until a full fleet of high-capacity vehicles can be assembled, the informal operators are adding capacity to the transportation system.

— **Feeder services:** Even with a high-capacity public transport system in place, it may not be cost-effective for this system to service the entire city. Private operators can therefore service lower density, peripheral areas of the city, feeding passengers into higher-capacity public transport services in the inner city.

— **Pool of drivers:** When a city is planning to move to more high occupancy road based transport, such as buses or BRTs, many of the operators' skills, such as driving or conducting, are transferrable. Therefore, the city can look at ways to incorporate current informal operators as bus drivers

32 Bajpai, J. and Haas, A. (2017). *A Framework for Initiating Public Transport Reform in the Greater Kampala Metropolitan Area*. London: International Growth Centre.

33 Godard, X. (2006) "Coping with paratransit in developing cities, a scheme of complementarity with institutional transport" Presentation at Future Urban Transport Conference Gotenburg 2-5 April 2006

34 AfD (2015). *Paratransit: A Key Element in a Dual System*. Accessed from: http://www.codatu.org/wp-content/uploads/transports_collec_artisanal_V03ecran_EN.pdf in November 2018.

35 Fowkes, N.D. et al (unknown) *The Effect of Allowing Minibus Taxis to Use Bus Lanes on Rapid Transport Routes*. South Africa: University of Witswatersrand

or they can bid for overall contracts to operate the new public transport systems system. There are benefits of this given that informal operators represent a relatively cheap pool of labour, and they are well-positioned to co-ordinate feeder services into the new system, given they have already run the routes previously.

CASE STUDY: INVOLVING PARATRANSIT OPERATORS TO INTRODUCE A BRT IN LAGOS, NIGERIA[36]

Due to a lack of public transport options, the paratransit sector in Lagos provides a large share of the transportation. In particular, in 2008, there were an estimated 83,000 the minibuses, called danfos, serving 7.25 million passengers every day. This accounted for about 69% of all the trips taken. When Lagos introduced a BRT in 2008, the idea was that this would be the start to phasing out the minibuses altogether. However, given the political clout of the minibus drivers, and their associated union, it took a number of years to institute bus reforms. During this time, the government had to undertake numerous negotiations as well as paying for representatives of the union to travel to Latin America to both understand how a BRT worked. These trips also allowed them to interact with minibus drivers who had previously been part of the informal transportation sector in their cities and subsequently incorporated into the overall system.

Once the BRT was launched, the Lagosian state government also decided to incorporate existing operators in the BRT to overcome the political economy of reform. They did this by granting cooperatives of minibus drivers concessions to operate the BRT. Furthermore, since these operators often lacked the ability to finance the higher-capacity buses, the government assisted by providing them with finance to form cooperatives and invest in higher-capacity vehicles. The inclusion of the minibus drivers into the BRT was ultimately key in being able to introduce the system overall, which served 200,000 passengers per day at its introduction 2008 and had lower fares than minibuses. However, the government still faced challenges in how to ensure the quality of the BRT because the danfo operators were not accustomed to. Therefore, they also had to train the minibus drivers in how to provide a high quality and efficient service, including aspects like taking into account customer feedback.

36 de Gramont, D. (2015) *Governing Lagos: Unlocking the Poltics of Reform*. Washington D.C.: Carnagie Endowment for International Peace.

Key success factors

Integration across all relevant government institutions, geographies and modes

In designing and implementing integrated multimodal transport, plans faces two major challenges:

— Multiple levels of government have different authorities over various parts of transport planning. This often creates overlaps in jurisdiction and unclear mandates, making it difficult to coordinate.

— In many places cities have grown beyond their administrative boundaries. Therefore, for transportation to successfully enhance connectivity, it has to cover a wide geographic jurisdiction. In these cases, if there are no metropolitan governance arrangements in place, then there is a challenge of coordinating and integrating across multiple geographic areas and jurisdictions.

Therefore, this challenge is mitigated if there is one institution that is responsible for transport planning overall. This agency should have both the necessary mandate in terms of geographic coverage as well as modes of transport. Furthermore, as has been highlighted, transport and land use planning are complementary when it comes to improving connectivity and density in the city. Thus any institutional arrangement will need to ensure that it can effectively influence decisions on land-use planning and transport at the same time.

Transport and land use planning are complementary when it comes to improving connectivity and density in the city

Where one institution does not exist, effective coordination mechanisms, such as joint planning authorities, need to be set up. This can happen in a number of ways: in Curitiba it was facilitated by a bottom up approach through coordination by local city governments[37]. In Lagos, however, the Lagos Metropolitan Transportation Authority was established as a condition to World Bank funding for urban transportation[38]. In both cases the agencies are functional because they have sufficient technical, human resource and financial capacity to be able to institute reform.

Where one institution does not exist, effective coordination mechanisms, such as joint planning authorities, need to be set up

37 Ibid 29

38 Ibid 34

Building on plans across different planning hierarchies

Transport is both provided at, and therefore needs to be planned for, at different geographic and administrative levels. Transport planning is often undertaken at the neighbourhood, regional, state or national level. Furthermore, aside from geographic stratification, plans can also be designed across different modes of transport. For example, there may be a plan specifically for bus routes and a separate plan for the railway. At the highest planning level there is usually an overall strategic masterplan for the country that contains a more visionary and longer term outlook. To be effectively integrated all of these plans need to build off and thus support each other.

In addition, plans need to take into account consumer preferences at a very individual level. This is captured through an individual's decision on where they want to go and which mode of transport they will take, i.e. route planning from their origin to their destination. There are usually a number of ways that the individual can complete this trip, e.g. walking, car or public transport. They will plan their route based on a number of considerations, such as which mode will get them to their destination in the fastest, most convenient and affordable manner. These choices can be captured using so-called origin-destination matrices, which are determined through a series of surveys with the travellers themselves or, more recently, through the use of mobile phone data[39].

Another very localised level of transportation planning are traffic impact studies. These are used to plan on how an investment in transportation will potentially affect the overall network as well as the surrounding community. This includes factors such as the environment, congestion and parking. It is a plan that should be carried out prior to the investment taking place and thus feed into decisions on both the costs and the benefits of undertaking the investment.

The further up the geographic and administrative hierarchy, the more the plan can take into account interactive effects along the network. However, localised planning, which is usually undertaken for a shorter term time horizon, is also required to provide more granular levels of detail to aid the overall implementation of higher level plans. More local plans may include information on the specific investments, projects and programmes that will be carried out as part of higher level plans. The key to having multiple plans, therefore, is that they all correspond and build off each other, i.e. that they are not developed in isolation of each other.

The key to having multiple plans, therefore, is that they all correspond and build off each other, i.e. that they are not developed in isolation of each other

39 Toulouei, R., Psarras, S. and Prince, R. (2017) "Origin-Destination Trip Matrix Development: Conventional Methods versus Mobile Phone Data." *Transport Research Procedia* Vol 26, pp.39-52.

Linking transport and land-use planning

In many cities, transport and land-use planning are carried out by different institutions and as a result have generally been detached from each other. Furthermore, in some cities, transport has been reactive and retrofitted to where populations have already settled. This is both inefficient as it often results in urban sprawl . It is also not cost effective as estimates show that retrofitting infrastructure, including for transport, where cities have already been built can be up to 3 times more expensive[40]. Planning for transport proactively can determine where urbanisation happens and thus ensure the city grows efficiently. More specifically, transport and land-use planning are complements in two ways:

In some cities, transport has been reactive and retrofitted to where populations have already settled; this is inefficient as it often results in urban sprawl

1. Together land-use and transport determine accessibility which is what really matters in cities – the ability to access jobs, shops and services

2. Intensive land-use facilitates high population density, which in turn makes transport systems more cost-effective. This is because a given transport node can service a higher number of people and thus recover higher revenues from user fees. It is estimated that BRT systems, for example, can only remain financially viable if there are at least 10 passenger boardings per kilometre per day per bus[41].

	Built-up density: people per hectare of land in urban use	Residential density: people per hectare of residential land
One bus per hour	21	30
Two buses per hour	31	44
Light rail	37	53
Heavy rail	50	71

Minimum densities needed to support mass transit (O'Sullivan, 2011)

In many cities, transport and land-use planning have to date been detached. Rather, transport nodes are surrounded by low-density development, meaning expensive transport services are under-utilised and consequently under-funded. In cities such as Cape Town and Johannesburg, transport nodes are situated in low-density areas and densification is restricted by planning regulations. As a result, there are approximately only 2 passenger boardings per kilometre per day per BRT bus, which has been a key reason why these systems have been unable to meet financial or passenger targets[42]. This could be mitigated if transport nodes were placed in high-density areas, where these exist, or if land administration and planning laws were reformed to allow high density development around public transport investments.

Low ridership could be mitigated if transport nodes were placed in high-density areas, where these exist, or if land administration and planning laws were reformed to allow high density development around public transport investments

40 Fernandes, E. (2011). *Regularization of Informal Settlements in Latin America*. Boston: Lincoln Institute of Land Policy.

41 Adam Greenfield, "Buses Are the Future of Urban Transport. No, Really," *The Guardian*, August 27, 2014, sec. Cities

42 Ibid 3

One particular way of doing this is through transit oriented development (ToD) corridors. These are development corridors that are specifically planned around transport nodes, with a mix of housing and commerce as well as employment opportunities. Governments can facilitate these types of developments through permissible zoning and other regulatory instruments as well as providing anchor infrastructure investments amongst other options. By locating these amenities close to public transport, it improves connectivity, as people can access their residences and jobs more easily, and thus may lower transport costs for household, as they will not have to spend as much on traveling long distances. ToD can also reduce congestion as pedestrians are able to access all their respective amenities via public transport and thus may be incentivised to use it. It also improves accessibility to amenities and jobs through non-motorised transport means, which is better for the environment as well. Increasing density around transport nodes should have an overall effect on ridership and thus fare generation, making respective transport option more financially viable. To undertake ToD requires careful planning of the station sites as well as for a radius around them. To leverage the benefits, this should happen at the same time as the public transport is being developed as it may require significant investments in infrastructure, including buildings and utilities. ToD can improve the efficiency, cost effectiveness and sustainability of the transport network overall[43].

ToD can improve the efficiency, cost effectiveness and sustainability of the transport network overall

San Diego Metropolitan Transit System. Photograph by Oran Viriyincy/flickr.

43 EPA (2013) *Infrastructure Financing Options for Transit-Oriented Development*. Washington D.C.: Environmental Protection Agency.

Incorporating existing informal private operators

As noted in this paper, cities that have ignored the integration of operators have faced numerous challenges in implementing transport reform. For example, in Dar es Salaam, Tanzania, resistance to a new BRT from informal transport operators contributed to a 7-year delay between design completion and the start of construction. This is because operators were concerned about lost profitability on key transport routes, and the loss of employment of their drivers.[44] In Quito, Ecuador, informal operators were not included in the first BRT line in 1995, but difficulties in co-ordinating the BRT with feeder services led the government to include ultimately informal operators in the third line in 2005.

Cities that have ignored the integration of operators have faced numerous challenges in implementing transport reform

The ability to effectively incorporate informal transport operators depends not only on political will within government, but also on the internal organisation of transport operators themselves. Where governments can collaborate with clearly defined and well-organised collectives, this can help to facilitate the co-ordinated shift in current practices required from current operators – e.g. redirecting current routes towards feeder routes, or agreeing to trade in low-capacity minibuses for higher capacity buses. Where existing operations are highly fragmented and competitive, such co-ordinated shifts of practice can be very challenging. Therefore, understanding the incentives for how these cooperatives can be formed will also need to be considered as part of transport reform[45].

CASE STUDY: COUPLING TRANSPORT AND LAND-USE PLANNING IN CURITIBA, BRAZIL[46]

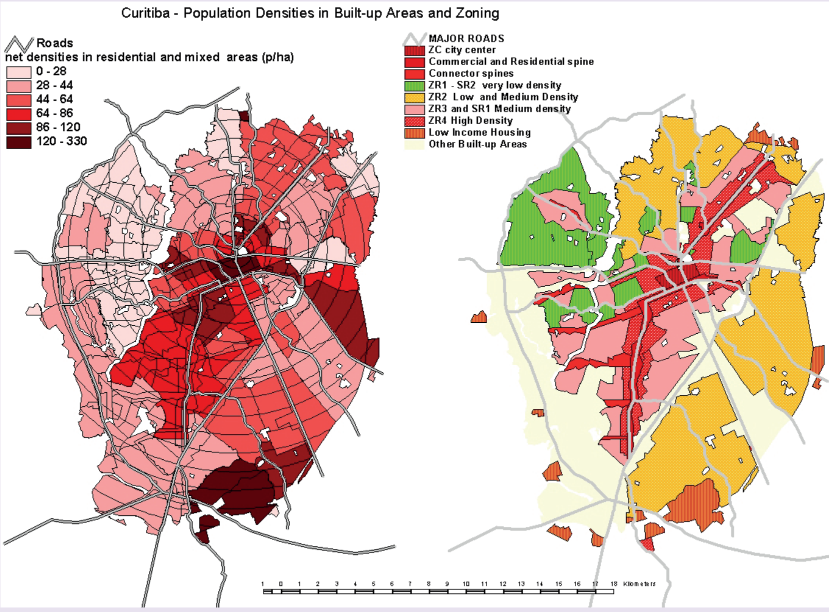
From the outset, when it introduced high capacity bus routes, which ultimately became the BRT, Curitiba has linked land-use planning and transport. They did this by having land-use regulations encourage high density development around the routes. In particular, urban plans, which integrated transport and land-use, allowed for much higher floor-to-area ratios (FAR =6) for developments along two key transport arteries, and lower ones (FAR =4) for developments on roads near public transport links. The allowable ratios decreased further as developments become further away from public transport links. As a result, usage of the BRT has increased (28% of commuters have switched from car to BRT since 1991), and consequently costs per passenger of the overall BRT system has been reduced.

44 Rizzo, M. (2015) "The political economy of an urban mega project: The Bus Rapid Transit Project in Tanzania." *African Affairs*, 114:455, pp. 249-270

45 Ibid 31

46 Bertaud, A. (2002) *Notes on Transportation and Urban Structure*. World Bank ABCDE Conference, Washington D.C.

In order to undertake this successfully, Curitiba had to have the right institutional mechanisms in place. In particular the Urban Development Agency, which was created in 1963, at the relative advent of Curitiba's urbanisation process, was tasked to manage transport. By 1990, this agency, through a number of legislative changes, was given the mandate to coordinate transport across 14 of the 26 cities that make up the metropolitan area of Curitiba. This means that it had the sufficient geographic scale to ensure that its coordination was effective. The initial impetus to coordinate came from the cities themselves, as opposed to a more top-down approach from national government. By then having one transport authority that was responsible for the majority of the network, it then made it easier for coordination with the agency, IPUCC, which is responsible for land-use planning. To this day both these agencies continue to work closely together[47].



Population density and zoning regulations in Curitiba. Zoning has been implemented to encourage high density development along transport corridors (Source: Bertaud, 2002[48])

47 World Bank (2011) *Metropolitan Transportation Institutions: Six Case Studies Australia, Brazil, Canada, France, Germany and the United States*. Washington D.C.: World Bank.

48 Ibid 46

Cost-benefit analyses for modal choices, to ensure investments reflect value for money

As noted, integrated transport planning will inevitably require a city to decide between modal choices both for the city that exists and any future planned expansions. To ensure the investments required represent value-for-money for a city, cost-benefit analyses, which compare the monetised benefits and costs of a project, need to be undertaken. In this context, value-for-money aims to achieve a favourable balance between costs and quality (economy), outputs and inputs (efficiency) as well as ensuring the anticipated outcomes (effectiveness)[49]. For transport investments, costs across the realms of planning, design, construction but also importantly, operation and maintenance, need to be considered. The anticipated benefits to consider include, for example, time and cost savings with respect to the commuter as well as wider impacts on the environment and health, through reduction on pollution or road accidents. It is important to note that cost-benefit analyses are also where aspects of sustainability as well as social justice should be weighted and considered.

Accompanying transport plans with realistic financing and funding strategy for anticipated investments, programmes and projects

Consistently one of the major barriers to implementation of transportation plans is that they include financially unsustainable projects[50]. This can then result to the stalling of the implementation of overall plan as the integrated nature may mean one investment is dependent on the other. Therefore, if the integrated multimodal transport plan sees the need for new, particularly large-scale investments that need to take place in the transport sector, then critically assessing these, from the outset, to ensure financing and funding can be raised, for these will be key. The aforementioned cost-benefit analyses of each of the individual investments should be used to help decide what to include in the plan. Coupled with this there should also be affordability studies to understand how high fares can be set and therefore the likelihood and scale of funding from this source will be.

Financing large scale transport investments will require a mix of sources and will most likely involve borrowing, either at a national or international level. This is particularly the case at the initial capital investment phases of infrastructure investments. However, where borrowing is involved, a clear funding stream should be determined from the outset, to ensure that the city can pay back the loan. Ideally, the revenue funding stream is linked to the financing and built in from the outset. For example, for transportation, this can be in the form of fares collected from tickets, although these alone are usually not a sufficient source.

Where borrowing is involved, a clear funding stream should be determined from the outset, to ensure that the city can pay back the loan

49 Jackson, P. (2012) *Value for money and international development: Deconstructing myths to promote a more constructive discussion*. Paris: OECD

50 Ibid 36

Linking land-use planning to transport policy, for example through ToD, also enables cities to recoup investments in transport through land-value capture. Evidence shows that transport investments can raise land values in surrounding areas; for example, estimates from Bogota indicate a 15-20% increase in nearby land values in response to BRT extensions. Land value capture is an efficient instrument as land is in fixed supply and therefore taxing it should not have adverse effects on investments. Administratively, given land is immovable and many of the characteristics of valuation are observable, it is relatively easier to tax than other more mobile factors. Furthermore, given that the investments that will be made as a result of the integrated multimodal public transport plan will likely be done by governments, it is fair that the rise in land values that arise as a result should not accrue to private individuals.

Evidence shows that transport investments can raise land values in surrounding areas – estimates from Bogota indicate a 15-20% increase in nearby land values in response to BRT extensions

This land-value uplift can be taxed to fund the transport investments which created it in various ways, including:

— Imposing development fees to nearby landowners to fund the infrastructure built[51];

— Charging developers for additional density allowances near the transport link, which works particularly well for a ToD approach[52];

— Using tax increment financing to enable property taxes to recoup revenues from increasing property values, although evidence shows this has in general only had limited success[53];

— Buying up land around transport nodes in anticipation of land-value increase, to later sell off and fund the project.

For land value capture to provide a potential financing and funding stream, enabling legislation and sufficient data needs to be available before the plans are in place before the investment has been made. Furthermore, it is important to note that even where land value capture mechanisms are in place, the revenues generated by large-scale transport infrastructure investments, for example, are only sufficient to fund between 10-20% of the capital costs[54] of a major infrastructure project, with most of these increases attributed to commercial areas. Additionally, it is important to note that empirical evidence shows that property and land values may not increase as much if the area where new infrastructure investments are being made are already well served[55].

For land value capture to provide a potential financing and funding stream, enabling legislation and sufficient data needs to be available before the plans are in place and before the investment has been made

51 See example of Hong Kong: Murakami, J. (2011) “Transit Value Capture: New Town Co-Development Models and Land Market Updates in Tokyo and Hong Kong.” In Ingram, G.K. and Hong, Y.H (2011) *Value Capture and Land Policies*. Boston: Lincoln Institute for Land Policy

52 Hong, Y-H.,Murakami, J, Suzuki, H., and b. Tamayose (2015), “Financing transit-oriented development with land values” Washington, DC: The World Bank.

53 Jason, W. (2018) *Why Tax Increment Financing Often Fails and How Communities Can Do Better*. Boston: Lincoln Institute for Land Policy

54 Siematycki, M. (2018) *Options for Finacning and Funding Infrastructure*. London: International Growth Centre.

55 Giuliano, G. (1995) “The Weakening Transportation-Land Use Connection.” *Access* No 6

Furthermore, there may be adverse effects; for example, a large road may decrease values as people may not want to locate too closely due to noise and air pollution. Conversely, there is evidence that vacant properties or properties not developed to their full potential benefit the most.

CASE STUDY: THE MISSED OPPORTUNITY FOR LAND VALUE CAPTURE IN BOGOTÁ, COLOMBIA[56]

The city of Bogotá is relatively segregated between high-skill, high income earners, living in the northern parts of the city, and the lower-skilled, lower income earners in the southern parts. It is also divided in terms of which strata of society uses which transport options: higher income earners tending to commute with cars and lower income earners were primarily using buses. Before the opening of the BRT, the buses had the highest modal share at 73% but were estimated to be about 35% slower than cars.

The BRT, Transmilenio, which opened its first route in 1998, is the largest in the world, accounting for over 2.2 million trips per day. In addition to dedicated lanes, the BRT also has allocated stops and a smart card ticketing system. It was phased in, in three stages: the first phase, accounting for 42km opened in 1998, the second and third phase, which added 70km in total, opened in 2006 and 2011 respectively. Its operating speeds are about as fast as the New York City subway and thus greatly improved the commutes. Furthermore, as the routes in particular connect the city's periphery to the centre, the BRT has been particularly beneficial for low income residents. Although the Transmilenio is said to represent the gold standard in terms of what a BRT can contribute to urban mobility, a major criticism is that, when it was planned and introduced, it ignored the corresponding planning for land use around its routes and stops. Therefore, even though connectivity improved, due to regulatory restrictions, there was no commensurate increase in density, particularly from housing supply. Using modelling simulations to understand what could have happened if zoning laws were adjusted at the same time, research from Bogota estimates that if the city had allowed building densities to increase around BRT nodes, and charged developers for this, the welfare gains of the BRT would have been 23% higher, and fees to developers could have recouped 18% of BRT construction costs.

56 Tsivanidis, N. (2018) "The aggregate and distributional effects of urban transit infrastructure: evidence from bogotá's transmilenio" Job market paper

Participatory planning can help understand the different requirements from a diverse consumer group

A city's transport system has to service multiple needs from diverse sectors of society. In order to do this, understanding what the specific needs the potential stakeholders are, including their income levels, where they will travel and at what times of the day this is likely to occur, is key. This can be done by involving as many of the relevant stakeholders as possible in a participatory planning process to ensure that the resulting plan addresses their requirements. A more participatory process from the outset will also have the additional benefit of ultimately generating support for the implementation of the plan.

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Improved data[57] for realistic designs and assessing impact of investments[58]

In order to design and implement a realistic evidence integrated multimodal transport plan, cities will require data. Data can be costly to collect on a regular basis. However, with new technologies, such as mobile phone data, as well as data from smart cards, for example, data can be generated relative easily. Regular data will also allow for continuous monitoring and evaluation of the plan and its implementation, allowing for evidence-based improvements to be made to the system. For example, changes as a result of integration may lead to changes in how people travel, which in turn should be reflected in the operation and design of the transport system. This will require iterative process to achieve optimization but requires data analysis capacities.

As many of these plans will require major investments, it is also important that the city understands the overall impact once these have been made. For example, impacts of investments can include direct effects on travel time as well as indirect effects on employment, land and property values or commuting responses. Therefore, following major investment it is important that the city undertakes impact assessments to outline where further improvements need to be made, to unleash the previously outlined benefits, as well as to inform future investments. Assessing impact, however, requires rigorous methodologies to isolate the actual part of the outcome that can be attributed to the intervention itself. To be able to this requires, amongst other factors, the availability of high quality historical and future data. Therefore, as part of integrated transport planning exercise, understanding what data is available, what will need to be collected as well as having a detailed strategy for collecting this data is critical in ultimately understanding whether the intended outcomes and benefits have been achieved.

Following major investment it is important that the city undertakes impact assessments to outline where further improvements need to be made

57 For further information on data for transport reform, see: Graham, D.J., Hörcher, D. and Carbo Martinze, J. (2018) *Data-oriented urban transport reform in developing cities*. London: International Growth Centre.
58 For further information see: Ibid 48

Cover photo: Suburban sprawl in Kigali, Rwanda. Photograph by Zdegiulio.

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