Bridging the Urban Transport Infrastructure Gap

In the Context of Smart and Resilient Cities – the Role of Private Sector and Public-Private-Partnerships.

Background Paper for Twelfth Regional EST Forum in Asia. October 2019, Viet Nam.

Contents

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Executive Summary

Cities across Asia are growing at unprecedented rates with over one billion people born in Asian cities between 1980 and 2010 and a further one billion expected by 2040. Many of these cities are quickly becoming megacities, with populations over 10 million people. Increasing urbanization has led to many benefits and is consistent with the 'Rise of Asia' that has occurred in recent times, lifting millions out of poverty, increasing average incomes, and improving quality of life. However, taking the lead from Western cities, much of this urbanisation has assumed that automobiles, mainly cars and motorbikes, are the best primary mode of transport for cities leading to what is known as 'Automobile Dependence' (Newman & Kenworthy, 1989; Newman & Kenworthy, 1999; Newman & Kenworthy, 2015).

This approach may be effective for low density cities in early stages of development but it is unable to cope with rapid increases in private vehicle ownership, population and urban density. This often results in implementation of stop-gap measures such as roadway lane expansions, bypass freeways, tunnels, and even vertical multi-layering of roadways. Such investments typically deliver short term relief from congestion with only minor longer term improvements in mobility while exacerbating a range of negative impacts that are particularly relevant to Asian cities given the high densities.

In short, an approach to providing a city with mobility that is based around private vehicles has a number of insurmountable shortcomings as it leads to a number of adverse outcomes that affect the economy, environment and communities, such as: increasing levels of congestion and delays; reduced accessibility due to increased trip times as cities begin moving outwards; increased risk of injury and fatality from road accidents; reduced physical activity leading to health related issues; significant increases in local air pollution and global greenhouse emissions; and continued dependence on oil which is often imported. In short, there are impacts on liveability, safety, resilience and sustainability – the core goals of SDG 11 and the heart and soul of environmentally sustainable transport as set out in the Bangkok Declaration.

In particular a model based on automobile dependence struggles to accommodate density given the need for extensive road and parking based infrastructure as well as the loss of economic opportunities from the associated and growing congestion on streets. The many advantages of urban density in enabling economic development are well established (UNDP, 2019; Newman, Beatley, Boyer, 2017; Glaeser, 2011) a transport method better suited to supporting density or even facilitating density needs to be considered. Hence, growing cities in Asia and around the world are seeking ways to offer an effective transport system that can accommodate rapid increases in urban density as part of their continuing need to increase economic development opportunities and to provide improvements to the key parameters in SDG 11.

Many cities are now turning to what is referred to as 'Smart City' technologies in an attempt to make their cities achieve these goals. This background paper looks at how the application of such technologies may or may not lead to improved outcomes by bridging key transport infrastructure gaps. Smart city technologies, like any technology, need to be directed and city governance systems will need to make choices about how best to implement the various

sensors, information systems, and control services that are now available. This background paper examines two distinct scenarios for how smart city technologies can be applied to cities: the 'Smart Automobile Dependent City' and the 'Smart Transit City', in order to compare how the application of smart city technology can be directed and how the resulting outcomes can include environmentally sustainable transport.

A Smart Automobile Dependent City uses smart technologies in a number of ways, namely: to inform efforts to increase the flow of mainly private vehicles; to enable greater awareness of how to avoid network congestion; to offer greater opportunities for cars to remain the dominant mode of transport; and to facilitate development of the city at its fringes (rather than around the high capacity roads). Such a city may indeed see some short term improvements in mobility by using smart city technologies, however these benefits will inevitably be lost as population and traffic density increases, ultimately leading to the exacerbation of the issues that called for a new approach in the first place. Such outcomes are often overlooked when proponents of smart city technologies present associated products and services as a solution to almost any urban problem as long as their particular brands of smart city technological systems are adopted.

On the other hand, a *Smart Transit City* uses smart technologies in a number of ways that enhance multiple outcomes, namely: to inform the effective and efficient expansion and operation of shared transit services (such as train lines, metro lines, light rail and tram lines, bus services etc); to enable seamless mode changes as part of a journey; to streamline ticketing between modes; to allow for predictive maintenance to reduce associated costs; and to enable the transport system to deliver enhanced mobility across a city. Such a system, better connected for last mile accessibility, is more affordable, promotes walkability and density around stations, provides information services for simplicity, and enables the funding/financing through effective partnerships. This city is not only better in terms of short term transport goals but long term goals that include all the SDG 11 characteristics of an 'inclusive, safe, resilient and sustainable city'.

If designed well a 'Smart Transit City' approach can be both well aligned to long term planning goals of cities and nations along with having a clear rationale and evidence to counteract a focus on automobile-oriented solutions that are heavily promoted but are not part of long-held understandings of what makes a good city. Such an approach can leverage similar technologies that are promoted for 'Smart Automobile Cities' such as smartphone applications, sensors and control systems – however the core planning ethos driving this vision must prioritise transit and sustainability rather than persist with the notion that private vehicles can be accommodated on mass in growing cities.

> *If a city is primarily automobile dependent the application of Smart City technologies and approaches may improve conditions for a short while but overall it will have diminishing returns until eventually the negative impacts will outweigh the benefits, which will further strengthen the 'lock in' to automobile dependence. Hence despite initial aspirations to improve conditions it may in fact lead to an overall worsening of conditions leading to ongoing economic, social and environmental damages. If such cities are to see lasting improvements such technologies need to be used to accelerate*

a transition to greater shared mobility options that are seamlessly connected and effectively integrated with new and existing development.

So this then begs the question of how to do it, especially given that many cities in Asia already have extensive automobile dependent infrastructure and services, meaning that roads are seen as places for private vehicles rather than the logical place for a number of effective shared transit options. The core of this question comes down to how transport and land use related investments in cities can be better directed to not only avoid mis-using the opportunities provided by smart city technologies, but to begin to reduce the growing negative impacts of automobile dependence? This challenge is not new as cities have long been struggling with how to integrate new technologies to achieve better outcomes whilst also needing to demonstrate clear benefits for their economies, societies and ecosystems. Given the rise of smart technologies it is now the time to clearly understand how a range of urban issues can be exacerbated through the use of such technology, or else there will be significant lost opportunity and mis-direction of investment if cities react to this new technology and are simply driven by the branding aspects of being a "Smart City".[1]

This background paper seeks to address the challenge by suggesting ways of proceeding that are practical and useful. It will attempt to show how automobile focused smart city technologies can play a role but will need to be less of a focus than including smart city technologies in transit and active transport. The key to achieving such a transport system is to integrate transport and land use planning to create strategies that focus on transit activated corridors, where effective shared transit corridors activate greater development potential that in turn attracts people to the shared transit. This will call for a new approach that sees new partnerships formed between government agencies and between government and the private sector to deliver such corridors.

These partnerships would use dedicated lane corridor transit services (with the potential for other shared transit vehicles to streamline behind trams) to activate greater land value along the corridor, working with developers to attract investment around stations and help pay for the transit service – rather than simply using this space for car parks. In effect, the transport service provides the patronage for the station precincts and the precincts provide destinations for travellers as well as homes and businesses that can be serviced by local transit services. This is a synergistic relationship that can make such transit activated corridors a primary method of urban transport and urban development that harnesses existing road space to increase capacity rather than expect it to be continually expanded to accommodate more and more private vehicles. Such an approach is used in a number of cities in Asia but is not common as it requires new governance and partnership approaches that are not well understood or supported.

Hence it is important that smart city technologies are prioritised that can improve efficiency, quality and modal interconnectivity of shared transit options to create a quality transit system

[1] Note that the United Nations processes that have led to the SDG's and The New Urban Agenda have not used the term 'smart city' for many reasons allied to the concerns being expressed in this report. Nevertheless, many cities and nations do have smart city programs and hence the UNCRD have used the opportunity of the 10th Annual Workshop on Environmentally Sustainable Transport, to focus on this topic.

supported by new electric micro-mobility for last mile connectivity. This is at the heart of a 'Smart-Transit City' and it needs to be the focus of planning, investment and capacity building in Asia. A number of Asian cities foresaw this eventuality and along with a focus on providing infrastructure for cars have also long embedded public transport options into their urban form, with differing degrees of success, some like Tokyo, Hong Kong and Singapore have become world best practice in reduced car dependence, something increasingly being seen as important in most Asian cities, along with recent financing priorities of the Asian Development Bank.

Below is a summary table comparing attributes of a 'Smart-Car City' compared to a 'Smart Transit City' that demonstrates the clear case for a shift from the former to the latter.

Attributes of City Transport Network	***Smart-Car City***	***Smart-Transit City***
Spatial efficiency for moving people	Low	High
Ability to cope with increasing urban density	Low	High
Ability to cope with increasing congestion	Low	High
Ability to cope with interruptions to the network	Medium	Medium
Ability to create people focused walkable spaces	Low	High
Energy efficiency per passenger	Low	High
Level of dependence on oil (assuming electric transit)	Low	High
Level of safety	Low	High
Level of liveability	Low	High
Level of resilience to disasters and climate change	Medium	High
Contribution to achievement of SDG's	Low	High

This background paper sets out how to make a Smart Transit City, especially the partnerships needed to bridge the gap in funding and financing. It presents some case studies with Delhi, Beijing, Thimphu and Perth, to illustrate how the Smart Transit City can be part of the planning in cities with different scales in size and different levels of economic development. And then it concludes by setting out a seven step way forward.

1. Background

Introduction

Much of the urbanisation around the world in the last 70 years has occurred with private vehicles as the central transport mode (Newman and Kenworthy, 1989, 1999, 2015) resulting in growing congestion, safety and pollution issues. While many American and Australian cities have sprawled outwards around freeways, this has been less obvious in European and Asian cities. Many Asian cities have grown upwards and to some degree outwards which means that transport distances are shorter than in sprawling cities. However, such cities will inevitably develop major transport problems if the only alternative to private vehicles is poor quality, underserviced and thus overcrowded shared transport options. It is now clear and widely documented that this approach gives rise to increased traffic congestion and a number of direct impacts on both society and the economy such as air pollution, noise, road accidents, and community disruption (UNCRD, 2019).

Thus, although many Asian cities are ideal for both shared and non-motorised transport options in terms of their density, the lack of consideration for alternatives to private vehicle based transport means that much time has been lost in designing and implementing effective transport systems that may not serve the needs of the city. This background paper outlines a model for responding to this realisation that both sees an effective transition to shared transit in cities but also identifies opportunities for the use of smart technologies to enhance efforts. The background paper also shows that some Asian cities have pioneered such an approach to overcome automobile dependence with world best practice outcomes. These cities, like Tokyo, Hong Kong and Singapore, have shown how rather than creating transport systems around private vehicles they can be created to provide shared transit services that are embedded in high density station precincts with strong economic, social and environmental outcomes – in short the cities just function better and will continue to do so as they grow (Newman and Kenworthy, 2015). Such a model is well underway across mist Asian cities and this paper seeks to share ways it can be enabled further.

Transport infrastructure facilitates the movement of people between places in cities, and the decisions that cities make about what types of transport infrastructure they build has a lasting legacy, as transport infrastructure usually impacts where and how urban development occurs. Therefore, transport agencies, working across agencies and with the private sector, have a significant role to play in shaping the coming decades of urban growth in Asia, learning from the mistakes and successes from other cities around the world. Given Asia's fast economic growth, relatively young populations and rapid urbanisation, the choices made in Asian cities will have a strong influence on global transport trends.

It is clear that Asian cities need to now diversify their transport systems to expand past a focus on private vehicles and quickly move to an integrated multi-modal system that can not only cope with growth but also underpins ongoing economic and social development. The need for such a shift is now well recognised, with for instance, the financing priorities of the Asian Development Bank shifting from investing 91 percent on non-urban roads and just 1 percent on urban public transport in 2010, to investing 50 percent on roads and 10 percent on public transport in 2018, projected to reach 40 percent on roads and 30 percent on public transport by 2021, as shown in Figure 1. (ADB, 2019)

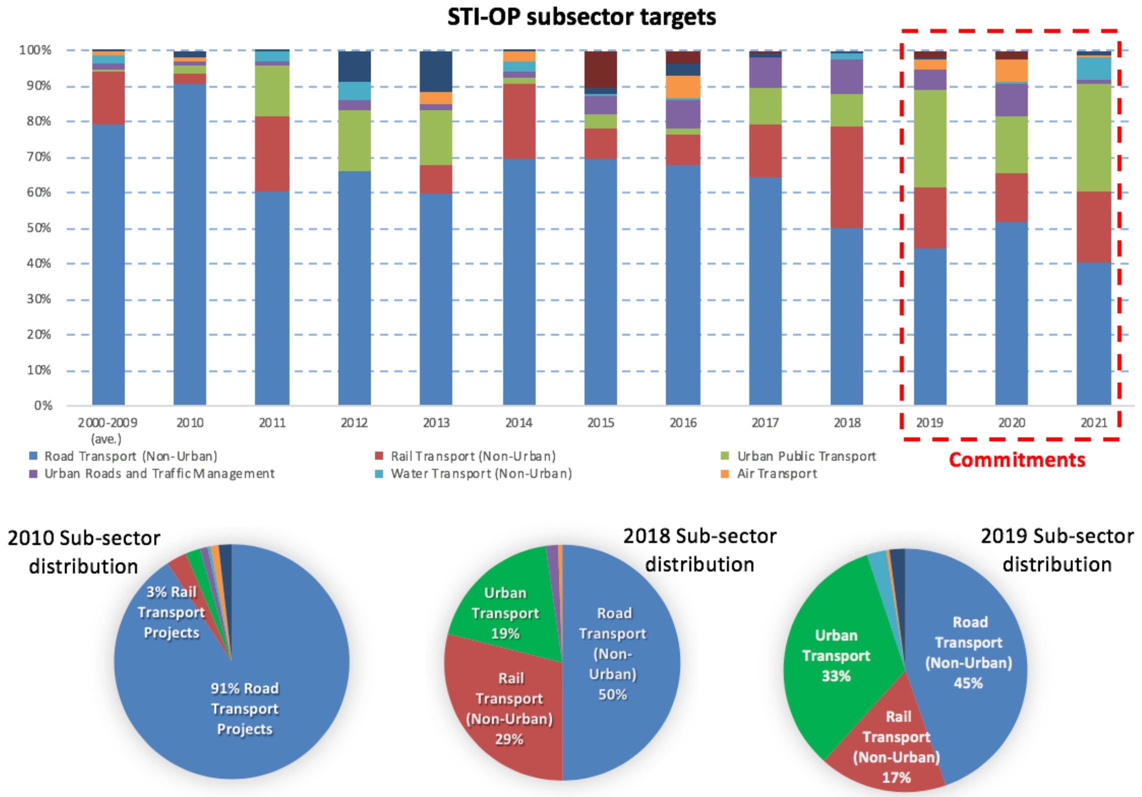

Figure 1: *Transport financing targets and commitments for the ADB from 2009 to 2021*

Source: ADB, 2019.

Given the critical role of transport in the operation of cities and nations it is not surprising that a focus on this area will result in multiple climate change and SDG outcomes, however the most compelling reasons for action are coming in response to local impacts on human health and the quality of environmental quality. The World Health Organisation reports that 92 percent of the world's population are living in cities with levels of air pollution in excess of the recommended limits (WHO, 2016). According to the Asian Development Bank, 80 percent of the air pollution in Asia is attributed to the transport sector (ADB, 2018). This issue has been worsening, with vehicle numbers doubling every 5-7 years in Asia, and based on current forecasts, Asia's share of global transport emissions are expected to rise from 19 percent in 2006 to 31 percent by 2030 (ADB, 2018).

Asian economies are also suffering from the inefficiencies caused by automobile-dependence, for instance, suffering a loss of 2-5 percent of GDP due to traffic congestion (ADB, 2015). As mentioned above, although Asian cities have lower rates of automobile dependence than cities say in America and Australia, and to some extent Europe (Newman and Kenworthy, 2015), the rapid population and car ownership growth in Asia means that current infrastructure is under significant strain and new investment is needed. How this investment is secured and used will have significant implications. In short, many cities are now asking 'What is the smart and sustainable way forward?'

The key question underlying the background paper is: '*How can current high-density automobile-dependent Asian cities upgrade to provide effective and integrated modes of transport in a manner that creates multiple benefits including the ability to cope with increasing density?*' And importantly: *'How can smart city technologies now make this process more feasible?'*

<u>Making 'smart' choices about transport infrastructure</u>

With the rapid growth in digitisation of cities around the world there are calls for a focus on achieving 'Smart Cities' as a solution to many of the issues facing cities. However, it is important to understand that this term is often misinterpreted.

> *Typically, a 'Smart City' is considered to be one that uses information and communication technology to improve the quality of life of its citizens. However, these technologies are often supplemental to a city's core infrastructure, such as its transport and energy systems, and as such can only do so much if the infrastructure is not well aligned to achieving multiple sustainability objectives. The combination of both smart and sustainable can create a set of systems and infrastructure that can not only accommodate rapid growth and high densities but continue to offer accessibility, safety and quality of life - making cities 'more liveable, safe, resilient and sustainable' (SDG 11).*

When considering the transport system, in the case that a city persists with an assumption of automobile dependence, no matter how much technology it employs it will ultimately fail to achieve the broader goals of liveability, sustainability and resilience, despite using 'smart technologies', as the new technologies will just build on the fundamental structure of a city. For example, if 'smart' systems are installed on freeways in order to increase throughput it may initially alleviate some of the congestion but it will ultimately lead to rebounding congestion with more cars now able to fit on the freeway. This phenomenon of rebounding congestion has been understood for decades (Newman and Kenworthy 1985) and is the basis of what is now called 'induced demand', where improvements to the traffic management system just induces more private vehicle use, leading to 'lock in' of automobile dependence. Smart city technologies based around this structure and priorities in investment is simply creating a 'Smart Automobile Dependent City'.

Alternatively, cities that shift from a focus on providing infrastructure for private vehicles to providing infrastructure for effective mobility are far more likely to cope with rapid urban densification by harnessing road and land space to provide an interconnected system of mobility choices. When smart city technologies are applied with this structure and this investment priority these cities can become 'Smart Transit Cities'. When well designed and operated, shared transit options with dedicated space, such as railways, subways, or trams, have been shown to effectively and comfortably provide mobility and accessibility despite the high density of travellers. It is well understood that this type of development also leads to a number of urban design and walkability co-benefits compared to increasing coverage of roads and freeways.

Urban transportation systems are intended to provide people with affordable access to the parts of the city that they want to go to. In order to facilitate economically productive and socially inclusive cities, the system needs to accommodate large numbers of people to move quickly into and out of areas of the city with high activity density. Hence at its core, transport decisions are about selecting the right combination of shared and private transport infrastructure to suit the availability of space. However, as it is inevitable that most large Asian cities will quickly grow in density, meaning that space will continue to be a premium, a combination that offers effective shared transit services as the primary form of transit complimented by private vehicles or low occupancy services stands to deliver the best outcomes in the longer term (Ewing and Bartholomew, 2013; Sharma and Newman, 2017; Newman *et al* 2018). Bus services are critically important to the functioning of Asian cities and will continue into the future providing a service for those without any other option. However the problem has been the growth in cars (and in some Asian cities, motorbikes) used by people seeking a better option than provided by crowded buses. The agenda being addressed by this paper is how to enable cities to find a mass transit option that can compete with individualised solutions of cars and motorbikes. Despite bus services offering shared transit given that they are operated in traffic and often meander through areas stopping at multiple locations they rarely provide a service comparable to the use of private vehicles, calling for a focus on dedicated corridors with a fast, high capacity, quality transit service.

Cities that have emphasised shared transit infrastructure have found that effective partnerships between government and the private sector are needed to combine the new transit infrastructure with new development opportunities along the route. We have called this approach as a 'Transit Activated Corridor' (TAC) (Davies-Slate *et al*, In Press). Figure 2 below shows both an automobile dependent city and a transit dependent city corridor. In the first case trip times are acceptable and accessibility is convenient until population and vehicle levels grow too high leading to lengthy commute times and difficulty parking vehicles when arrived. In the second case accessibility is provided by offering a local shared transit service to bring travellers to high density precincts built around shared transit stations that can continue to offer accessibility and convenience despite growing population levels. And further, if done well this model can attract new investment in station precincts that is not possible in the automobile dependent model. With cars and buses as the focus, development is created around much more scattered development with high spatial requirements to provide extensive car parking and wider roads, creating less dense nodes. This is the land use outcome choice that is associated with transport infrastructure choices. Either a car-based low density corridor that inherently creates a corridor of traffic or a series of dense centres distributed along a corridor supported by frequent shared transit services.

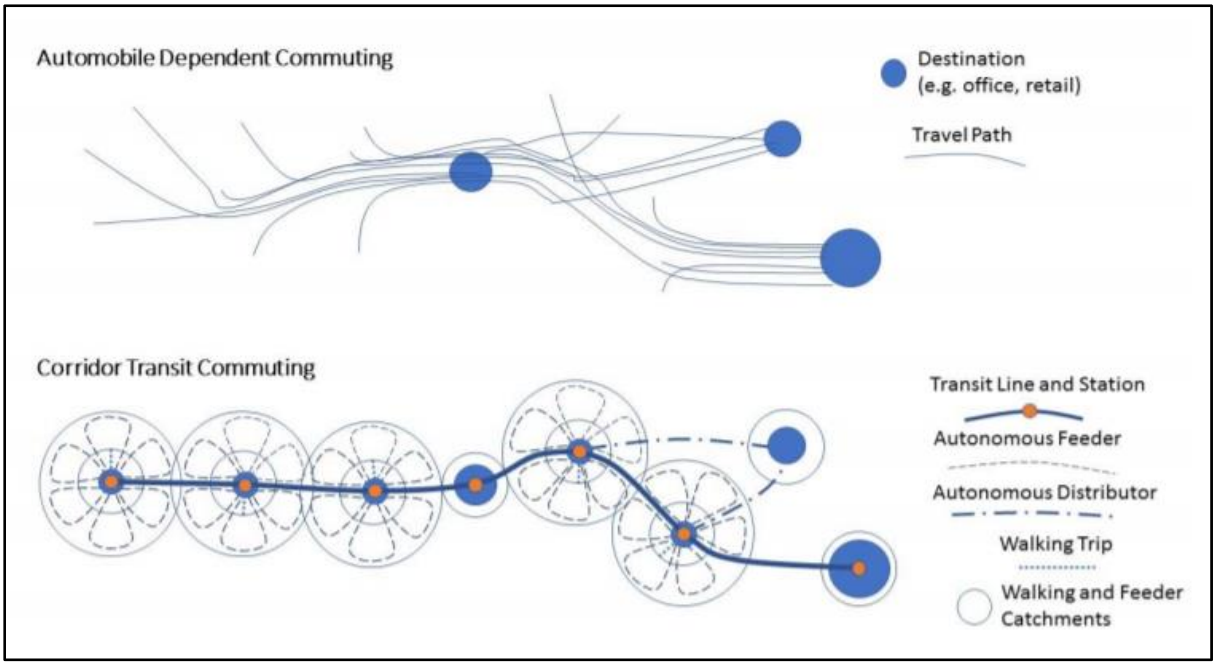

Figure 2: *Comparison of traditional 'automobile dependent commuting' to 'Transit Activated Corridor commuting' with quality transit lines, last mile connectivity and integrated stations underpinning development.*
Source: Adapted from Glazebrook & Newman, 2018.

Hence to accommodate growth and provide quality of life, cities need to shift to the corridor transit approach that creates Transit Activated Corridors with their ability to enable denser land use. This approach can also be enhanced with smart technologies, both in cities already experiencing space constraints and congestion issues and in cities that are likely to face such constraints in the near future, and are currently automobile dependent. The main focus of the Transit Activated Corridor approach is to prioritise high quality, efficient corridor transit with last mile connectivity running between a series of dense station precincts. This then allows for fast, high quality mobility along the corridor that can harness emerging technologies to improve efficiency and reduce costs that are built in as part of the urban regeneration process (Newman *et al*, 2019).

> *In short, although the automobile has provided access and mobility for decades, like the horse and cart before it, it is no longer suitable as the primary form of transport in rapidly growing cities around the world – the negatives simply out-way the benefits. Such cities, if they have not already, need to upgrade their transport systems to now fully harness existing land and road space to accommodate shared transit options that deliver both mobility and development outcomes. This approach will call for new partnership arrangements not to mention it will need to draw on a range of smart technologies.*

Making 'smart' choices about transport technologies

As described previously smart technologies are increasingly being applied to cities that have been designed around private vehicles and despite best intentions progress to improve conditions is likely to be stifled by the sheer size of growth in car use, population and urban densities, calling for shared transport options to be integrated into the urban form. A number of technologies can then be employed to enhance the operation of the system and ensure that accessibility, safety and quality of life are maintained as part of rapid urban growth.

Cities around the world have deployed smart city type technologies in a range of older functions to improve information about transport networks. However in the last 10 years a number of new and powerful ICT systems and software options have been developed that stand to significantly improve the functioning of transport systems (Hargroves *et al*, 2017), namely:

- *Real Time Information:* Providing information on mobile phones or public signs to improve traffic conditions for motorists or schedules for public transport users, to allow for changeable speed limits and lane allocations for motorists and bus drivers, and to inform those using bikes and pedestrians of anticipated trip times.
- *Internet of Things (IoT) Sensors:* The use of sensors in transport systems has a long history however in more recent times the ability for these sensors to communicate via the internet in real time provides a unique opportunity to improve the management of transport systems. For instance sensors can be used to change the cycle duration of traffic lights in response to real time traffic conditions, entry ramps on freeways can be restricted to allow for improved flow rates of vehicles, and sensors can monitor safety concerns and provide warnings.
- *Mobility-as-a-Service (MaaS):* App-based mobility platforms have the potential to allow for the integration of different transport modes such as shared transit options, taxi/Uber services, and last mile options including shuttles, scooters and bicycles into a single user interface . By doing so users will be able to see different options for their travel, choose a combination of particular modes based on time and cost, and then make a single payment. Hence in cities where effective shared transit options are provided (such as a metro system or a light rail corridor) such a platform could steer people towards alternatives to car use. This could be done by removing barriers such as needing multiple tickets or being caught in the overlap between services and having to wait for long periods for the next service.
- *Artificial Intelligence (AI):* Artificial Intelligence can be a powerful tool for learning how to manage and predict flows of objects, making it particularly useful for the transport sector (Hargroves *et al*, 2019). Of particular interest is the ability for artificial intelligence to harness big data analytics to enable predictive congestion management by comparing historic data to real time conditions and then alerting operators when congestion conditions are likely to be experienced in the near future. Ai can also be used to: identify and analyse network and asset characteristics such as vehicle data, engineering data, hazards etc; assist with traffic management by identifying interruptions to flow and using predictive congestion management; monitor vehicle behaviour to create a baseline of expected behaviour to identify irregular and unsafe vehicle behaviour; identify breaches in lane use, weight limits, allowable vehicle types, etc; optimise traffic signals based on real time conditions; provide priority to emergency and shared transit vehicles; optimise routing, ride share, and Mobility-as-a-Service offerings; and enhance multi modal connectivity and scheduling.

- *Distributed Ledger/Blockchain Technology:* Trusted distributed ledgers such as Blockchain provide a range of functionality to transport systems (Hargroves *et al*, 2019). Of particular interest is the ability to establish identification and streamline vehicle ownership documentation and reduce associated transactions; facilitate congestion zone charging, road user charging and collection of tolls and charges in real time; remove intermediaries and improve from ride share services; form the basis of MaaS and multi-ticketing platforms; allow driverless vehicles to make payments; and enhance freight tracking and authenticity.

Even with this new level of functionality the benefits to the transport systems of these types of technologies is limited by the provision of alternatives to private vehicle use. Hence the real 'smart' choice is to ramp up the provision of shared transit services, especially along designated corridors, complemented by a range of vehicles including private automobiles. As discussed previously, given the trends in growth in cities around the world the option to remain automobile dependent is disappearing as the space and time implications (as well as EST implications) of highly congested cities is driving urban transport planners to find more transit-based and active -transport-based solutions. This process starts with planning that conceives of appropriate ways to ramp up shared transit services in a manner that attracts development and reduces disruption to the current system. Once this is built into the planning system it will be possible to choose smart transit technologies from the above list in order to make the transition to a more sustainable city more economical and more beneficial to the multiple agendas associated with transport planning.

However, given that in the past it has been hard to justify funding public transport options, this new agenda needs a fresh approach to financing, which we will now discuss.

<u>Asia's urban infrastructure funding gap</u>

Whether Asian cities choose to remain automobile dependent or not the growth in cities will call for greater levels of funding to provide the associated infrastructure. Understanding that continued automobile dependence is a stop-gap measure as cities grow, many cities in Asia are struggling with the need to invest in efficient shared transit corridors and station precincts in order to enhance sustainability and liveability. Considering that governments do not always have the funds available to fund transport infrastructure at the scale needed, and that often shared transit services do not pay for themselves through ticket revenues – especially if the service quality is low - it is important that governments focus on opportunities to collaborate with the private sector to source new forms of investment for urban infrastructure.

Currently in many Asian countries the public sector funds the majority of transport infrastructure – approximately 78.6 percent compared to 21.4 percent sourced from the private sector. Figure 3 below shows that the current level of infrastructure investment in Asian countries is between 1.7-6.8 percent of GDP, and that the majority of this comes from the public sector (ADB, 2018).

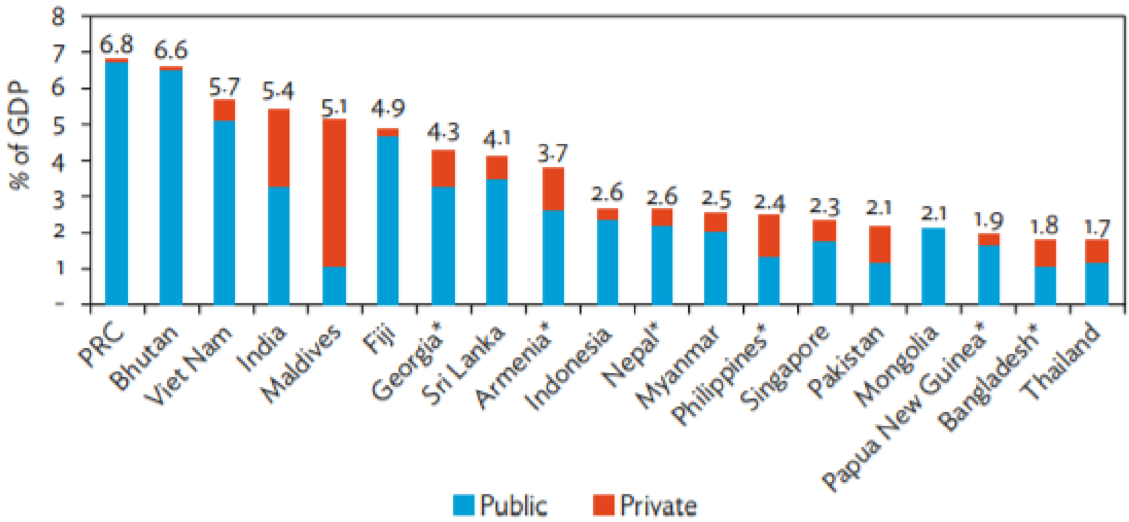

Figure 3: *Current infrastructure investment in Asian countries as a % of GDP, by countries and source of finance*

Source: ADB, 2018

Of the various infrastructure finance gaps across different sectors, the largest in Asia is in the transport sector, estimated at $600 billion per year in ADB member countries, calculated from an annual need of $982 billion and a current investment of $386 billion per year (ABD, 2017). If Asian cities are to meet infrastructure objectives in-line with targets such as those set out in the Bangkok 2020 Declaration then partnerships with private investment are essential. Traditionally the private sector has been more willing to fund telecommunications and power infrastructure than transport infrastructure. This is partly due to unattractive returns from road expansion and freeway projects and partly due to the typically sub-optimal provision of shared and rapid transit services again resulting in unattractive returns.

However, as cities are now shifting toward a focus on environmentally sustainable transport as shown by the trends in ADB priorities from 91% non-urban roads in 2010 to 45% in 2019 (see Figure 1), then there is a real demand and hence a market for such partnerships that can enable new transport investment models involving the private sector. As set out in this background paper such partnerships can achieve win-wins for investors, governments and society.

The role of the private sector in driving sustainable infrastructure provision

Privately funded shared transit infrastructure is not a new concept. Many of the original train and tram lines of the 19th and early 20th century around the world were developed by the private sector as a way to unlock new opportunities for real estate and land development (Davies-Slate and Newman, 2018). Once it was shown that by taking an entrepreneurial approach and investing in a train line to provide access to new land resulted in lucrative opportunities, this approach quickly became popular across the United Kingdom. This then spread across Europe and the United States up until the 1940's where corporate pressure from automobile related companies resulted in a focus on automobile dependence and the decline of public shared services. More recently the 'second rail revolution', as outlined by Glazebrook *et al* (2014), has changed priorities in many cities, generating a renewed interest in how private financing of shared transit can be achieved, suggesting this could be the preferred model going forward once again. Given that today the majority of infrastructure spending is in real estate, linking this with transport provides a lucrative new funding option (as set out in Figure 4).

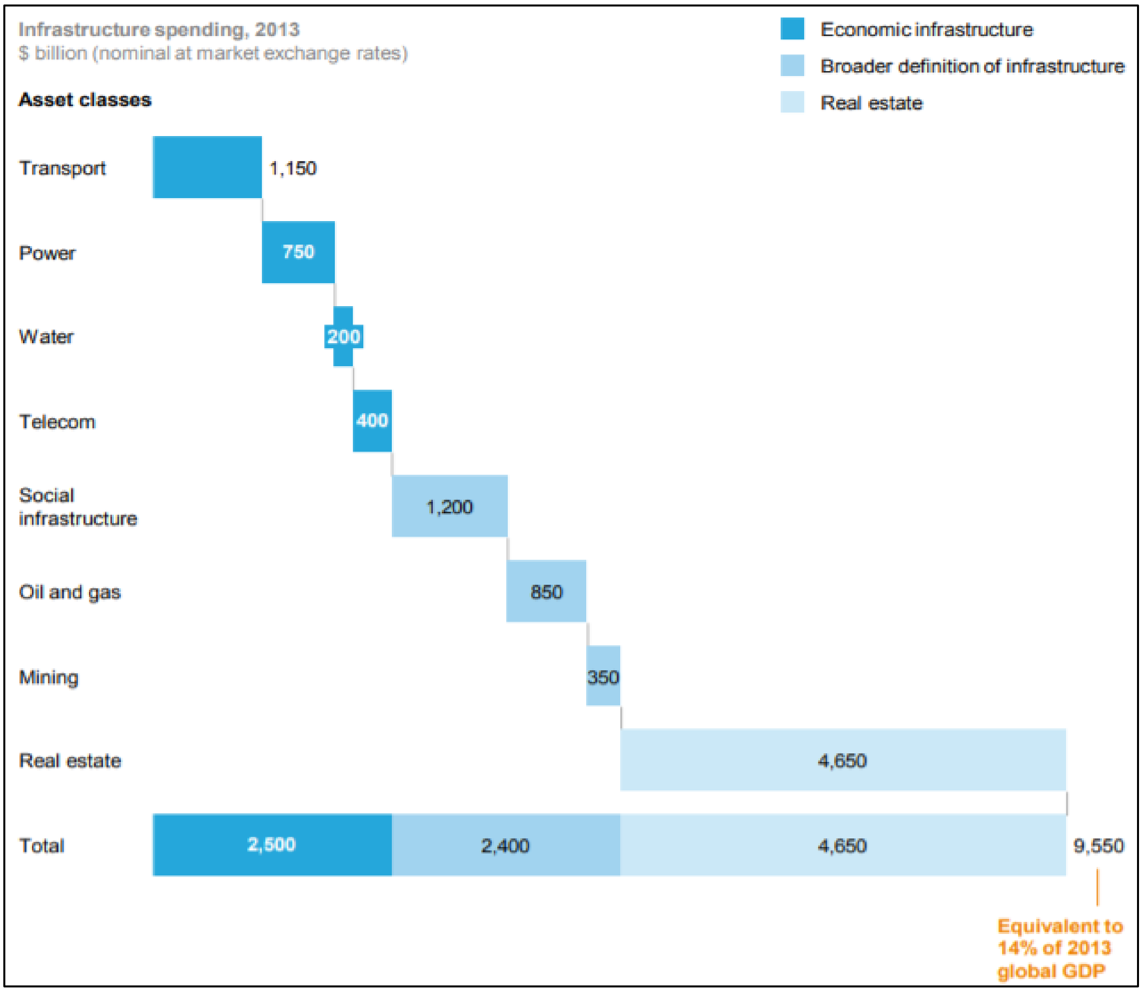

Figure 4: *Global infrastructure spending compared with real estate investment*
Sources: HIS, Euroconstruct, IMF, World Bank, and OECD, as compiled in McKinsey, 2016

It is thus suggested that reviving the model where land development opportunities underpin transit infrastructure provision could be a major way to attracting private sector investment in 'Smart Transit Cities', and thus bridge the gap in the lack of shared transit services whilst also helping provide well-located housing and offices in a desirable Asian urban form. This could be the most significant infrastructure gap in Asian cities. Our background paper therefore explores how this can be achieved as Asian cities struggle to find better ways of funding and financing their critical infrastructure needs.

The first step is to prioritize the role of land development in structuring and planning transit projects. Since transport engineers have not had to worry about the real estate outcomes of their transport systems, as they would have had to do in the rail and tram era from 1850 to 1940, their focus has been more on the transit infrastructure and less on the land development opportunities. Even when some attempt has been made to create a revenue stream from land development it has not been particularly successful as the value easily leaks away when government planning steps in after a transit system has been planned without considering land owners and developers in the planning process. This is called a 'value capture' approach rather than a 'value creation' approach. In a value capture approach, a portion of the public funds spent on new transport infrastructure is recouped using mechanisms such as greater land taxes applied after the stations have been constructed. As can be expected this approach is not well supported by land owners and developers in the station precinct. In a 'value creation' approach government engages with private sector developers early in the planning process to identify opportunities for new stations to activate greater land development opportunities rather than just apply greater land taxes – and thus maximising the margin for private contributions to the costs of the transit. This approach is represented in Figure 5 below, and will be discussed in greater detail in Section 3.

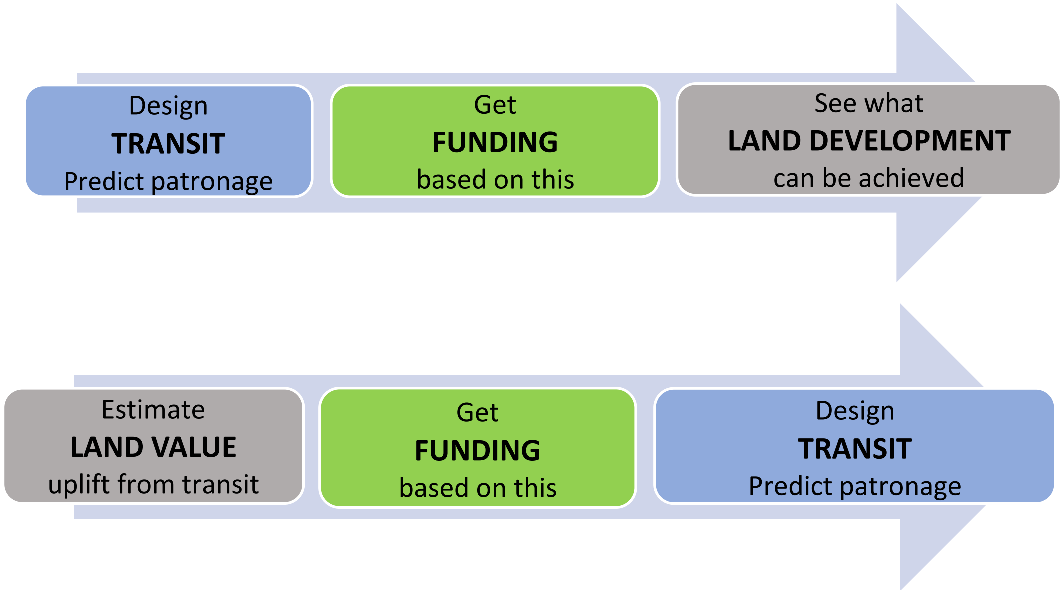

Figure 5: *Schematic representations of the conventional transit planning process (above) and an entrepreneurial transit planning process (below)*

Source: Newman et al, 2017

Taking this approach to the provision of shared transit allows for a series of station precincts to be developed or renewed that are connected by a transit corridor. Not only are the private sector developers incentivised to supply the transit service, they are also inherently incentivised to maximise the outcomes of the land development process they undertake in proximity to the transit, meaning that the sustainability and efficiency of the station precinct are also increased. Both the public and private sector are able to share risks accordingly, and the private sector are able to bring know-how and innovation to the projects to enhance the outcomes. This is the basis of a public private partnership (PPP) and these will be pursued in greater detail in Section 2.

<u>Closing Comments for Section 1</u>

The first section has set the context for this background paper by defining key concepts, particularly how best to harness 'smart' technologies in cities, and how to enable cities to bridge their transport infrastructure gap with PPP's. This background paper will now outline how Public-Private Partnerships can be used in Asian cities to attract private sector funding for the transition to shared high density transit infrastructure and associated station precincts. Such projects will also take advantage of innovative technologies to improve efficiency and reduce costs. Such corridors are integral to creating Smart Cities and Communities that can handle urban population growth in a sustainable manner, by attracting investment in sustainable forms of transit, and inherently contributing to economic, social and environmental outcomes for the communities they serve.

2. Overview of Urban Transport Infrastructure Gaps in Smart and Resilient Cities relevant to Asian cities

Urban transportation infrastructure shapes cities and locks in choices around accessibility, energy use and built form, and therefore infrastructure decisions directly impact the resilience and sustainability of cities. This section outlines key elements of sustainable transport for a smart and resilient city, and discusses urban infrastructure gaps facing Asian cities in relation to the types of infrastructure preferable to create sustainable outcomes using the Transit Activated Development (TAC) approach.

When infrastructure gaps are generally discussed for transport, the infrastructure elements considered for Asian cities include roads, railways, airports and ports. Specifically, this section focuses on key components of an urban transport system that can be strategically implemented with private investment (such as railways, bus rapid transit or trackless trams) and supporting land use and policy measures. It is clear that continued automobile dependence will not lead to improved conditions in Asia's growing cities. Therefore, the solutions presented in this background paper are ones that have significant potential to accelerate cities towards sustainability and resilience, based on the choice of 'smarter' urban growth using TAC-smart city opportunities.

Sustainable transport for a smart and resilient city

As highlighted in the first section, cities and their transport systems are constrained by the space available and as urban density increases such space is growing more and more scarce. Most cities, especially the dense cities in Asia simply have too many people wanting to achieve their mobility objectives for everyone to drive their own private vehicle each day and higher density shared options are needed. Figure 6 below illustrates the passenger capacities of different modes of transport (NACTO, 2016). As can be seen public (or shared) transport and active (or non-motorised) travel modes produce the most spatially-efficient transport outcomes, however, given such infrastructure typically needs to be retrofitted into existing urban forms rather than by original design it must be integrated with land developments in order to access required capital.

Hence, the only smart response to congestion and other traffic related issues that are set to be exacerbated by rapid growth in cities is to reorient transport systems to be shared transit dependent systems rather than automobile dependent systems. This means shifting from a focus on funding infrastructure for mixed traffic with in-traffic bus systems to dedicated on-street transit-ways, in conjunction with smart city technologies that can enhance benefits.

This approach will be expanded throughout the background paper after outlining the different components of a smart and sustainable transport system, namely:

1. Separated Transit Corridors (Railways and subways on tracks).
2. On-Road Transit Corridors (Light rail, bus rapid transit and trackless trams).
3. Feeder and Distributer Services (Buses, shuttles, bikes and scooters).
4. Integrated Land use Measures (integrating land use and transport planning).

Each of these will be briefly presented before considering the potential for Public-Private partnerships.

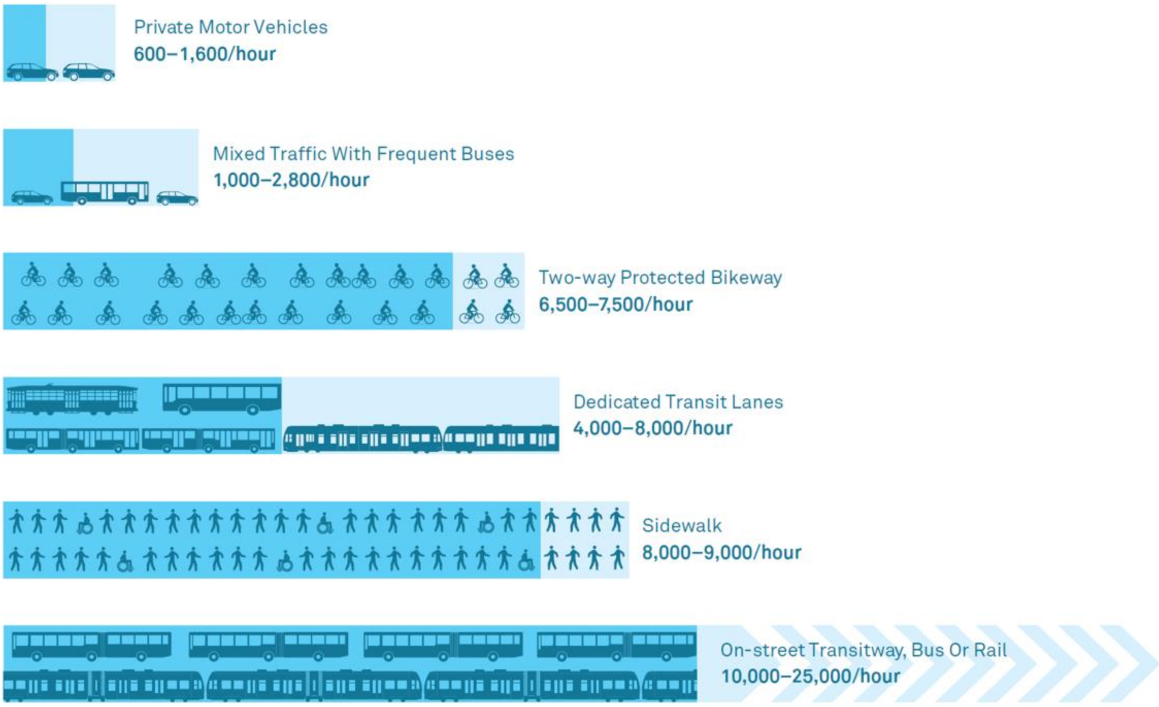

Figure 6: *Passenger capacities of different modes*

Source: NACTO, Global Street Design Guide 2016

Separated Transit Corridors – Railways and Subways

Railways and subways that operate separate to the road network can be a major element of the transport infrastructure for a Smart Transit City, and can provide rapid high density transit services that have significant economic and city-shaping benefits. These rail lines can not only connect parts of cities together, but can form the backbone of a city's transport network where the land is available or metro construction is feasible. From a transport perspective, connector routes (such as buses or light rail) can be used to feed commuters into major railway hubs where they can travel longer distance on trains given the high capacities. As seen in Figure 7 below, global expansion of rail is increasing on average each year, with the majority of this growth occurring in Asia (China makes up a significant portion of this), although still mostly publicly funded (ADB, 2018).

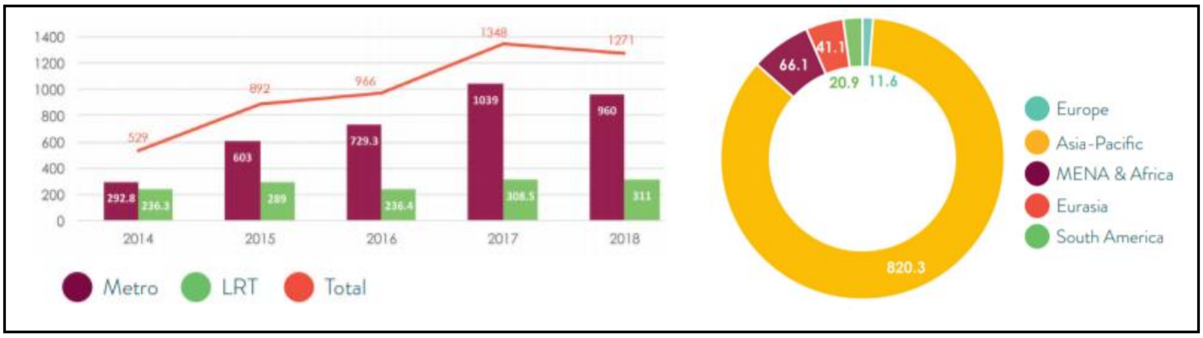

Figure 7: *Left - Annual growth of urban rail globally (km); Right – New rail in 2018 by region*
Source: UITP, 2019. Statistics Brief, New Urban Rail Infrastructure in 2018.

Cities in Asia such as Hong Kong and Japan have leveraged private finance to deliver extensive railway networks. The cornerstone of the finance for Hong Kong and Japanese systems has been land development around station precincts, the approach that is recommended in this background paper. More detail will be provided in subsequent sections.

Key considerations for Public-Private Partnerships with Metros and Subways:

- Asian cities are leading the world in the expansion of separated urban rail systems, however the majority is still publicly funded and there is only a small proportion of stations are serviced by collector transit on urban streets (such as a light rail system).
- Due to the large capital investment required for train lines, once constructed there is significant 'permanence' to the lines that provides confidence to land developers and financiers.
- Public-Private Partnerships have been developed in Japan and Hong Kong but in few other places where the majority of separated transit systems are government funded.

On-Road Transit Corridors – Light Rail

Where land is available for a railway, or subway construction is viable, the first option for a smart transit city should be fast rail capable of efficiently moving large quantities of people between cities and along major commuter routes. The second stage is then to create on-road transit corridors as connector lines using light rail (LTR), bus rapid transit (BRT) and/or a trackless tram system (TTS) to connect railway stations to key activity hubs across the city. The length of such lines can typically be expected to be around 12-20km, and should travel along major urban streets creating boulevards that are walkable and filled with activity.

The graphs below in Figure 8 below show that globally there is a steady increase in new light rail lines around the world, with Asia-Pacific countries leading Europe in new lines in recent years. Europe has traditionally been a leader in the construction of light rail systems however the graph to the left in Figure 8 indicates a 'decline' in the rate of new lines being added in Europe, this is likely due to a significant amount of existing lines needing to be re-laid, thus using up budgets without adding 'new' lines (UITP, 2019). However this is a cost that can be avoided by leapfrogging light rail to a trackless tram system as will be discussed below.

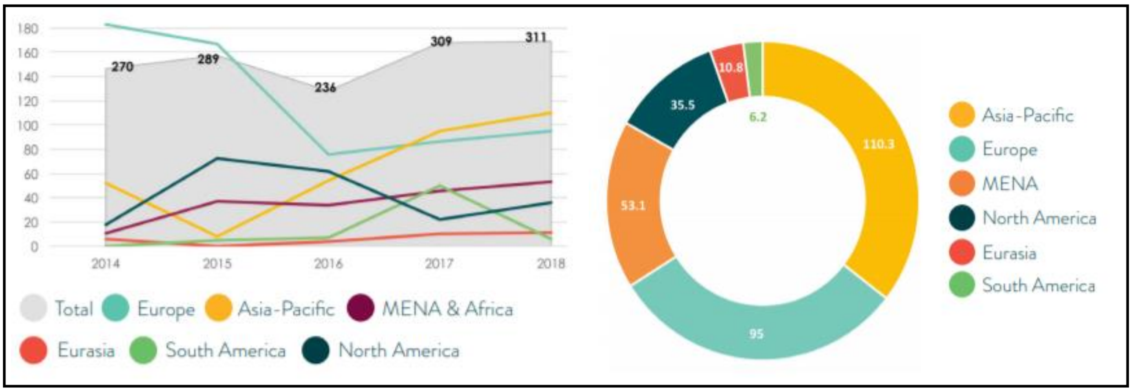

Figure 8: *Left – Annual growth of light rail; Right - Source of new light rail in 2018 by region*
Source: UITP, 2019. Statistics Brief, New Urban Rail Infrastructure in 2018

Key considerations for Public-Private Partnerships with Light Rail:

- Light rail provides an attractive mass transit option for cities as they have speed and capacity beyond buses on streets, and are suitable for main street amenity and a smooth ride that can get people out of cars. LRT's are an effective transit technology for turning 'main roads' into 'urban boulevards'.
- LRT have great potential to be integrated with land development along corridors, however this potential is has only just begun to be realised in a few cities in North America and hardly at all in Europe.
- Some cities in Europe are now capital constrained by needing to replace old light rail lines that they cannot afford to expand new lines at the same rate as previously achieved.
- The LRT construction process can be costly and disruptive in comparison to new technologies such as Trackless Trams (discussed below).

On-Road Transit Corridors – Bus Rapid Transit

Bus Rapid Transit, or BRT, systems have been used to varying success in a few cities around the world, however the forecast widespread adoption has not been seen (Stokenberga, 2014). Such systems seek to create priority transit corridors to allow conventional buses to gain faster access to key destinations and avoid traffic congestion. A key difference between a BRT system and a light rail system is that buses are able to depart the corridor and provide coverage services (lower ridership services that may circulate through less dense suburban areas to provide 'coverage' across all parts of the city, rather than just key corridors) and then enter the rapid transit corridor.

However this can be both a positive and a negative. For example, the bus that wanders through low density areas can be very slow and hence leaves the commuter with little option but to take the wandering route before getting onto the fast corridor. Also given the system is composed of buses carrying a maximum of 50 passengers, rather than a 3-5 carriage light rail that can carry up to 450 passengers, interchange stations are often congested, are very uncomfortable and require multiple loading points. In short although the shift to a dedicated lane system is a step in the right direction the system needs a high occupancy, fast loading vehicle on a closed system to fully harness its potential. As well as good precinct design around dense stations areas.

In recent decades BRT systems have been considered a low-cost option and often touted as a pre-step to a future light rail system by budget-constrained transit agencies facing growing populations and increasing transit demand[2]. Thus, systems have been funded by transit agencies or local government rather than the private sector. A study of various BRT systems and their influence on land value found that:

1. In some cases, Bus Rapid Transit systems can raise rental prices in close proximity to the stations, however the results vary significantly.

[2] There have also been publications that suggest much of the BRT lobby was funded by an oil lobby seeking to prevent electric transit solutions (see Ross B (2016) 'Big Philanthropy Takes the Bus' *Dissent* Summer, https://www.dissentmagazine.org/article/brt-bus-rapid-transit-big-philanthropy-oil-lobby).

2. The transit system alone is likely not the only factor that contributes to development outcomes and increased land values, and must be enhanced by features such as:
   - Giving buses dedicated lanes and addition doors for fast loading and unloading.
   - Urban streetscape/landscape improvements.
   - Supportive policies to enable development.
   - Urban design detail around stations such as walkability and safety.

Most buses used around the world are still diesel powered, and these buses do not perform well in creating the main street amenity that light rail create due to noise and air quality issues. This means that generally bus rapid transit systems have not been as successful as light rail (which offer an early electric alternative to diesel power). In particular light rail is good at creating urban boulevards that generate the places that people want to live and work near, leading to greater commercial opportunities along these corridors.

Key considerations for Public-Private Partnerships with BRT:

- Bus rapid transit systems are able to act as effective on-road transit corridors to/from activity centres, and thus do enable higher densities of car-free development to occur around nodes.
- Bus rapid transit systems are able to increase development and land values in proximity to stations, but will require a lot of other features outlined above.
- Buses generally are not as amenable for main street boulevards as light rail due to larger numbers of smaller vehicles and the lack of electrification.
- BRT systems typically don't have the capacity of trams or light rail and often have slow passenger loading due to limited doors[3].

On-Road Transit Corridors – Trackless Trams

The 'Trackless Tram' is a new form of transit technology emerging in Asia that harnesses the best aspects of rail, bus and cars to create a breakthrough urban transit vehicle developed by the CRRC Corporation Ltd (CRRC) – the world's largest rolling stock manufacturer, shown in Figure 9. The fact that this technology has been developed by a company whose history is in manufacturing rail vehicles, rather than buses, has contributed to the trackless tram being much more than a bi-articulated bus as it may first appear.

[3] There is often contention about whether capacity numbers on BRT are similar to rail capacity when the rail capacity in terms of space is clearly bigger – however there is frequent use of a maximum figure for capacity reached at the highest point of a day's activity being assigned to a BRT whereas rail always has measured capacity across a peak time divided into an hourly base.

Figure 9: *Trackless tram in operation in Yibin, Sichuan Province, China*

The Trackless Tram represents an exciting new smart city technology that combines the best elements of various transport modes with new innovations and technologies to create a new mode that out-performs light rail and bus rapid transit systems without the cost. The new technologies incorporated into the Trackless Tram (Newman *et al*, 2018) are:

- *Inertia Management Unit:* Drawn from high speed rail technology the inertia management unit minimises 'tilt and sway' as the tram travels along the road. As a result the Trackless Tram feels more like riding a light rail than a bus with children able to walk freely about the tram without risk of sudden breaking or sway as in a bus.
- *Rail type bogies:* Rather than the axle system used in busses a Trackless Tram utilises low set rail type bogies to provide added stabilisation and distribute weight to approximately 9,000kg per axle (compared to around 15,000kg per axle for trucks which is often the pavement design vehicle).
- *Optical guidance:* The vehicle follows 'virtual rails' using radar and lidar, meaning that it can automatically follow the corridor and steer accurately into stations, with the lines on the road intended to alert motorists of the path taken by the tram. Fixed markers can also be positioned along the path of the vehicle to provide additional calibration of positioning. Lidar is also used to detect obstructions in the path to avoid collisions and given the tram is not on a fixed rail it can join the traffic to avoid obstructions rather than being stopped.
- *Bi-articulation:* The Trackless Tram matches the capacity of light rail vehicles using bi-articulation to increase capacity along with train style doors along both sides of the carriage, also making the passenger-to-driver ratio more productive, reducing operational costs.
- *Solid core rubber tyres:* Rather than rails, the Trackless Tram travels on rubber tyres suitable for pavement, meaning there is no digging up of underground services or major infrastructure works required to install a new line given adequate pavement conditions. The weight of a tram carriage applied at the axel is equivalent to a bus and less than a truck

and hence will fall within the design parameters of most well designed roadways without further reinforcement.

- *On-board batteries:* On-board batteries that are capable of recharging at stations mean that the vehicle is quiet and suitable for main street amenity, and has a much better environmental performance than diesel buses (even better if the recharge points are powered by renewable energy). The batteries also eliminate the need for overhead gantries and cables to provide electricity to the tram.

By using the types of 'smart' technologies described above, combined with a dedicated corridor and permanent station precincts, the Trackless Tram is able to achieve many of the preferred outcomes of BRT and light rail systems while overcoming some of the key challenges. Table 2.1 summarises the performance of the Trackless Tram across various important measures, in comparison with light rail and bus rapid transit (Newman *et al*., 2018).

Table 2.1: *Indicative comparison of characteristics of corridor based transit systems*

Characteristic	Bus Rapid Transit	Light Rail Transit	Trackless Tram System
Speed and Capacity	✓	✓✓	✓✓
Ride Quality	×	✓✓	✓✓
Activation of land development	✓	✓✓	✓✓
Cost	✓	×	✓
Disruption during construction period	✓✓	×	✓✓
Implementation Time	✓	×	✓
Overall	✓	✓✓	✓✓✓

Source: Adapted from Newman *et al*. 2018

A key outcome that attracts private investment, and one that is discussed throughout this background paper, is the activation of additional land development potential due to fixed-route transit providing greater accessibility to development sites. Given it's tram-like stations and fixed-route nature, trackless tram routes can be planned in conjunction with land development and attract private finance for station infrastructure and minor infrastructure works. Also, as part of a wider transit system Trackless Tram corridors can act as connector service to railway stations that provide access to longer distance transit in Asian cities. Hence Trackless Trams are a modern and cost effective way to deliver transit services while activating boulevards and main streets, which can attract significant commercial activity and residential demand. Such outcomes have previously only been available using light rail systems that come at a significant cost and hence have been out of reach for many Asian cities. With the invention of Trackless Trams the implementation of new routes in conjunction with new land development projects is much more viable. This approach is outlined in detail in Section 3 of this background paper.

Key considerations for Public-Private Partnerships with Trackless Trams:

- Trackless Trams can achieve many of the transit, amenity, sustainability and development outcomes that light rail can but with significantly lower costs and disruption.
- Financially, the reduced cost of trackless trams makes developer contributions much more feasible, particularly in urban regeneration areas.
- Trackless Trams provide an opportunity to bring smart city technology into urban developments and this can be paid for by land developers and facilitate efficient shuttles for last mile connectivity as set out in Section 1 and below.

Feeder and Distributer Services – The Last Mile

High capacity railways and supporting transit corridors and feeder services are integral to a well-functioning city. To support this in the outer suburban areas and in areas surrounding boulevards and transit precincts, last mile mobility solutions can play a role in extending the catchment of stations without needing additional car parking, with the walking catchment typically around an 800 meter radius. Buses and shuttles can play this role and have been shown to work in Europe and in Perth (MacIntosh *et al*, 2014) as long as the interchange infrastructure enables quick transfers and the services are integrated to meet every train. The idea of a transfer penalty has been shown to not apply when people are transferring up to a faster and better quality service (Newman and Kenworthy, 2015).

Emerging rideshare platforms such as Uber, Grab, Didi and others are positioning themselves to provide last mile transit for cities. This is an opportunity, particularly because the private sector is willing to provide these services, especially in low density, poorly serviced areas where bus integration has not been easy to provide. However, it is also possible that these services can begin to take over the core role of transit down corridors causing congestion issues with evidence of this emerging in a number of US cities (Schaller, 2018). The key consideration for last mile services is that it needs to be a feeder to the main transit system rather than a replacement. Rideshare companies should not be taking customers on long haul journeys taking up valuable space along corridors and in dense centres that are usually the destinations that require car-free walkability as much as possible. Instead, assuming adequate shared transit services are available, they should be integrating with a broader transit network where they can provide last mile services and feed people into transit journeys.

Micro-transit such as scooters and share bikes are another way to expand the catchment of transit nodes with active travel options. These options will likely be provided by the private sector, and thus transit authorities should ensure they set the regulations for private operators to behave within. This is a growing problem that needs to be addressed through regulation and policing.

Key considerations for Public-Private Partnerships with Feeder Services:

- Effective integration with last mile services will enhance the transit activation of corridors assuming it is not a replacement for walkable trips. Feeder services need to be scheduled to meet corridor transit services to avoid lengthy delays in changing modes.

- It is important that transit agencies collaborate with private last mile mobility providers to ensure that their networks are aligned, and that on-demand services can prioritise transit ridership rather than long haul travel causing congestion.
- Digital ticketing systems need to be streamlined (potentially interacting with mobility as a service platforms) in order to efficiently integrate different transit modes (such as on-demand last mile bookings on mobile phones, or hire-bikes).

Integrated Land Use Measures

Although 'smart' technologies such as the ones outlined above provide significant opportunities to enhance the mobility of cities without a broader integrated approach to surrounding land use and policy, efforts to achieve multiple benefits are likely to be hindered. This can be due to a number of reasons, such as: push back from businesses that do not have access to value creation opportunities and face higher land taxes and rates; a lack of patronage given stations are not co-located with dense developments; leading to a lack of private funds that enable infrastructure to be provided. These integrated measures don't just enhance the viability of transit infrastructure, but also enhance the success of private sector participation. The two outcomes are intricately linked, and when governments seek to attract private investment for transport infrastructure, focusing on mutual private-public benefit can lead to better outcomes for all participants. The table below summarizes four key measures for integrating land use and transit infrastructure.

Table 2.2: *Integrated land use measures to enhance benefits to both the city and the private sector*

Integrated measure	Benefits for the City	Benefits for private sector
Urban design that supports walkability and active travel around station precincts, integrated into open space areas	Transit corridors and station precincts should prioritise walking and active travel options as the primary mode to connect with transit services. This will reduce the use of private vehicles, reducing congestion, noise, pollution and making these areas safer and more inviting.	Walkability and active boulevards and precincts generate more commercial activity and lead to higher rent and sale prices of retail real estate. The face to face interaction that takes place between people in these areas stimulates innovation, attracting knowledge economy workers.
Commercial activity intensification at stations and interchanges, such as retail outlets, office complexes, and other mixed-use amenities.	Commercial activity should be encouraged at stations and interchanges. The 'trip chaining' benefits of co-locating commercial destinations with transit hubs allows people to reduce their car travel, and can reduce total number of private vehicle trips by up to 7 times (Newman and Kenworthy, 2015).	Increasing commercial activity at transit hubs creates new revenue sources for private sector investors that are not possible without the shared transit. Businesses located in these areas achieve higher productivity due to increased foot-traffic past stores and greater accessibility without the need for a car (Newman and Kenworthy, 2015).

Densification of residential dwellings at station precincts	Station precincts provide a high service location for residential developments that can substantially reduce private vehicle use. Residents are healthier, more socially connected, and avoid lost time in congestion and additional trips to access shops and services now located around the station (Matan *et al*, 2015).	By facilitating higher density growth in close proximity to transit hubs, private land developers are able to generate more real estate activity and potential revenues. The walkability and safety of neighbourhoods adds to the attractiveness of particular areas, and hence these outcomes are better for business.
Parking management to respond to the reduced need for private vehicle use	Car parking takes up significant space and encourages greater automobile dependency (Newman and Kenworthy, 2015). By reducing the need for parking, cities can allocate space that is currently used for cars, and often sits idle, to higher value uses. Reducing the availability of parking will further encourage the use of transit services and reduce private vehicle use.	Mandatory minimum parking requirements mean that land developers need to attribute more developable land to car parking. This means less building space and less returns (or at least higher individual sale/rent prices). Therefore, by providing transit services and reducing the need for car parking by resident and visitors, developers can generate more revenues from higher value uses of space.

Summary of key gaps in transit infrastructure in Asian cities

As this section has shown the key gap in transport infrastructure in Asian cities is the provision of alternatives to automobile dependence. While cities are dependent on automobiles and motorbikes for mobility they face inevitable issues related to the space required to service this model as populations grow, and the efficiency gains from 'smart' technologies deliver diminishing returns until they have little to no effect. Hence a 'Smart-Transit City' focused on providing an integrated system of high density transit to carry the majority of commuters and private travellers, reducing the pressure on roads and freeways will make reduced car use feasible longer term. This underlying architecture is then enhanced with 'smart' technologies both in vehicle design for trams and buses, in network optimisation technologies like machine learning and predictive congestion management, and in advanced database technologies to deliver new levels of service to travellers.

However, an effective public transit system and the application of smart technology needs to be complimented by effective methods for government to partner with the private sector to deliver transport infrastructure. This is where the Transit Activated Corridor (TAC) approach to cities provides new insights as the approach places sustainable transport and urban design principles at the core and uses this to attract private investment to create multiple benefits. The activation of land use potential that is achieved, the same activation that creates the opportunity for the private sector, is a result of high quality shared transit that links dense, mixed-use precincts. Hence the improvement to the liveability and sustainability of cities and the attraction of private investment are integral to one another, and using this approach they will not be maximised without one another.

Table 2.3 considers the priority of each of the areas discussed above as they relate to infrastructure investment.

Table 2.3: *Prioritisation of components of viable transport systems for investment*

Key component of viable transport system	**Considerations in context of infrastructure gaps for sustainable transport**	**Impact on public investment budget – prioritisation as *'public infrastructure gap'***
1. *Off-Road Transit Corridors: Backbone of railway and subways.*	Significant gap in public investment. Heavy rail is expensive and is required as the backbone of an efficient transit system.	*High* – Cities need new, innovative approaches to attract investment for heavy rail systems that can move large quantities of people long distances.
2. *On-Road Transit Corridors: Light rail, bus rapid transit, and trackless trams.*	Significant gap in public investment. Conventional technologies (such as light rail) have been expensive for cities and present a finance gap.	*High* – Cities need connector services that can link people to heavy rail transit backbones. Need innovative finance and technologies.
3. *Feeder and distributor services: Shuttles, on-demand mobility and micro-transit.*	Private interests have begun to provide these services (on-demand ride share and micro-transit). The real need is for government to coordinate properly, rather than fund.	*Low* – Priority here is for government to collaborate and coordinate preferred outcomes. Private sector likely to provide services (incl. funding, innovation, operation).
4. *Integrated measures: Supporting land use and policy.*	These are key in attracting private investment in infrastructure. Rather than treated as individual category, should be integrated with all of the above three options.	*Integrated* – Not directly a major 'infrastructure gap' (as these are more policy), but need to be integrated with 1, 2 and 3 above to ensure investment is maximised.

<u>Closing Comments for Section 2</u>

The second section suggests there is a need for a new model that goes beyond the rail corridor approach in Asian cities (which has been highly successful) and shifts to a focus on transit in road corridors (which has not been very successful as it does not have the speed or the business case of rail corridors due to their extra capacity and ability to provide comfortable services). Only by doing both the rail corridor and road corridor approach will Asian cities be able to continue to grow effectively. Thus, the background paper suggests that there needs to be a new focus on effectively integrating transit services along road corridors with a strong emphasis on using land development as the core focus and rationale for funding, and that the mechanism should be based on a public-private-partnership approach. This model is referred to as creating a 'Transit Activated Corridor' (TAC).

Components 1 and 2 from the last table will therefore be the key focus of the rest of this background paper, with the integrated measures outlined above assumed to be necessary to achieve the best outcomes. These are the priority measures to create TAC's, and can only be done through public-private partnerships with mutual benefits as it is heavily dependent on how land is developed, a task primarily conducted by the private sector. Once this transit foundation is created – both the rail corridors and road transit corridors - the right policy approach will ensure that privately provided last mile, on-demand services and smart city technologies will increase the efficiency, sustainability and resilience of the network.

3. Public and Private Finance & Public Private Partnerships

This section will outline the following:

1. Why private investment in Transit Activated Corridors creates economic value
2. How land value increases due to urban rail and by inference Trackless Trams
3. Land value capture tools
4. Land value capture tools and value creation

Why private investment in Transit Activated Corridors creates economic value.

Transport infrastructure significantly influences urban economic value creation as it shapes the urban fabric around which the economy is created (Glaeser & Kahn, 2004; Newman, Kosonen & Kenworthy, 2016). The following three urban fabrics each have their roles in urban economic value creation:

1. **Walking city urban fabric:** Where major government and financial services are provided as well as many tourist and recreational services;
2. **Transit city urban fabric (TOD's)**: Around which increasingly the knowledge economy services of education and health and many business services are created; and
3. **Automobile city urban fabric:** around which manufacturing and consumer services and space-hungry freight services are created and where increasing need is now seen for transit fabric.

The overlap of these city fabrics and the trend towards knowledge economy jobs in cities means that there is an increasing demand to create TODs where car use is minimized, allowing for space efficient dense urbanism (Newman, Matan & Mcintosh, 2015). However, each of these urban fabrics require significant private investment, which underpins the need for a Transit Activated Corridor (TAC) approach.

There are several ways of understanding how private sector investment creates economic value in cities. Wealth creation is essentially a process that is based on a combination of the hard infrastructure that services buildings and their needs as well as the soft infrastructure that enables opportunities for innovation and job creation (Newman, Davies-Slate & Jones, 2017; Glaeser, 2011; Porter, 1990). The private sector do the vast majority of this city building within a framework of governance providing equity and sustainability, and a wider framework of community values. The three sectors of private, government and community, need to work in partnership to enable urban economic value creation (Newman & Kenworthy, 1999, 2015). Such economic value in cities is the major element of economic growth around the world. See Figure 10.

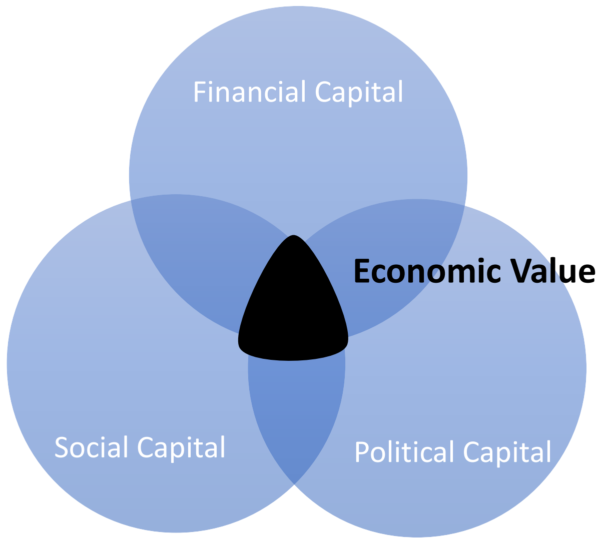

Figure 10: Economic value creation through integration of financial, social and political capital

Economic value is created in a city through integrating different forms of capital that are all involved in city building. There is financial capital that is necessary to build anything in a city; this depends on a range of technical assessments of how well the infrastructure will be used and what kind of demand there is for the urban development. This financial capital depends on risk assessment and demand evaluation which are also associated with social capital. Social capital comes from communities that develop trust in an urban development because they see the demand and they recognize the risk if they don't have the new infrastructure and urban development. Social capital provides the ethical value and third party political validation necessary for the difficult process of urban regeneration.

The third kind of capital is about the system of government which provides the settings and processes that either encourage or discourage the infrastructure and urban development; it could be called political capital. The political capital is a combination of the transport and town planning regulations and the way it enables the links to the other kinds of capital. When the three kinds of capital – financial, social and political – are integrated into a partnership then the best and highest value is created. This is what we are calling economic value and can be measured in terms of flows of activity and agglomeration benefits but it depends on the three other kinds of value being integrated. Underlying the need for investment in TAC is the need for risk management that can enable both rail investment and urban development investment. In both investment situations there is a need for the three sectors of private, government and community to be in partnership if the full value of a TAC project is to be enabled.

Governments need to encourage an optimal land use mix through zoning, planning and operation of transit that integrates with the rest of the system and with local interchanges, planning for long-term project life cycle risks, and all the land assembly and statutory planning requirements of local amenity. Community is needed to ensure the TAC provides the extra services and opportunities as well as the specific demands of local amenity as part of the bigger goals for access and new services in the TOD. Private sector involvement can address these elements by bringing innovation, technology, design stage efficiency, market driven land development skills, improved operational efficiency and long-term value for money through risk sharing. These latter skills are not readily available within government.

Figure 11 is a qualitative explanation of sharing risk for private participation in an urban rail project life cycle. The risk appetite of the private sector is higher when it is involved from the concept/ development (design) stage of the project and it decreases when the participation happens during the following stages of the life cycle. This is due to the fact that the private sector would be able to decide on technology, infrastructure, cost optimization, revenue streams and others for the project life cycle during the concept and planning stage. Private participation in urban rail projects has shown efficient exploitation of non-transport revenues such as advertisement, station area development and kiosks/ shops at stations along with bringing efficiency in construction and operations when involved from the design stage. Bigger projects which depend on even more land development for private investment opportunities, require even more obvious ways of incorporating private bids on how best to do it.

Involvement of the private sector at design stages can also enhance budget predictability for government. Private sector taking the life cycle risk can secure economies of scale (GIZ, 2013; Sakamoto, Delka & Metschies, 2010; Sharma, Newman & Matan, 2015). After the design stage, optimization of cost and revenue streams becomes limited in the construction stage and even further limits opportunities in the operational stage of urban rail if private sector involvement is delayed.

In sectors like mining and energy private participation has been engaged from the concept stage which has proven to show positive results (Cheah & Garvin, 2009). Transport has been mixed in its involvement with the private sector. Airports and seaports have become primarily private investment-based incorporating much closer integration with land development as a result. In the Modernist period of planning after the 1940's both road and rail have been primarily public within a strongly siloed regime of governance. Urban road provision remains heavily government based with some toll roads but few links to urban land development. Urban rail has been seen as a completely public responsibility in most developed and emerging cities with a few exceptions in Asia. However as shown below a range of mechanism are now developing to enable the same partnership approach to be applied for a TAC development.

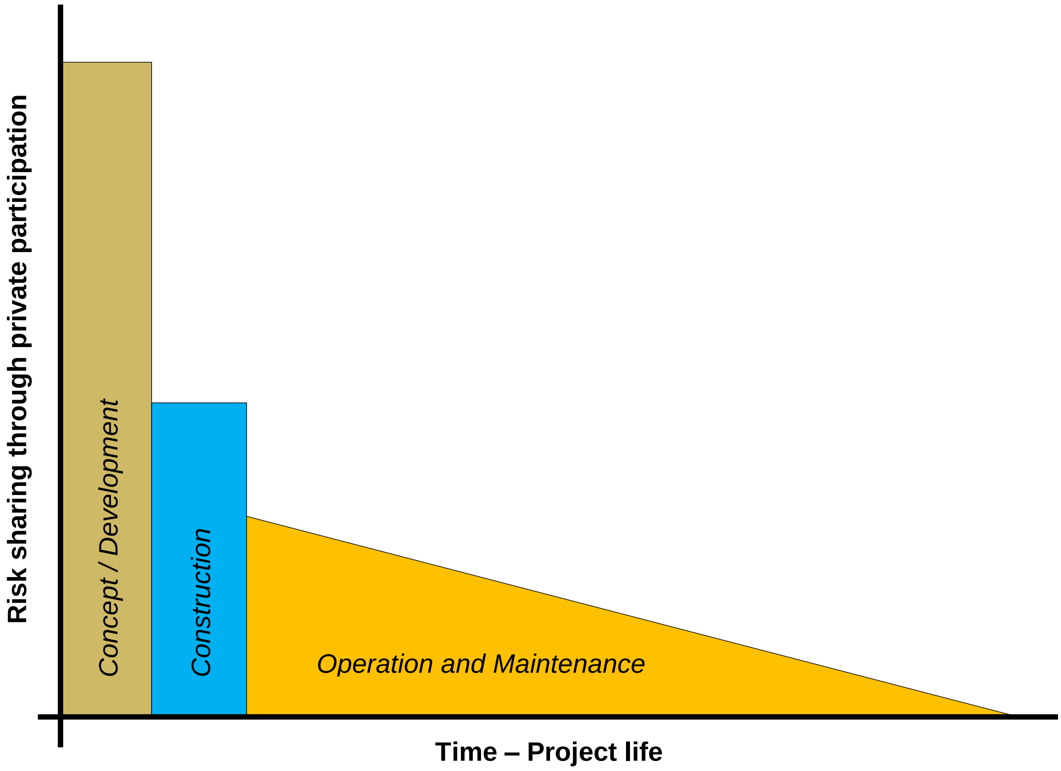

Figure 11: Urban rail project risks – sharing through private participation.

In order to optimize private participation Land Value Capture tools need to be aligned with two core needs:

1. How much cities are looking for help with financing TAC development to avoid conventional sources of finance, and
2. The extent to which cities are looking for economic outcomes in the associated TODs.

In the next section we discuss land value capture tools' potential for TAC development with private participation by discussing how land value increases happen. The data are from rail studies but by inference would apply to rail-like technologies such as Trackless Trams.

How land value increases due to urban rail and by inference Trackless Trams

The impact of urban rail on land value is well documented (see Anantsuksomsri & Tontisirin, 2015; Armstrong & Rodriguez, 2006; Cervero, 2003; Du & Mulley, 2007; Garrett, 2004; Laakso, 1992; Medda & Modelewska, 2009; Mulley, 2014; Sharma & Newman, 2017; Yankaya, 2004). There is a large variation in how much land value increases; this is expected as the factors that cause land value to increase include: the extent to which a station precinct is now connected to an improved transport system that can save time; how much local amenity is improved around the station; and probably most of all whether other economic opportunities are created through the TOD with its access to the train line.

Land value gain is generally estimated through quantitative price modelling (Freeman, 1979; Rosen, 1974). Hedonic price models have revealed the land value increase with respect to distance from stations at about 16% of the land value up to 1 km from the urban rail station in Izmir, Turkey (Yankaya, 2004); 11% increase in land values from 500 m to 750 m in Helsinki, Finland (Laakso, 1992); 17% increase in land values within 800 m in San Diego, USA (Cervero, 2003); 10% increase in land values within 800 m in Massachusetts, USA (Armstrong & Rodriguez, 2006); 7% increase in land values within 1 km in Warsaw, Poland (Medda & Modelewska, 2009).

In the case of Perth, the Southern Railway increased land values in the 500m around stations by 42% over 5 years after the announcement of the rail service (McIntosh, Trubka, & Newman, 2014). In Bangalore the value around Metro stations increased by 25% in the area going out between 500m and 1km and more significantly a 'before' and 'after' from the commencement of the metro rail operations shows a price uplift of 4.5% across the whole city; this indicates a major agglomeration economic event resulting in substantial economic value increase of USD 306 million from the metro rail's accessibility (Sharma & Newman, 2017).

The traditional approach to building urban rail based on top down supply of funding without much orientation to land development options will provide an increase in land value due to urban rail that benefits the landowners (both government institutions and private) without the owners making any direct investment in the rail. The increased desirability of that urban rail-accessible land, stimulates changes in land use, zoning and development intensification resulting in economic improvement which can be of significance across the city (Bowes & Ihlanfeldt, 2001; Cervero & Murakami, 2009; Chapman, 2017; Mathur & Smith, 2013; Medda, 2012; Pagliara & Papa, 2011; Salon, Wu, & Shewmake, 2014; Smolka, 2013). However, the full value creation is mostly lost to the land owners who did very little to deserve such a windfall gain but happen to be in the right place to receive the gain. It is not hard to see why attempts are therefore made to try and capture some of that value to help pay for the rail infrastructure.

<u>Land value capture tools</u>

LVC tools have long been applied to recover the windfall of land value uplift to fund public infrastructure (Chapman, 2017; Gihring, 2009; Ingram & Hong, 2012; Smith & Gihring, 2006; Zhao et al., 2012). The earliest implementation dates back to the days of the Roman Empire when the citizens to be benefited by the infrastructure were charged with the construction and maintenance of public roads and aqueducts, a practice followed by other civilizations the world over (Smolka, 2013). The literature on land value capture tools is large, some of the recent contributions on LVC tools includes Chapman, 2017; Connolly & Wall, 2016; Iacono et al., 2009; Levinson & Istrate 2011; Mathur & Smith 2012; Mathur, 2014; McIntosh et al., 2015; Suzuki et al., 2015; Vadali, 2014; Zhao, Das & Larson, 2012; Zhao et al., 2012.

As discussed in the sections above there is an important role for the private sector in enabling the best partnerships that create the most value in TAC projects. If projects are fully planned and delivered by governments without involving private land development in investment partnerships then they will leak value and the opportunity to capture it will be minimal. It is not enough just to see value capture simply as a way of taxing windfall gain after it has happened. The full financial, social and political capital is not achieved in such projects.

The LVC tools are therefore set out under four groups that move from Fully Public through to Fully Private with two groups in between that are Partially Private or Partially Public. The four groups are shown in Figure 12 to illustrate the extent to which they create economic value.

Fully Public: Land Based Levies

Governments set up land based levies to immediately begin recouping value increases due to infrastructure construction. Such tools can be Business Levies, Developer Levies, Special Area Levies and Parking Levies.

a) *A Business Levy is used in various countries such as France ('Le Versement Transport tax), Austria (Dienstgeberabgabe tax), the USA (employer/ employment tax) and the UK (Business Rate Supplement tax) to fund transit.*

   The Le Versement Transport tax is paid by public or private companies in France when the company has nine or more workers located within a 10,000 inhabitant urban transport zone to fund public transport services (Pascal, 2003, as cited in Milan, 2015).

   In the United Kingdom the Business Rate Supplement (BRS) tax is used by local authorities to impose a levy on business taxpayers to help finance local projects that can promote economic development like urban rail. BRS is a temporary tax imposed for a period to cover full cost of the infrastructure. The development of Crossrail in the Greater London Area is financed partially by business rate supplement (BRS). The BRS is expected to fund GBP 4.1 billion of the GBP 14.8 billion project by 2038. The tax is proposed to be increased by 15% in revaluations to take place every five years. In the first financial year 2010-11, collection surpassed the projected amount (Roukouni & Medda, 2012; Medda & Cocconcelli, 2013).

b) *A Developer Levy is imposed on land developers to fund public infrastructure gap created due to the new development.*

   In the US, the Impact Fee is a charge to land developers as a form of developer levy. The Impact Fee is a one-time charge levied on development projects during the issue of building permits to fund new public infrastructure and services associated with new development (Vadali, 2014).

   In Latin American countries developers are either asked to mitigate any shortage in supply of public services caused by their private project (Colombia, Guatemala and Argentina), referred to as an 'in kind payment', or are simply offered additional development rights against a 'cash payment' (in Colombia and Brazil) (Smolka, 2013).

c) *The Special Area Levy is used by governments to charge all land owners in a specific area to fund local transport services. These are imposed by governments rather than being partnerships as explained in the Partially Public: Special Investment Districts LVC tools section below.*

   Two examples of Special Area Levies and rail projects are in Milan and the Gold Coast in Australia. In Milan, such a levy was imposed on properties located up to 500 meters from local transit stations. The levy was proportional to the windfall gains on the land value to help fund the construction of the subway system (Ridley & Fawkner, 1987). In Australia, a

Transport Improvement Levy of AUD 111 per year for every rateable property (245,687) in the Gold Coast City was introduced to fund the Gold Coast Light Rail (SGS Economics and Planning, 2015). In both cases most of the funding was coming from other government sources and in the case of the Gold Coast with its very wide area the imposed levy did not help with TOD's.

Betterment Contribution charges are a form of special area levy that has been widely documented in statutory documents in the UK, Latin America, India and Australia. The overall application of Betterment Contribution has however been poor except in a few Latin American countries. The Indian city, Nagpur, has not been able to implement Betterment Contribution charge since 1936 due to lack of an implementation strategy and framework (Nagpur Improvement Trust, 2013). Smolka (2013) notes that most successful cases of Betterment Contribution seem to rely on rather arbitrary technical shortcuts to keep it manageable.

d) *The use of Parking Levies as a government charge on parking spaces in a designated area have been used to fund transit. The levy is based on the notion of discouraging the use of cars as well as providing an alternative transit mode. These parking levies can be just imposed but if done with the involvement of community and businesses then they enable more effective economic value to be created.*

The City of Perth, Australia uses the Perth Parking Levy to fund the local transit, pedestrian and cycling infrastructure system and has significant community and business support as it minimises car dependence. Perth is funding 'free' local transit through this levy (Parliament of Western Australia, 2014).

Land based levies are completely governmental tools through which specific public infrastructure services are funded without private participation. If the levies are imposed they will obviously have some effect on development being driven away; at the same time the infrastructure to be built through the levy makes the site more attractive for developers to invest in an area close to the infrastructure. The result will be less economic value in the TOD but it is still better than doing nothing and continuing with car dependence. This first set of LVC tools can be considered to have the lowest economic value creation potential as it does not align partnerships and incentives around integrated land development with new transit.

However, such levies are also probably the simplest set of tools to implement as it does not mean much change to transport and town planning agencies; the levy generates the funds for the rail and the governance remains un-integrated and does not need partnership development. For the TOD to be more integrated in planning and delivery the governance systems require another kind of process that can include private finance and expertise from the beginning rather than just putting a levy on them. It also requires community and business partnerships. Fully public LVC tools that impose an LBL are not therefore really integrated transit, finance and urban land development as the finance is not providing the integration and need for partnerships.

Partially Private: Tax Increment Financing

Tax increment financing (TIF) is a tool used to fund redevelopment projects (infrastructure and community projects) based on forward hypothecation of property tax due to prospective land value increase. It simply requires governments to set up a Treasury Fund that hypothecates funding from a specific area where government rail investment is improving the area resulting in land-based rates and taxes going up (McIntosh, Trubka & Newman, 2015).

US cities use TIF extensively for redevelopment and infrastructure provision in urban 'blight' areas. Blighted areas are usually characterized by dilapidated infrastructure, low income, unsanitary conditions, and a high rate of tax delinquency (Mathur & Smith, 2012). TIF has also been used to fund rail extensions and station area projects in several American cities such as Chicago and Portland. TIF is considered a 'self-financing' tool as local governments do not need to put up additional fees or increase existing tax rates. In terms of private sector involvement, TIF is less likely to drive away private investment as the normal taxes are used to collect the increased value and they are simply hypothecated in later years. The Land Based Levies begin immediately in order to pay back government loans but TIF waits until the developments are completed and value has seeped through the land-based taxes into Treasury. It is therefore likely to create more economic value as market forces are not impeded but are tapped in the same way they are in any other part of the city.

TIF has enabled cities to issue project-specific TIF bonds to raise capital costs of the project. A USD 2 billion subway extension project (to Hudson Yards) in New York City is being financed by raising funds through municipal TIF bond sales (Demause, 2015). The city of San Francisco uses a tax increment financing approach to fund transit and local development (Clark & Mountford, 2007; Schlickman et al., 2015).

TIF is a fully government-controlled LVC tool where no extra private investment is required directly into the infrastructure. It also does not need to involve partnerships with community and businesses to enable it to happen. However, TIF does eventually flow into the infrastructure pool controlled by Treasury and can be re-used for other projects. Because the infrastructure is targeted to enable urban regeneration it is better at value creation as it is attempting to invite more private investment into the precinct being targeted and thus there is an integrative force linking transit building to urban regeneration. TIF tools thus are targeting broader economic gains from specific areas though they are somewhat remote from the process of TOD building and could indeed be marginalized in the focus on building the rail system as has happened in many cities.

One other flaw in TIF is that revenue streams are not always stable and predictable due to fluctuations in real estate values. It is possible for governments to suspend or cancel TIF districts due to budget deficits or according to local and political circumstances like in the case of California and Chicago. TIF also requires significant institutional capacity to implement due to assessment, planning and compliance processes at local levels however this is a necessary part of any attempt to create urban economic value through TFUL.

Partially Public: Special Improvement District Levies

Special Improvement District (SID) levies come historically from a local amenity based levy set up where an area needs improving and private interests initiate or are willing to contribute a levy to improve the amenity of an area. Businesses are encouraged to tax themselves for the good of the infrastructure or amenity that they create together. Local governments simply collect the funds and manage the procurement of the disbursement to enable the improvements. This can be for security, for heritage conservation or simply providing better spaces that attract people to stay and hence create value in the area (Matan & Newman, 2016). SID levies are now being extended into whole corridors to create urban rail and urban regeneration in TOD's.

SID levies are called various things in various parts of the world. In America, Special Assessment District (SAD) fees have begun to be used in Los Angeles and Seattle to fund new rail lines. The SAD is also known as BAD or Benefit Assessment Districts in Los Angeles and LID or Local Improvement District in Washington DC and even a BID or Business Improvement District as they have become known in Australia. To implement a SID, SAD, BAD, LID or BID fee, governments identify specific special districts which can benefit from the planned public infrastructure in terms of land value uplift. The identified area usually comes out of a partnership from the bottom up where businesses, local governments and communities recognize the need for a new urban rail line and a new set of TOD's that could be unlocked by this. Through negotiations a partnership is established where a SID levy is agreed that can enable the whole process of urban rail and urban regeneration to proceed (Mathur & Smith, 2012). This is different to the Land-Based Levies as they are worked out in partnership based on the redevelopment potential that is assessed to be unlocked by the private investment enabling the infrastructure. They are not imposed from a remote agency and hence they create good will about urban development among the private and community partners which can contribute significantly to value creation. SID can also include special area levies and parking levies as set out in the Fully Government LVC tool but only if they worked out in partnership with business and community to enable more significant economic value possibilities.

In the case of the South Lake Union Streetcar project in Seattle, a SID fee from 760 land parcels was estimated to provide 52 percent of the total project cost. The City of Seattle issued government bonds to raise capital and linked them with a SID fund. The city assessed a SID fee in 2004 and land owners of the SID area approved it in 2005, the street car project became operational in 2007. The assessed SID fee was based on estimated land value uplift for various land uses. The land owners were provided an option to pay a SID fee up front or in 18 years at a 4.4% interest rate. In this case the use of SID was considered as low-risk as it was applied in an established urban area with a strong real estate market (Mathur & Smith, 2012).

In San Francisco a SID began with the establishment of a local committee by the district's residents, business owners, tenants, schools and developers. The committee prepared a local development proposal including financial plan and sought approval from local government authorities. The district residents were charged with elevated property taxes to fund the infrastructure. The involvement of developers in the committee from early stages was notable as they were perceived as a catalyst for the investment (Clark & Mountford, 2007).

Business Improvement Districts (BID) are common in the US and Australian cities for small area improvements. A BID is a non-profit organization for a designated commercial area involving the local land owners and is used to enhance infrastructure and services of the commercial area to help improve local business. BID services are funded through an additional charge on land owners. There are about 72 BID's in New York City serving 84,000 business (City of New York, 2016). The potential to turn a BID into a larger SID with urban rail and TOD outcomes remains as a real option in many cities as the BID processes are well understood and trusted.

Most of the SID based tools are structured as public private partnerships involving community participation, sometimes called PPPC's. In this partnership property owners and businesses self-impose a fee, in partnership with the government and community, for perceived land value gains due to the improved benefits in access or multiple non-transport services in TOD's. Thus the financial risk is primarily borne by the beneficiaries of the project.

No BID or SID tool has ever been used to create an urban rail project in Australia but could be used in the new City Deal process outlined below.

Fully Private: Entrepreneur Rail Development

The Entrepreneur Rail Model was developed out of the need to truly integrate transit and land use through finance to create the highest value outcomes (Newman, Davies-Slate & Jones, 2017). However, this is not an entirely new approach as historically this is how tram and train lines were developed. 'Joint development' has also been used for building urban rail since the 1980's wherever a major TOD was considered as a joint outcome (Newman & Kenworthy, 1999). These joint developments were set up to supplement government money through land development but they can also be used to go further and create a fully private approach.

The Entrepreneur Rail model emphasizes the important role of involving private sector expertise and approaches to redevelopment in the early stages of any new urban rail project otherwise it is not going to be possible to generate private investment or to create the economic value that is sought from developing urban regeneration-based TOD's.

Thus the tools in this section are based on formal public-private partnership arrangements designed to implement infrastructure projects through risk-sharing but all the finance is coming from private investment. These PPP arrangements where the private sector pay for the infrastructure and make money out of the value created, are common in mining, energy, ports and airports but are not yet very common in many parts of the world like Europe, America and Australia for transit projects. They are however common in Japan and Hong Kong. In our view, this LVC tool is likely to create the most economic value.

Historically private entrepreneurs have initiated public transport in cities. The US's first omnibus started in New York City in the 1820s by private operators who then laid down rails (in 1860's) to replace horse drawn carriages (Glaeser, 2012). The first private rail projects began in the 1840's in the UK and the earliest in the US dates back to the Pacific Railroad Act of 1862, under which government provided land grants, 400-foot rights of way plus ten square miles for every mile of track built, for the construction of the transcontinental railroad. Other private projects in history, especially in Perth, are outlined in Newman, Davies-Slate & Jones (2017). These projects are similar to what is now known as 'unsolicited bids' from the private sector. The Entrepreneur Rail Model enables partnership proposals that involve fully private investment but are still best developed with community and government involved as well.

Fully private capital and operational funding with minimal government in-kind support can be illustrated from case studies where this approach has been used including the Brightline project in Florida, Rapid Rail in Gurgaon and Tokyu Den-en-toshi Line in Tokyo.

Brightline is a privately owned inter-city rail service and TOD project linking Miami to Fort Lauderdale and West Palm Beach using a relatively fast train (160 kph). The phase 1 of the Brightline project will be opened in late 2017. The project utilizes an existing freight rail line of 312 kms and plans to add 64 kms to Orlando after the first stage has been established. Project finance was raised through a mixture of debt, bonds and equity. Private developers have not had to seek public subsidies or grants other than federal low-interest private activity bonds which provide a risk guarantee. Such private sector financing structure has been made feasible through the establishment of TOD's at each of the four rail stations (Renne, 2017). Brightline's economic study (The Washington Economics Group, 2014) notes that in the timeframe from 2014 to 2021 the project will result in an economic impact of approximately $6.4 billion comprised of $3.4 billion from Rail-Line Construction, $887 million from Rail-Line Operations, $1.8 billion from TOD Construction, and $284 million from TOD Operations, in the same timeframe the project will add USD 653 million to Federal, State & Local Tax revenue, $945 million from rail and $235 million from TODs. Therefore, Brightline is showing significant value creation through private investment and expertise in land development.

Japan has historically used Entrepreneur Rail Model development in order to fund and build urban railways. They amalgamate irregularly formed properties that result in smaller but fully serviced urban neighbourhoods and involves sale of 'extra' land to fund the associated railways. The government, as in-kind support, enables land consolidation and acquisition. This approach is known as land assembly or land adjustment. In case of Tokyu Den-en-toshi Line in Tokyo, in addition to land adjustment, the private company purchased land before announcing their plan to build the rail line and on some land parcels they co-developed the land with landowners. A private developer promoted the area development by selling land, constructing housing, and attracting shopping centres and schools. This project was mainly implemented on a greenfield area (Bernick & Cervero, 1997; Sanders, 2015). The economic downturn in Japan in the last few decades has resulted in additional strategies for value capture such as strategic infill urban development around train stations. Private companies have been able to raise equity from the stock market for rail projects in Japan to avoid interest on loans (Metrolinx, 2013).

The Entrepreneur Rail development cases show a larger value creation potential through such extensive private participation enabling comprehensive and integrated development of TODs. The cases show that urban rail projects require private involvement to enable any active and entrepreneurial approaches for creating innovative ways for higher value and revenue.

<u>Land Value Capture Tools and Value Creation</u>

Considering different value capture tools the joint PPP development is the best one to create new economic value through bringing innovations in the planning and administration of public infrastructure, new technology, and most of all in creating the best market-oriented development potential in the land areas around stations. In other words, the Fully Private model enables a high value creation TAC.

The fully government land value capture tools are rigid in terms of their application to fund a specific infrastructure element and will make some development around stations less attractive for investment. Value capture occurs in land based levy, tax increment financing, and special investment district levy tools to help government fund urban rail. But this capture may not lead to enough further private investment and wider value creation to enable the full economic potential of the infrastructure and its agglomeration opportunities.

As shown in Figure 12 if government agencies continue to plan and fund urban rail they will have fewer and fewer opportunities to create sustainable transport and high value TODs. If governments seek greater involvement of the private sector from the start of projects, then by competitive transparent bidding it is possible to achieve greater and wider public and private economic goals through economic value creation.

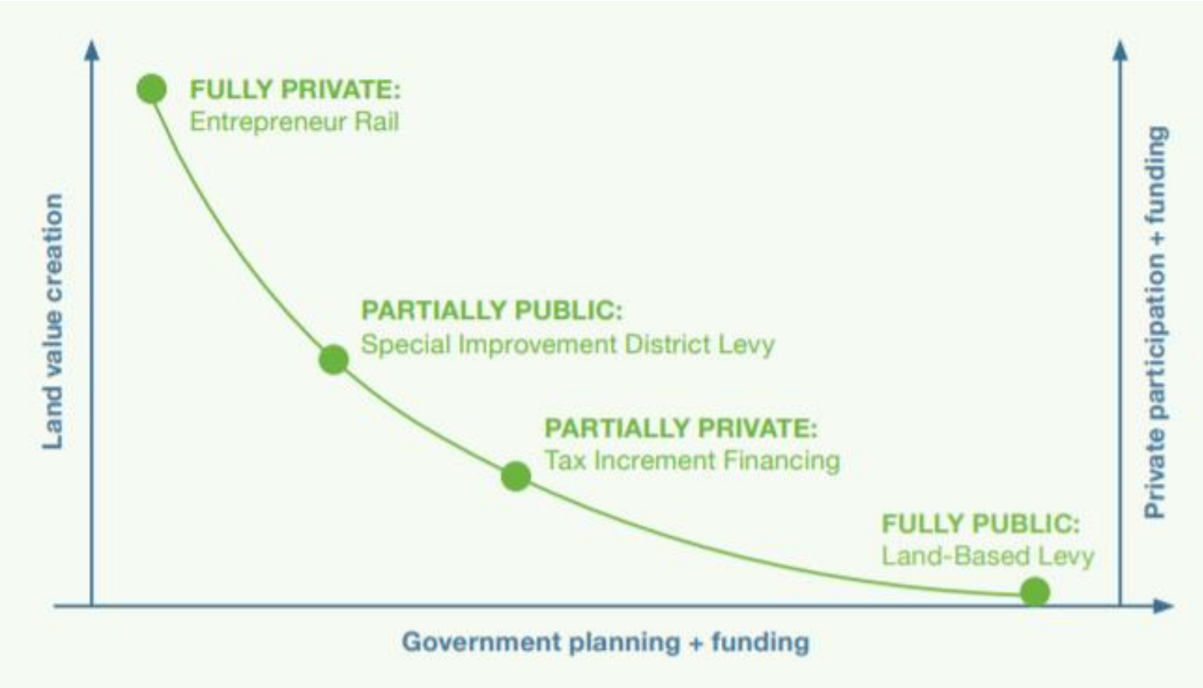

Figure 12 How land value creation varies with the extent of private involvement in TAC partnerships. (Source: Newman et al. 2018)

In the case of Entrepreneur Rail development, the full private participation can create additional value and capture opportunities as entrepreneurial opportunities are created, such as in the case of Brightline and Japan. Therefore, for the TAC development approach the optimal tool seems to be the Entrepreneur Rail Development model due to the private sector participation and comprehensive development for wider economic gains.

However, the next best is the Special Improvement District Levy model where private and community partnerships that help drive the rail and TOD planning and delivery, are developed in specified corridors. The other tools are able to deliver urban rail but may not achieve much in the way of value creation in the associated TOD's.

The Australian Federal Government have begun a new approach to funding urban rail called City Deals – they only provide financial risk guarantees. Many governments reacted by saying they would prefer the traditional approach of being given cash for projects. However, this misses the point that with financial risk guarantees significant numbers of new projects can be built but they require a new approach with various levels of LVC tools and partnerships with community and private expertise and investment.

City Deals mean that cities must create partnerships between the three levels of government and be based around partnerships with private investors who provide the capital that they can return through TOD and urban rail activity. City Deals also require multiple urban outcomes for inclusive, smart and sustainable cities, as well as being clear about community goals. The LVC tools can all provide some help but the Fully Private and the Partially Public tools are likely to be the only ones that can create a City Deal. Such approaches are increasingly occurring around the world (Clark & Clark, 2014).

Conclusions to section 3

The tools that can be used to create a PPP-based Transit Activated Corridor vary from traditional wholly government controlled processes that enable value to be captured but sacrifice value creation, through to entrepreneurial development where greater value creation happens with lower levels of government control but extensive partnerships. We have discussed these through various global examples in this background paper. Obviously, each city and each project will have different needs and requirements that will determine the appropriate mix of public and private investment in a PPP for integrated land use and transit. The main conclusion from this section of the background paper is that the more the private sector is involved in the investment and the process of developing a project, the more value creation is likely. This then has important implications for how a city is able to achieve its goals of development and especially its ability to achieve SDG's. And from the perspective of smart city technologies, it gives the fundamental framework from which these technologies can create a Smart Transit City, and not just a Smart Automobile Dependent City.

Private sector involvement for joint PPP development of a TAC project from the concept stage could increase the redevelopment potential commitment from the private sector and lead the public sector to focus on their core role of governance including community engagement and partnership development. This will lead to wider agglomeration benefits and economic gains as well as many local amenity gains.

The implementation process for TAC is not straightforward; it will require significant dialogue between community, private and public sectors. The public sector will have to create regulations to enable such processes and frame contracting documents for TAC that will address equity, sustainability and livability concerns of the community. Community engagement should be seen as an essential component not an optional extra as this can enable political validation as well as improving local amenity through their detailed knowledge of needs and options and hence provide the basis for partnerships with government and business. Smart technologies can be part of these dialogues.

Further research on such partnerships for a major project involving rail corridors and TODs, or road corridors and TAC's, can show the efficiencies and challenges in the life cycle of the project. The global move towards City Deals for such projects could show such partnerships required for infrastructure provision and sustainable urban growth in a city. Delivery mechanisms and procurement processes for TAC will need detailed consideration as the structures of most town planning and transport planning do not easily lend themselves to such outcomes.

4. Case Studies

This section will look at cities in China, India and Bhutan to compare different approaches to transport and urban planning and particularly how they are doing in managing the automobile. China and India have both had dramatic economic growth based on their cities which has led to substantial automobile usage growth whilst in the other case study city of Thimphu in Bhutan, this small city in a relatively poorer nation, is also growing rapidly in cars creating significant congestion issues. Data on the countries are provided in Table 4.1. and Figure 13. Thimphu will be compared to Perth, Australia, to see how Transit Activated Development could work in both cities although they are very different in many ways.

Table 4.1: Relevant National Characteristics for People's Republic of China, India and the Kingdom of Bhutan. (Data Sources: UN , 2018; WB, 2019; IEA, 2007; IEA, 2017; Bhutan energy data directory, 2007; Yangka, 2019)

Indicator	People's Republic of China	India	Kingdom of Bhutan
Population in 2000 (Millions)	1,270	1,053	0.573
Population in 2015 (Millions)	1,397	1,309	0.787
% Compound Annual Growth Rate (CAGR) for Population 2000-2015	*0.6%*	*1.5%*	*2.14%*
Share of Urban Population (2015)	55.5%	32.8%	38.68%
GDP per capita PPP 2015 (constant international 2011 $)	13,319	5,748	8,380
Transport Energy Consumption 2000 (Mtoe)	90	32	0.035
Transport Energy Consumption 2015 (Mtoe)	300	85	0.126
% CAGR Transport Energy 2000-15	*8.4%*	*6.8%*	*8.91%*
Transport CO2 Emissions 2015 (Million tCO2)	968	265	0.382
Per Capita Energy Intensity transport 2015 (ktoe/person)	215	65	160
Per Capita CO2 Emissions transport 2015 (kgCO2/person)	693	202	485

The three case studies will focus on Delhi, Beijing and Thimphu. The table and graph show trends in mobility drivers and mode share in New Delhi and Beijing (Thimphu data has not been collected at such scale over these timeframes).

Table 4.2: Trends in Mobility Drivers across New Delhi and Beijing
(Data Sources: Kenworthy, 2017, MRSP, 2012, Pojani and Stead, 2017, MRSP, 2012)

Cities	Year	Population (x 1000)	Per Capita GDP (USD 1995 rates)	Density (Persons/Hectare)
New Delhi	1995	11,635	1,264[b]	63.5[a]
	2017	15,906	6,646	112.9
	CAGR	***1.4%***	***10.9%***	***2.2%***
Beijing	1995	8,355	1,829	123.1
	2017	19,228	11,463[d]	109.0
	CAGR	***3.9%***	***18.2%***	***0.5%***

Where a=1991, b=2001, c=2011, d=2015

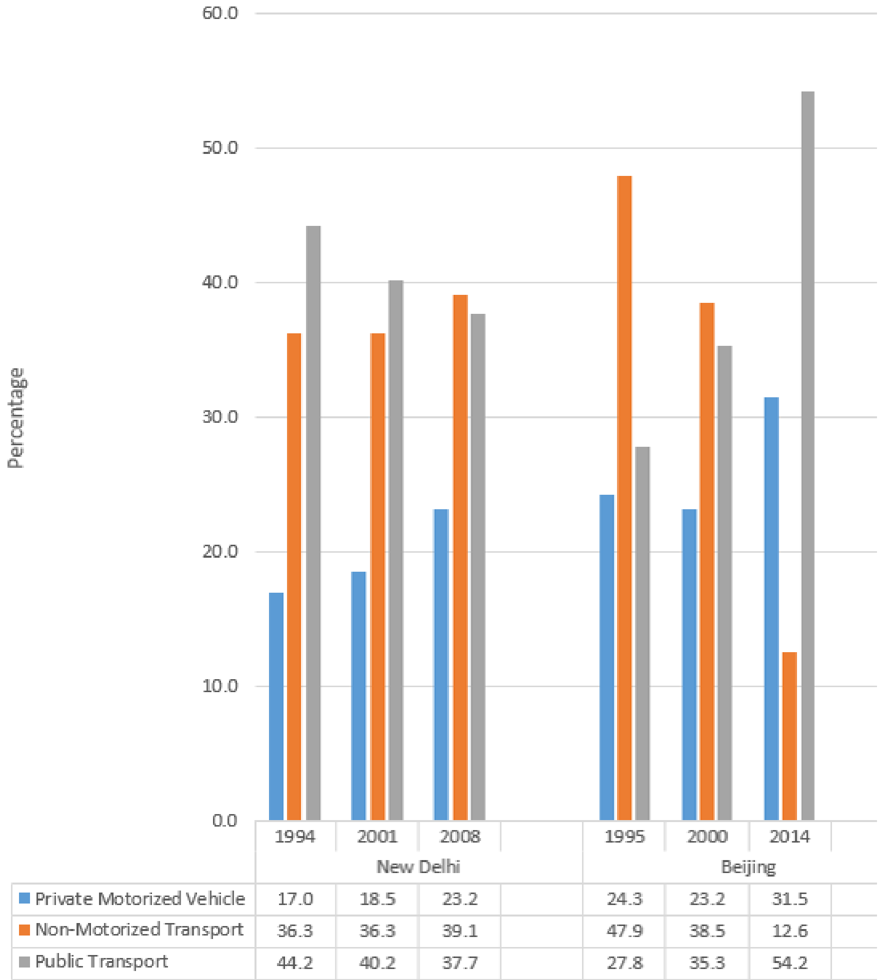

Figure 13 Transport mode share in New Delhi and Beijing over time: Source Dhar et al., 2019

<u>Case Study 1: How China's capital Beijing is coping with automobile dependence</u>

China's urbanisation has led to dramatic increases in economic growth. Between 1978 and 2013, the disposable per capita income in China increased 50 times. Beijing, the capital city, has increased from 8.1 million in 2012 to 13.5 million (Kenworthy, 2017). However, the density has decreased from 123 in 1995 Persons/hectare to 109 Person/hectare in 2015, which is mainly due to development in the outer metropolitan area of the city though inner and central areas continued to increase in density (Gao and Newman, 2018). The decrease in density because of city expansion into outer areas and increased per capita income has increased the reliance on car travel in Beijing. The number of cars per 1000 persons in Beijing increased more than five times from 42.9 in 1995 to 230.9 in 2012. The mode share in the total trips has also changed dramatically, the share of non-motorized trips drastically reduced from 42.6% in 1995 to 13.9% in 2012, whereas the share of both public and motorised private modes increased from 30.7% to 44.0% and from 26.7% to 42.1% respectively.

More recent trends for Beijing are set out below which suggest that motorization-based mobility in emerging cities can be curbed but will require a range of infrastructure and policy changes that increase the relative speed and cost of transit and NMT. The decline in car use per capita across most developed cities in the past decade has been attributed to a range of factors (Newman and Kenworthy, 2015) but has been generally seen as not applicable to emerging economies as their disposable incomes across the average citizen are still much lower. However, Beijing has achieved peak car in 2010 (Figure B1) at per capita income level of around 11,000 USD.

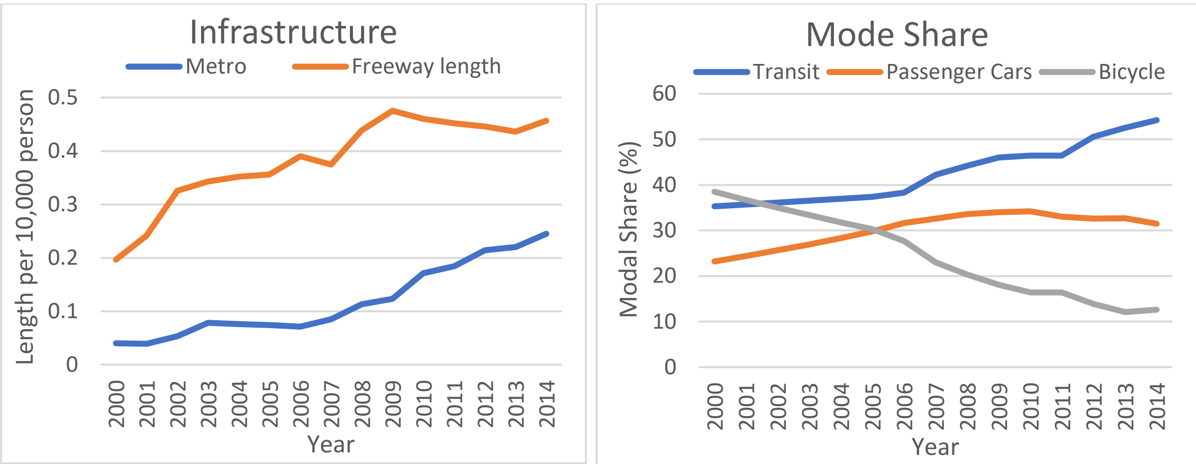

Figure 14: Transitions in Modal Shares, Metro length and Freeways in Beijing

The achievement of peak car in Beijing is the consequence of deliberate policy and infrastructure choices. The peaking of car use coincides with a change in priorities for spending on infrastructure with a switch from Freeway spending to transit systems (Metros). Similar trends are also witnessed for Shanghai (Gao and Newman, 2018).

The peaking of car use in Chinese cities besides policies on the supply side that augment transit capacity is also the result of demand-side measures that reduce the availability, convenience and flexibility of cars e.g., there are restrictions on the purchase of cars and you are not allowed to drive fossil-fuelled cars inside the city (Gao and Newman, 2018). It is now possible to build smart city technologies into the whole transport system as it has a core of transit and NMT opportunities. It is therefore taking on some of the new smart transit systems such as Trackless Trams (Newman et al. 2018).

The Chinese government does do value-capture related transit as it builds shopping centres and offices into stations to help pay for the Metro lines. The government owned Hong Kong Mass Transit Railway (MTR) Corporation has to run as a private corporation undertaking significant land development with private sector partnership to turn a net loss in the 1980s into profit worth USD 2 billion in 2015. The key to MTR financial success is starting the land development-based finances before the actual rail line operation (Cervero & Murakami, 2009; Mass Transit Railway, 2016; Zhao, Das & Larson, 2012). Such an entrepreneurial approach is required in urban rail projects which necessitates private involvement.

<u>Case Study 2: Transit Activated Development in India is an opportunity for New Delhi</u>

India has adopted a policy of slow urbanisation (until recently) while encouraging economic growth. Despite comparatively low urbanisation (32.8%), India has the second-largest urban population in the world (377 million). The per capita income (in PPP terms) has grown rapidly since 2000 from US $2130 to US $5,748 in 2015 (World Bank, 2019). However, the income levels are still below China. In Indian cities significant share of travel is with non-motorized modes, that is walking, and bicycling (around 40%), about 15% use public transport, and 36% use private transport of which, 20% is by motorcycle. The land use in cities in India has been characterised as having high density, low rise and with mixed land use.

In Delhi, the number of Vehicles/1000 persons increased from 125 vehicles/1000 persons in 2001, 441 vehicles/1000 person in 2011. In 2008, 39% of total trips in Delhi were made using NMT modes (35% by walking), 38% by public transport (31% by Metro/bus and the rest by auto-rickshaw and cycle-rickshaw) and 13% trips were made using private motorized modes of transport (9% by car). Delhi's metro has grown rapidly since this period (Sharma & Newman, 2018; Sharma & Newman, 2016). The population density in Delhi is 93 persons/hectare which increased to 112 persons/hectare in 2011.

Delhi has been trying a range of partnership approaches to try and help build new transit systems like Metro. Other Indian cities have been doing likewise. In the case of Gurgaon, the urban rail project is fully privatised under a Design Build Finance Operate Transfer (DBFOT) agreement with a 99-year concession period. The private developer financed the project through private loans and equity raising. The government provided an existing right of way for the rail line, however access to the station and transport interchange facilities as well as land acquisition for stations was undertaken by the private developer. Project revenue sources include fare-box collection, advertisement and leasing of shops within the station area, however no land development was involved. The private developer conducted an aggressive advertising campaign which resulted in 61% of the total revenue in 2014-16 through the auctioning of the naming rights for the stations (even before the stations were opened) and advertisement space on the inside and exterior of the train coaches (Deloitte Haskins & Sells, 2015). The private developer operates 'free' feeder bus service to adjacent industrial hubs from stations in order to increase fare-box revenue. The feeder service benefits the commuters by providing comfortable last mile connectivity. This case shows that full private participation results in innovative revenue strategies and greater public benefit however it is very unusual not to have used land development opportunities and it remains to be seen whether the project can survive without this.

In other Indian cities there are clearly lessons that can be learned for Delhi. In Mumbai a new rail line was built based entirely on the private owner paying for it from the fare box but this was never enough, even in Mumbai where rail is so important. In Bangalore the value around Metro stations increased by 25% in the area going out between 500m and 1km and more significantly a ‘before’ and ‘after’ from the commencement of the metro rail operations shows a price uplift of 4.5% across the whole city; this indicates a major agglomeration economic event resulting in substantial economic value increase of USD 306 million from the metro rail’s accessibility (Sharma & Newman, 2017a). Thus a PPP approach involving land development can work in India.

Hyderabad Metro involves significant land development. It is built on a DBFOT agreement wherein a private developer was provided about 10% of the capital cost as grant (equity) from the federal government of India and the state/ provisional government granted air-rights for commercial development of about 12.5 million sq. ft. over the three depots and 6 million sq. ft. at the 25 select stations. The private developer has raised capital through loans and equity. The private developer’s concession period is for 35 years. The project was operational in mid-2017. The private developer started renting the spaces before the rail is operational. This case shows the private sector’s active approach towards enhancing revenue streams.

Case Study 3: The potential for Transit Activated Corridors to shape both developed and developing car-dependent cities: The case of Thimphu, Bhutan and Perth, Australia.

Trackless trams can provide both developed and emerging cities facing different urban challenges an opportunity to break out of automobile dependence and avoid more urban sprawl and congestion. Let us consider two cities:

1. *Thimphu, a developing city which is the capital city of The Kingdom of Bhutan with a population of 100,000 and aspirations to grow to 400,000 in a valley with very limited development space.*
    - Automobile dependence: Thimphu’s automobile dependence has seen a rapid rise in recent times and has been forecast by the Asian Development Bank to increase from 75,000 vehicles in 2015 to over 350,000 in 2040. Over 50% of the total vehicles in the country are located in the Thimphu region (Road Safety and Transport Authority of Bhutan, 2018).
    - Forecast urban growth: The city is only 26km2 in land area, and plans to accommodate an additional 300,000 people by 2050 in addition to it’s existing 150,000. This would mean the city would quadruple in size. The steep topography of the valley surrounding the city means that the city cannot spread much beyond it’s initial footprint.
    - Corridor transit opportunity: Hargroves and Gaudremeau proposed a new 8.5 Km transit corridor with 12 stations for Thimphu that has the potential reduce the need for 75km2 of land on the fringes to 37.5 km2 of dense, urban re-development. The results are seen in table 4.3.
2. *Perth, a developed city which is the capital city of Western Australia with a population of 2 million that is sprawled 150km along the coast of Australia.*
    - Automobile dependence: Perth has a strong history of automobile dependence since the 1950s like many developed cities that once had tramways but removed them to prioritise cars. This has led to significant urban sprawl along the Indian Ocean coastline.
    - Forecast urban growth: The city is looking to grow it’s metropolitan population by an additional 1,200,000 people by 2050. The strategic plans of the city state that over half

of this population growth is intended to occur within inner to middle urban areas (rather than more sprawl.

- Corridor transit opportunity: A proposal has been put forward for Perth to provide a new 25km transit corridor with 12 stations that stands to reduce the need for 100km2 of urban fringe development and instead focus on facilitating 65.7 km2 of urban re-development – see Table 4.3.

Table 4.3 below shows the space saving possible for both Perth and Thimpu if the next decades of urban growth are steered towards inner to middle metropolitan urban regeneration rather than fringe sprawl. This type of infill must happen around transit nodes.

Table 4.3. Estimates of land space savings from adoption of corridor transit systems in Perth, Australia and Thimphu, Bhutan (Newman et al, 2018)

Parameter	Perth	Thimphu	Units
Predicted Additional Population	120,000	300,000	People (Ppl)
Population Density (Fringe)	12	40	Ppl/Hectare
Population Density (Corridor Stations)	35	80	Ppl/Hectare
Additional Area Required (Fringe)	100	75	km2
Additional Area Required (Corridor Stations)	34.3	37.5	km2
Area saved by corridor transit approach	**65.7**	**37.5**	**km2**

Similarly, for each of the cities, the space saving from reduced parking is significant, as more of the population can instead ride transit. This also opens up the opportunity for re-development of greater intensity due to less parking requirements. These estimates can be seen in table 4.4 below.

Table 4.4: Estimates of parking space savings from adoption of corridor transit systems in Perth, Australia and Thimphu, Bhutan (Newman et al, 2018)

Parameter	Perth	Thimphu	Units
Predicted Additional Population	120,000	300,000	People
Car Park Supply (Urban Fringe)	10	4	Ppl/Hectare
Car Park Supply (Corridor Transit)	4	2	Bays/Hectare
Additional Parking Area Required (Fringe)	15.6	15.4	km2
Additional Parking Area Required (Corridor)	6.2	7.7	km2
Area saved in a corridor transit approach	**9.3**	**7.7**	**km2**

These two cities highlight the type of decision making that is needed in growing cities around the world over the coming decades. Thimphu and Perth are cities in very different parts of the world, however have some commonalities that they share with many cities around the world:

- Both are going to experience significant population growth over the coming decades, meaning they will need to make pivotal decisions about what type of urban growth they facilitate – supporting by transport infrastructure provision.

- Both are seeking to break out of the constraints of automobile dependence that has gripped them and most cities around the world in recent decades, and led to much sprawl, pollution, low density growth and pollution.
- Both need Transit Activated Corridors to enable the growth of their cities to happen in a sustainable and resilient way, that does not sprawl further and instead creates liveable, higher density centres around highly efficient transit.
- Both cities need private investment in fixed route transit to accelerate this transition. This is where the private sector and government incentives can be aligned to both play a role in shaping the future of their city in a sustainable way through transit provision and dense urban redevelopment. It is clear there is a demand for both.

5. Conclusions and Recommendations

The final section of this background paper sets out 8 key conclusions and recommendations based on the discussion outlined in the background paper.

1. **<u>Making the right choices about the type of city we create with our infrastructure decisions depends on the priority given to transit or to cars.</u>**

It is clear that there are a number of public-private partnership mechanisms and 'Smart' technologies that have the potential to empower Asian governments to create more smart, sustainable and resilient cities. However, the partnership mechanisms are influenced by the transport infrastructure that is prioritised by a city – and the type of transit it facilitates. Similarly, Smart Technologies are not an 'add on' that will make any city smart and sustainable regardless of it's transport choices.

The key differentiator that underpins the success of both of these opportunities are the strategic, policy and infrastructure decisions that are made by city governments that determine what type of city is created for it's people. The two opposing futures are:

- **Automobile dependent cities** that prioritise car ridership, focus on building more lanes for cars which cause congestion, facilitate urban sprawl rather than density, and result in a number of negative environmental and social impacts.
- **Transit cities** that prioritise transit such as high speed rail, trams and buses, and aim to get people out of cars and move people much more efficiently using active and transit modes. Such cities can facilitate greater density, mixed use areas around transit and create economic value. The potential for Trackless Trams to bring smart technology and high quality transit into a road corridor of a city has been a major focus.

2. **<u>Adding 'Smart' technology to either of these cities will amplify their characteristics.</u>**

'Smart' car cities will have more cars on the road than car cities. 'Smart' transit cities will have more people on transit than transit cities. A comparison of these two cities is provided in Table 5.1 below. Both cities have the same level of smart technology applied to them but the outcomes are very different depending on whether it is marking the city a Smart Transit City or a Smart Car City.

Table 5.1: Performance attributes of Smart-Car Cities and Smart-Transit Cities

Attributes of City Transport Network	*Smart-Car City*	*Smart-Transit City*
Spatial efficiency for moving people	Low	High
Ability to cope with increasing urban density	Low	High
Ability to cope with increasing congestion	Low	High
Ability to cope with interruptions to the network	Medium	Medium
Ability to create people focused walkable spaces	Low	High
Energy efficiency per passenger	Low	High
Level of dependence on oil	Low	High
Level of Safety	Low	High
Level of Liveability	Low	High
Level of Climate Transformative Development	Low	High

Level of Resilience to climate change impacts	Medium	High
Level of achievement of SDG's	Low	High
Level of 'Smart Technology' applied	Medium	Medium

3. **Create new transport capacity in-line with a trajectory towards transit-based cities of the future using an integrated approach.**

This will need a strategic transport plan to:

- Prioritise mass transit (both heavy rail and on-road trams and buses) as outlined in Section 2, rather than focusing on expanding highways to prioritise more car use and congestion.
- Prioritise last mile mobility solutions around stations that can act as feeders into key transit nodes, rather than having no broader system coordination with long-distance transit lines. These can be a variety of traditional auto rickshaws or bikes and modern shared taxis like Uber and Lyft.
- Create opportunities for active travel for local and medium-term trips, through urban design for walkability and cycling infrastructure.
- Integrate all these with transit and dense, mixed land use at stations.

4. **Create new integrated land use and policy that align to sustainability and attractive private investment.**

This will require a Strategic Land Use Plan that will:

- Steer new urban growth over coming decades to within existing metropolitan boundaries ('infill'), particularly within close proximity to mass transit stations. Allow for greater densities in these key areas.
- Encourage mixed use development (where commercial, retail, and residential land uses are co-located) to occur rather than single-use development, so that people can reach nearby useful locations without a car.
- Encourage all station precincts and surrounding catchment areas to incorporate walkable and cycling-friendly urban design as to remove the need for private vehicles in these areas.
- Reduce requirements for car parking in dense urban areas, allowing more commercial, retail and residential land use and more open space.

5. **Determine the key transport infrastructure investment gaps and prioritize them.**

This background paper argues that transit cities are the only type of city that can effectively address the challenges of rapidly growing cities in Asia. The primary infrastructure finance gaps that exist for this type of urban future are:

- **Separated heavy rail infrastructure:** This includes potential subways and above ground rail lines where efficient metro systems can move large amounts of people. Such systems are expensive and are increasing in demand all over the world, with significant shortages in government funds to supply them.

- **On-road transit corridors:** These services include trams, trackless trams, bus rapid transit systems and the associated infrastructure. Transit cities need such corridor transit to support a primary heavy rail transit backbone, and should be complemented by attractive urban design and station precincts.

These two areas of critical funding shortages for Asian cities have been the focus of public private partnerships throughout this background paper. The suggestion has been made that the highly successful provision of separated urban rail corridors in Asian cities should now shift more towards a focus on urban road corridors with Trackless Trams, otherwise Asian cities will not be able to achieve their development goals. The following sub-section provides key recommendations for attracting private finance to this area.

6. **Funding can be created through leveraging the value created by transit through Public Private Partnerships (PPPs)**

Transit creates many economic benefits for a city. Governments can work with the private sector to close the transit infrastructure finance gap in their cities, leveraging the economic value that is created that offers commercial gain for private participants. The most integrated (most input provided from land use considerations) and collaborative (private sector involved from earliest in the process) this process can be, then the better the outcomes.

7. **The fundamental step in making a viable PPP to fund transit infrastructure is to create a Transit Activated Corridor.**

The main steps to making a Transit Activated Corridor will follow the Entrepreneur Rail Model:

a. Identify land use uplift potential of a corridor:

- Rather than focus solely on transport, instead begin the corridor planning process by considering land use opportunities within the corridor (which are also the key to meeting sustainable urban/population growth objectives).
- Once a potential corridor is identified show how new technology transit such as a Trackless Tram with integrated smart systems including last mile connection and recharge facilities for electric mobility, can help to unlock the value in this potential land development.

This stage requires collaboration between Government agencies, private land developers/real estate parties, and the community.

b. Investigate financing options for new Transit Activated Corridor:

- Estimate land value uplift potential by comparing current values and projected future values that could be achieved if quality transit and other smart technologies are provided.
- Explore financing options from private sources willing to invest in long-term projects based around the land development opportunities being created through the partnerships.

This stage requires collaboration between Government agencies (mostly land and economics), private land developers/real estate parties, and private finance sources (banks, investment funds, etc.).

c. *Design transit configuration that can 'Activate' the corridor (unlock the economic value):*
    - Undertake a transit planning process that provides optimum mass transit infrastructure to serve the key land parcels identified in the opportunity and finance phases.
    - Ensure that the new transit line integrates with the existing transport system.
    - Design the last mile integrated services and other smart technologies that can help create a totally integrated transport system.

This process incorporates Government transit planning agencies and land/economics input as well as private developers with an interest in smart technology related to transit activated corridors.

d. *Align governance mechanisms to project objectives*
    - Ensure that government policies allow for new technologies and partnership models to be implemented. Also consider a new government entity within land development/urban growth that could be responsible for linking land development to transit projects, either as a separate body or within the transit agency.
    - Ensure that station precincts and wider urban impacts are managed and appropriate community outcomes are achieved.

This stage of the project needs a high level governance process like a City Deal that can provide financial risk mitigation for private investors in projects.

8. <u>Governance approach to enable this Transit Activated Corridor-PPP model will establish partnerships early and extensively.</u>

The main ways to do this consist of establishing partnerships that:

- Engage private sector and land developers as early in the process as possible. Rather than government doing all of the planning and then bringing a project to the private sector and asking for funds, land developers should be engaged from the beginning to identify opportunities that work for them. This also encourages them to bear more of the risk.
- Align government, community and private sector incentives. Some of the value capture mechanisms rely on the costs of publicly funded transit being regained from land taxes after the infrastructure has been built. However, this does not result in as strong an incentive for development around stations as there is no upfront contribution and land taxes have now increased in these areas.
- Engage communities throughout the process. This reduces risk by ensuring that community expectations for services, opportunity and amenity are embedded in the project and thus greater demand for such precincts and services will be generated post-project. This is akin to 'incorporating customer feedback'.
- Allow some flexibility in the planning process. Conventional approaches rely on government to come up with the answers and want to control the outcomes. Allow for private bids to arise for new transit projects, and incorporate community and private ideation along the way. This is key in attracting private funding and creating integrated outcomes.

The Way Forward

Member countries of the Environmentally Sustainable Transport Forum in Asia and their cities have the opportunity to adopt the recommendations provided in this background paper to move towards a more safe, smart, sustainable and resilient future.

The past decade of Environmentally Sustainable Transport in Asia has been remarkably successful with the data shown by the ADB on the switch from financing road capacity increases to a greater emphasis on public transport. The model of how to do government-funded rail corridors has been very successful and needs to continue. However, there is a need to add a new model based on PPP-funded urban road-based transit, especially using the new technology Trackless Tram. This can also be a major way to enable smart city technology to be applied to enable broad SDG outcomes, not just branding.

The core to achieving a greater focus on urban road-based transit is Transit Activated Corridors that are driven by achieving better urban regeneration and redevelopment. Critical to this is partnerships, especially with the private sector who do the urban redevelopment. Partnerships are at the core of the Sustainable Development Goals (being Goal number 17 specifically) and are a key tenet of the 2030 Agenda for Sustainable Development. Not only must countries work together by participating in Forums such as the EST Forum, to share knowledge and best practices, but they must also work within their own boundaries with stakeholders including the private sector and the community. There are many sectors where this is being done but not much in transit projects. This is the way forward in EST.

Planning for Transit Activated Corridors in partnership with the private sector allows for co-benefits to be achieved, where transit, land use and finance are inherently linked and all participants are incentivised to achieve sustainable outcomes.

The approach to achieving these results are outlined in the background paper. The next wave of transit provision must be in partnership with the private sector if the required level of transit is to be funded and financed. The 2020-2030 period is key to achieving this. Therefore, the successor of the Bangkok 2020 Declaration (2010-2020) which will provide guidance to 2030, should focus on partnerships for meeting infrastructure needs.

Cities can seek to provide opportunities for private sector participants to invest in new transit infrastructure projects. This requires innovative thinking from city planners and decision makers. It is also important that social and community benefits are paramount.

Together, Governments, private sector and communities can partner to shape the next decade of urban growth. This pivot from automobile dependency is only possible through these partnerships, and if achieved will set Asian cities on a course that is ‘truly smart’; fostering sustainable growth, increased economic competitiveness and urban resilience.

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