Issues and Risks for Monorail Projects and Metro Systems

Issues and Risks in Procurement and Implementation of Monorail Projects compared with Metro Systems and the Methodology to mitigate the risks

Funded By
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Executive Summary

Modes Description

Both modes, i.e. Monorail and Metro Rail Systems are essentially grade separated high capacity public transport systems. Metro Rail is the highest in the hierarchy of public transport systems. It requires an exclusive, completely grade-separated alignment, underground or elevated structures. It is a high-capacity system with a train with four to ten cars and carrying capacity up to 80,000 Per Hour per Direction Traffic (PHPDT). It is costly to build, operate and maintain.

Nonetheless, for corridors with a PHPDT of over 25 to 30 thousand, it is the only system which works. At present more than 175 cities in the world have operational metro rail, while 50 more are in the process of constructing it – 25 of them in China and 9 of them in India itself.

Monorail is a sleek, elevated mass rapid transit system which operates on a single beam (normally concrete) guide way and with rubber tiered wheels. It can be built to efficiently serve areas dominated by high-rises and sharp turns and where metro rail cannot penetrate. Its traction system is typically 750 volt DC. It can be configured to run as a driver less system. It is known to carry up to 15000 PHPDT.

Use of Monorail is relatively limited; about 10 locations for public transport around the World. In India the monorail system is under construction in Mumbai- and its PHPDT in first and last year of Project life is estimated between 7000-8500 PHPDT. Similarly, the latest DPR of Kozhikode puts the first and last year peak PHPDT as 7000-11500 approximately.

Issues in Procurement and Implementation of Mass Rapid Transit Projects

The procurement of Urban Mass Rapid Transit Systems e.g. MRT/ Monorail could be achieved either through a conventional contracting process or through a private sector led PPP format. Conventional contracting process does not include financing by the contractor while PPP includes private financing including operational and management efficiencies.

The type of conventional contracting process to be used depends on the extent to which the project has been defined (Designed). FIRM FIXED-PRICE CONTRACTS are used when the project can be fully defined with detailed specifications. Otherwise FIXED-PRICE WITH PRICE ADJUSTMENT format may be used.

When it is not possible at the time of placing the contract to estimate the extent or duration of the work or to anticipate costs with any substantial accuracy TIME-AND-MATERIALS CONTRACTS or COST-REIMBURSEMENT CONTRACTS can be used. INCENTIVE CONTRACTS are sometimes used to harness the profit motive to stimulate the contractor to perform at a lower cost, to produce a better product or service, or to cut down lead time in delivery dates.

PPPs contemplate the private sector being responsible and financially liable for performing all or a significant number of functions in connection with a project. Agencies use PPP delivery approach to obtain time and cost savings and better quality projects with reduced risks to the project sponsor. PPP format may vary according to the scope of responsibility and degree of risk assumed by the private partner.

Under a Design-Build contract, the risks may be assigned to the party best able to handle them. For example private sector may be better equipped to handle the risks associated with design quality, construction costs, leveraging / raising finances and adherence to the delivery schedule while the public sector may be better able to manage the public risks of environmental clearance, and right-of-way acquisition. Design-Build-Operate-Maintain and Build-Operate-Transfer approach offers increased incentives for the delivery of a better quality plan and project. Design-Build-Finance-Operate and Design-Build-Finance-Operate-Maintain in addition makes the contractor responsible for all or a major part of the project's financing and transfers the financial risks to the private partner during the contract period. Under the Build-Own-Operate approach, the private partner owns the facility and is assigned all operating revenue risk and any surplus revenues for the life of the facility.

Risks in Procurement and Implementation of Mass Rapid Transit Projects

The main risks involved in MRT / Monorail projects at pre-development stage, during development stage and during operations stage can be categorized as: Political Risks, Construction Risks, Market and Revenue Risks, Finance Risks, Legal Risks and Operating Risks. In addition, contracts commonly address Force Majeure and legal liability because they have proven to be sources of time and cost overruns.

Political risk concerns government actions that affect the ability to generate earnings. These include termination of the concession, the imposition of taxes or regulations, restrictions on the ability to collect or raise passenger tariff etc.

Construction risks i.e. design changes and unforeseen weather conditions during the construction phase lead to time and cost overrun. The private sector typically bears primary responsibility for the construction uncertainties and attempts to cover it through insurance.

Demand uncertainty continues to be a major factor in most of the projects. Traffic and tariff levels may not be sufficient to cover all costs, including construction, operation and maintenance. The private sector fully depends upon the government for the handling of the traffic and revenue risks.

Financial risk is the risk that project cash flows might be insufficient to cover debt service and then pay an adequate return on sponsor equity. Financial risks are best borne by the private sector but a substantial government risk sharing is required either through viability gap funding (VGF) , revenue or debt guarantees or through participation by state or multilateral development institutions.

Legal risks stem from weak implementation of regulatory commitments built into the contracts and the laws or other legal instruments that are relevant to the value of the transactions as it was originally assessed.

Operating risks are the risks that emerge at the time of the operations of the project. It can also involve the risks like force majeure risks that are beyond the control of both the public and private partners, such as fire or earthquakes, or other non-political factors such as strikes and industrial disturbances that impair the project's ability to earn revenues. Sometimes private insurance is becoming available for catastrophic risks but generally public sector is faced with the need to restructure the project if such disaster or problem occurs.

Risks - Metro Rail Vs. Monorail

Political risks, market and revenue risks, financial risks and legal risks are same for both MRT and Monorail projects. Construction risks are faced by both modes. Metro rail faces more risks than monorail due to more requirement of scarce urban land for ROW, specially because metro rail requires flat curves (Desirable 300m radius) than Monorail (50-70 m radius). On the other hand Monorail procurement carries more risks than Metro rail as number of suppliers is limited.

Operating risks are more in the case of Monorail as the technology finds limited use around the World and is new to India. Hence absorption of technology for construction, operation and maintenance and availability of spare parts could pose a threat to reliability of service. There is no ongoing innovation / research process currently undertaken in India. On the other hand, Metro rail systems around the World and in India are already stabilized as far as technology acceptance and availability of manufacturing infrastructure (for spare parts etc.) in the country.

Secondly risk of derailment i.e. wheels jumping the rails is higher in the case of Metro rail systems than the monorail. Thirdly, the arrangement for emergency evacuation in case of Monorail system is more complicated than the Metro rail.

Instruments for Mitigating Financial Risks

Instruments for mitigating Urban Transit Risks mainly rely on Government providing equity guarantees, debt guarantees, exchange rate guarantees, grants/subsidies, subordinated loans, minimum traffic and revenue guarantees, shadow revenue and opportunities for concession extensions and revenue enhancements.

Conclusion

Metro rail and monorail do not substitute for each other. Metro rail is a high capacity mode and monorail is a medium capacity mode. Each has its own limitations and application. Monorail can be introduced in narrow width roads because it uses two beams only and not an elevated deck which would block light and air underneath.

Procurement, construction and operation risks in a monorail are higher than for Metro rail because of limited use (experience with operation) and new technology.

Section : 1 STUDY OBJECTIVE & METHODOLOGY

1.1 BRIEF ABOUT BMRCL

Bangalore Metro Rail Corporation Limited (BMRCL) is a Special Purpose Vehicle created as a Joint Venture (JV) between Government of India and Government of Karnataka. Bangalore Metro Rail Project is the First Metro rail project in India which has been commissioned with 750V DC Third Rail on Standard Gauge. The Project consists of the following two Corridors:

- East-West Corridor (18.10 km) starting from Baiyappanahalli in the East and terminating at Mysore Road terminal in the West, and
- North-South Corridor (24.20 km) starting from Nagasandra in the North and terminating at Puttenahalli in the South.

The Bangalore Metro has been designed for a capacity of 40,000 PHPDT. The number of passengers expected to travel on the metro everyday is estimated at 12 lakhs in 2013 and 19 lakhs in 2021.

BMRCL is considering alternative transit options to alleviate congestion on various other city corridors. Accordingly, BMRCL has retained **Institute of Urban Transport (IUT)** in undertaking a comprehensive study in order to assess the “Issues & risks in Procurement and Implementation of monorail projects compared with metro rail systems and accordingly to suggest the methodology to mitigate the risks”.

1.2 SCOPE & METHODOLOGY OF THE STUDY

This assessment report compares the technical features of metro rail (MRT, LRT) and monorail systems. All of these modes are becoming increasingly popular choices in urban communities beset by congestion problems. The urban mass transit modes examined in this analysis offer qualities of sleekness and high technology that help transit to overcome the stigma that many commuters attach to buses and IPT including some of the personalized mode of transports. Both the modes typically offer higher passenger capacity, increased reliability, and more frequent service than conventional bus modes.

1.2.1 Identification of Issues : MRT Vs. Monorail

The goal of this assessment report is to outline the issues pertaining to development of each of these modes. It will also introduce the basics of each mode so that an educated opinion could be formed about which mode is most appropriate and the issues & risks involved for its procurement. As a part of the study, IUT will identify various key issue areas for both the modes of transport, such as:

- planning and institutional;
- legal and regulatory;
- concession / implementation contracts;
- government support mechanisms;
- traffic forecasting & ridership determination;
- setting and adjusting the ridership tariff rates;
- financing structure and sources;
- public acceptance; and
- the role of international donor agencies.

The study shall also include a detailed section highlighting the issues pertaining to technological & operational parameters as stated below:

- A general discussion of metro and monorail systems
- Comparison of construction and infrastructure costs
- Comparison of vehicles
- Comparison of operational performance

1.2.2 Risks Identification & Allocation Mechanisms

Based on the Detailed Review of various issues involved in procurement / development of MRT/Monorail Systems, IUT shall identify key risks areas during the entire project life cycle and accordingly suggest the most appropriate mitigation mechanisms.

Choosing amongst the options for procurement of MRT / Monorail System under private participation / SPV structure depends on the particular needs of the authority and the nature of risk sharing between the public and private sectors. The risk to which each party is committed through the contract is to be clearly defined as well as understood so that disputes may not occur and the responsibilities will be based on the assignment spelled out in the contract.

The rule of thumb is that public or private urban mass transit projects such as MRT / Monorail work best when project risks and responsibilities are assigned to the party that can best bear them. The private sector is generally better managing commercial risks and responsibilities, such as those associated with construction, operation and financing. In contrast, urban mass transit may also depend on public participation in areas such as acquisition of right-of-way, political risk and in some cases, traffic and revenue risk. The government considers giving financial support or guarantees if traffic levels in the early years are insufficient.

The main risks involved in urban mass transit (MRT / Monorail) projects are:

- Political Risks
- Construction Risks
- Market and Revenue Risks
- Finance Risks
- Legal Risks
- Operating Risks

The risks involved at pre-development stage, during development stage and during operations stage shall be clubbed under the aforesaid categories. In addition, contracts commonly address Force Majeure and legal liability because they have proven to be the serious sources of cost overruns in the sector. The study examines all the above risks for procurement of MRT vs. Monorail and highlights the common mitigation measures.

SECTION : 2 METRO SYSTEM Vs. MONORAIL - TECHNOLOGY REVIEW

2.1 OVERVIEW

This section compares the fundamental technical considerations of metro rail including light rail transit (LRT), elevated light rail transit, and monorail. These modes are becoming increasingly popular choices in communities beset by congestion problems. The aforesaid modes examined in this review offer qualities of sleekness and high technology that help transit overcome the stigma that many commuters attach to buses. All of these modes typically offer higher passenger capacity, increased reliability, and more frequent service than conventional bus modes.

The goal of this review is to outline the issues pertaining to development of each of these mass rapid transit modes. The review includes:

- A general discussion of Metro Systems including LRT & elevated LRT, and monorail systems
- Comparison of construction and infrastructure costs
- Comparison of vehicles
- Comparison of operational performance

2.1.1 Metro Rail System

A metro rail system is defined as an urban, electric passenger transport system with high capcity and high frequency of service, which is totally independent from other traffic, road or pedestrians.

The dividing line between metro and other modes of public transport, such as light rail and commuter rail, is not always clear. A common way to distinguish metro from light rail is by their separation from other traffic. While light rail systems may share roads or have level crossings, a metro system runs, almost always, on a grade-separated exclusive right-of-way. And in contrast to commuter rail, metro rail systems are primarily used for transport within a city, and have higher service frequency, typically not more than 10 minutes between trains during normal daytime service. Furthermore, most metro rail systems do not share tracks with freight trains or inter-city rail services. It is however not relevant whether the system runs on steel wheels or rubber tyres, or if the power supply is from a third rail or overhead lines.

The metro rail system has proved to be most efficient in terms of energy consumption, space occupancy and numbers transported:

- Hi-capacity carriers – very high volumes of peak hour peak direction trips
- Eco-friendly – causes no air pollution, much lesser sound pollution
- Low energy consumption – 20% per passenger km in comparison to road -based systems
- Greater traffic capacity – carries as much traffic as 7 lanes of bus traffic or 24 lanes of car traffic (either way)
- Very low ground space occupation – 2 metres width only for elevated rail
- Faster – reduces journey time by 50% to 75%

2.1.2 Light Rail Transit (LRT)

Over the last few decades, light rail transit has become a popular rail transit mode that is cheaper than heavy rail systems *and of course less capacity*. Unlike heavy rail, LRT vehicles are lighter and generally operate singly or in two-car trains *(Even upto 4 car trains when fully segregated)*. Because they are powered from overhead wires, LRT cars can cross streets or even run along streets. Light rail is commonly used in European cities (such as Amsterdam, Stockholm, Paris and other cities where LRT has evolved from 100 year-old tram systems) and has become a symbol of sophistication for U.S. cities with such systems. Supporters of light rail argue that it is a more viable means of affecting modal shifts from single occupancy vehicles than enhanced bus service. Supporters also argue that light rail attracts investment and enhances development and redevelopment potential on land near LRT stops.

Typical light rail systems possess a similar mixture of characteristics as bus rapid transit:

- Traffic signal priority—signal lights turn green for vehicles as they approach.
- Boarding and fare collection improvements—low floors for quick, easy access and off vehicle ticket purchasing to reduce boarding times.
- Limited stops at stations—fewer stops means faster trip times and more amenities at each station.
- Improved stations and shelters—greater safety and comfort and helps catalyze transit oriented development.

- Intelligent Transportation Systems (ITS)—provides travelers with real time information on next train and improves dispatching of vehicles.
- Clean and quiet vehicles reduce noise and air pollution.
- Exclusive Right of Way—reduces trip time because trains do not have to run with traffic.

2.1.3 Elevated LRT

Elevated light rail is another ~~high~~- medium capacity rail transit option. The principal difference between elevated LRT and standard LRT is the right of way. Elevated LRT runs on raised track supported by steel or concrete structures. The elevated guide-ways are typically 5.5 meters above grade but can reach more than 10 m above grade to bypass existing roads and bridges. The guide-ways need to be supported by regularly spaced reinforced concrete columns or pillars. These columns are typically spaced 30 m apart along the right of way.

There are few purely elevated LRT systems in the world. Most American LRT systems operate limited elevated sections to cross highways and waterways, but the technology and issues are the same. Elevated LRT systems possess the same characteristics as conventional LRT systems, accentuating those associated with exclusive ROW operation. Elevated LRT trains do not mix with traffic and pedestrians resulting in higher speeds and more reliable operation. Exclusive ROW also allows for longer vehicles and/or coupling of a larger number of vehicles, limited only by station platform length. Systems that operate totally grade-separated systems can even make use of automated, driverless vehicles.

Another advantage to elevated LRT over conventional light rail is that less right of way may be required because track is elevated. Elevated systems can operate over existing highway ROWs, provided air rights exist.

When demand on a corridor is medium, LRT scores over metro rail in that it can go round sharp road bends (25m) and hence almost eliminate the need for property acquisition. Secondly the axle load in LRT is 11t against the axle load of 17 t for metro rail, thereby providing substantial ongoing energy cost savings. It must also be appreciated that the cost of at-grade and elevated LRT is similar because speed is better when elevated and hence lesser no. of trains are needed than is the case with at-grade LRT.

2.1.4 Monorail

Monorail and elevated LRT are similar in that they operate on elevated guide-ways and realize those benefits associated with exclusive ROW operation. As its name suggest, monorail operates on guide-way requiring only one rail (Concrete beam). Vehicles either ride on, or are suspended from, the single beam. The beam is typically concrete and measures around two feet in width. Rubber tires provide traction and propel a monorail vehicle along the guide-way. Bi-directional travel in a corridor requires two beams. Monorail systems can realize a number of benefits (when compared to elevated LRT) including:

- Quieter - rubber tires on concrete or steel guide-ways.
- Better performance on steep grades -rubber tire traction as opposed to steel wheel.
- Less imposing elevated structure - narrow beams instead of wider guide-way bed. Dual beam structures have air space between them and cast only thin shadows.

- Easier and less expensive construction – narrow beams require less construction material and allow for use of pre-fabricated guide-way segments.

More recent monorails use much more slender beams, though the elevated structure may still be deemed obtrusive in some communities. Monorail stations can sometimes also be integrated into buildings. Stations on two-way lines, with two tracks and two platforms, are much more difficult to integrate into existing or planned structures, though certainly not impossible.

2.2 CAPITAL AND INFRASTRUCTURE

This section presents issues related to development of each rapid transit alternative. These include:

- Right-Of-Way (ROW)
- Stations
- Construction costs
- Capital equipment costs

Table 1 on the following page presents a number of capital and infrastructure attributes for each of the highlighted transit options. The subsequent sections summarize the table's findings.

Table 1 Implementation Attributes of Alternate Modes

Attributes	Metro Rail System	LRT	Elevated LRT	Monorail
ROW Exclusivity	Exclusive ROW – at grade, elevated or underground.	Exclusive ROW or Separate traffic lanes or Shared traffic lanes	Exclusive ROW, elevated above ground	Exclusive ROW, elevated above ground
Right-of-Way Dimensions	7-10 m	7 m	7-10 m	Typically 6.5-9 m of actual ROW required, but guideways only 4.5 m in width (for dual beam system)
Station Requirements	Passenger boarding area (platform) Traveller information Off vehicle ticket sales	Passenger boarding area Traveller information Off vehicle ticket sales	Passenger boarding platform Traveller information Off vehicle ticket sales Access to street level	Passenger boarding platform Traveller information Off vehicle ticket sales Access to street level
Station Costs (basic infrastructure)	INR 50-150 million at grade	INR 20 – 100 million at grade	INR 180-360 Million elevated	INR 150-300 Million elevated
Vehicle Costs	INR 120 – 170 Million per vehicle	INR 100 – 150 Million per vehicle	INR 100 – 150 Million per vehicle	Technology dependent, typically INR 180 million for 3-car train
Construction Costs	INR 2750-4700 Million per km	INR 675-3000 Million per km	INR 2750-3000 Million per km	INR 750 – 3400 Million per km

Maintenance Yard Costs	INR 5.4 – 49 million per unit of capacity	INR 5.4 – 49 million per unit of capacity	INR 5.4 – 49 million per unit of capacity	Not Available; could be similar to LRT

NOTE: All costs in 2012 INR (converted with INR 50 = 1 USD) unless stated otherwise. Costs are brought to the same year level with WPI Indexation.

SOURCE: National Transit Database, Federal Transit Administration (FTA) 2010, FTA Characteristics of Urban Transportation Systems – Revised Edition September 1992, The Monorail Society, Market Information & IUT Research.

2.2.1 Right of Way (ROW)

Right of way refers to the space required for vehicle travel and is an important consideration when planning mass rapid transit. Rights of way range from traffic lanes or tracks separated from other traffic and exclusive to transit to shared traffic lanes.

The following terms describe various attributes of rights of way.

- ***Exclusivity*** refers to the degree of access of other vehicles to a particular right of way. Exclusive rights of way prohibit other vehicles' access. Exclusivity can be enforced at all times or during selected hours of the day, as with high occupancy vehicle (HOV) lanes on freeways.
- ***Shared*** rights of way allow mixed traffic to travel within them, as with conventional bus service.
- ***Grade separated*** describes rights of way that do not intersect streets or any other mode, separated often by some physical barrier or by raising above/sinking below other traffic. Good examples include rights of way for heavy rail, elevated light rail, and monorail. Separation enables vehicles to avoid traffic and traffic signals, thereby increase speed and safety. These rights of way are also exclusive.
- ***At grade*** describes rights of way that are at street level. Because LRT vehicles are smaller and lighter than heavy rail trains, they can operate at grade. This makes these modes cheaper to build and more flexible to design. For example, they can be routed through a downtown core of the city. At grade rights of way can be exclusive or shared.

In general, as exclusivity increases, speed and safety likewise increase. Grade separated and exclusive rights of way enable faster and higher capacity travel because vehicles are not affected by other traffic –important for fast and reliable transit service. Not surprisingly, these benefits come with higher land acquisition and infrastructure needs and costs. Moreover, the land required to build grade separated rights of way may not be available in densely developed areas like downtowns, prompting communities to consider costly elevated or underground rights of way. Elevated rights of way are far cheaper than underground, but they are also the most prone to aesthetic objections.

Table 2 compares some key aspects of three right of way options: grade separated, exclusive; at grade, exclusive; and at grade, shared.

Table 2 Right of Way Comparison

	GRADE SEPARATED, EXCLUSIVE	AT GRADE, EXCLUSIVE	AT GRADE, SHARED
Speed	High	High	Low to moderate (with signal preemption)
Reliability	High	High	Low to moderate (with signal preemption)
Traffic issues	Grade crossings	Traffic signals	Mixed traffic, signals, pedestrians
Vehicle length issues	Longer vehicle (or combinations) allowed	Shorter vehicles (limited by spacing between grade crossings, e.g. the block-length in a suburb)	Shorter vehicles (limited by spacing between grade crossings, e.g. the block-length in a suburb)
Safety	High	Medium to High	Risk similar to standard bus
Land acquisition needs	Variable. In some cases, existing public rights of way can be used	High if roadway widening is needed. Depends on whether space for surface ROW	Modest needs for stations and platforms.

		is available. Often, the needed space can be removed from other uses, such as on-street parking.	
Cost	High	Medium	Low
Mass Rapid Transit Mode	Metro rail, Elevated LRT, Monorail, BRT	LRT, BRT	LRT, BRT

Elevated systems may be able to use existing rights of way designated for roads and sidewalks, reducing land acquisition costs and/or permitting construction in land-constrained corridors. Depending on the situation, elevated systems may require procurement of "air rights" to operate over existing uses.

2.2.2 Right-of-Way (ROW) Dimensions

Right-of-Way requirements are relatively consistent for the various options. Exclusive ROWs require between 7.5 and 10 m in width for the running-way, control equipment and safety buffers. Monorail guide-ways themselves are quite narrow, but a dual-beam configuration and the space required to accommodate vehicles (much wider than the guide-way) results in comparable ROW needs, especially at stations.

2.2.3 Station Requirements

Though station requirements will vary with respect to the transit mode chosen, there are some basic features that stations, regardless of mode, should have:

- *Platforms*—Platforms should be long enough to allow multiple door entry and exit to minimize dwell times. Use of exclusive ROWs allows longer vehicles and/or a higher number of coupled vehicles. This may require very long platforms to allow boarding at all doors. In addition, platforms should be engineered to function well with low-floor at-grade LRT to improve boarding and alighting speeds, especially for the young, seniors, and disabled.

- *Shelters*—Stations should be covered or have shelters equipped with benches to provide comfort and protection from inclement weather.
- *Access*—Stations must be accessible to passengers and meet all the requirements. This is more of an issue with elevated LRT and Monorail, when stations are suspended above ground. Access to these stations will require staircases and ramps, escalators or elevators. For surface operations, low-floor vehicles are recommended with platforms raised to be flush with the vehicle floor, minimizing the complexity of ramps and eliminating the need for wheelchair lifts.

  Parking for automobiles and bicycles should also be available where appropriate. Automobile parking must be evaluated in light of land costs.

- *Lighting*—For safety and security reasons, stations should be adequately lit at night.

In addition to service speed, frequency, and reliability, station amenities can contribute positively to the "product" transit agencies deliver to their customers. Some of these amenities include:

- *Off-vehicle ticket purchasing*—to further minimize boarding times passengers should be able to pre-purchase tickets via machines at the station. Most pre-purchase ticket machines allow for credit and debit card as well as cash payment. This speeds up operations dramatically. As on most LRT systems, roving “fare inspectors” periodically board and ensure that everyone is carrying a fare receipt or pass.

- *Traveler information*—Many advanced public transportation systems provide real-time traveler information to passengers via display boards and/or kiosks. Information about current vehicle location and next arrival time help passenger plan their travels and make the best possible use of wait times at the station.

In addition to the display devices at the station, these technologies place additional requirements on the system. Metro rail, LRT and Monorail systems can determine vehicle location with the use of sensors along the guide-way Based on vehicle location information, the system can calculate and continually update the projected arrival times and communicate the resulting information to the station site for display. This requires the station to have access to appropriate radio or landline communication networks. Some systems display the actual location of vehicles on a schematic map of the line.

- *Fully-developed stations*—stations can consist of more than a shelter and platform. Some stations are built-out structures with commercial and retail activity on site, such as restaurants or magazine shops, designed to enhance passengers’ travel experience. These stations can also complement the built environment and catalyze other development—residential and commercial—along the transit corridor.

A number of stations will require adequate amounts of parking for autos and bicycles, particularly if the stations function as park-and-ride facilities. Appropriate pricing for parking is also another consideration, as high rates will discourage transit use.

Much has been said about the positive development potential of metro rail systems. In fact, metro rail supporters often justify its large capital costs by framing that cost as a catalyst for new development or redevelopment. Metro rail enjoys the characteristic of permanence—vehicles run on a fixed guide-way—providing greater certainty for developers. Public perception of metro rail is also quite positive. It is often seen to represent a community's sophistication, and thereby its ability to attract riders in a way that buses cannot.

2.2.4 Station Costs

Station costs of any MRT project shall vary in accordance with land values, the types of amenities provided, and the degree to which stations are built out. The range for LRT stations, not requiring additional infrastructure and cost to elevate the station above ground, may cost approx. INR 20 to 100 million per station. This cost includes platform, structures, and parking. The wide range in cost is due to the variation in which stations can be developed. The most basic include a platform and shelter. More elaborate stations can include automated fare boxes, real time traveler information, co-located retail, restrooms, and other amenities. Stations for elevated LRT and Monorail can range from INR 150 - 360 million per station. There are considerable costs associated with elevating stations, not to mention constructing the right of way. Elevated stations centered between bi-directional guide-ways can use a single platform and a common set of stairs/elevators to realize some cost savings as opposed to two separate platforms. LRT stations on center islands or median can also serve travel in two directions at achieve cost savings for shared station components. Detailed cost estimates will depend on actual station design.

2.2.5 Vehicle Costs and Technology Potential

Vehicle costs vary in accordance to a vehicle's size, sophistication, and propulsion system. Light rail, elevated LRT, and Monorail vehicles all run on electricity. Compared to BRT systems, which can use a variety of vehicle types, LRT, elevated LRT, and monorail systems offer limited choices. There are several manufacturers, but the trains are essentially the same—they are electric powered and run on rails.

LRT & MRT vehicle costs fall between INR 100 – 170 million. Monorail vehicles range from small people movers to large, mass rapid transit vehicles. A typical three-car monorail vehicle can cost up to INR 180 million.

2.2.6 Construction Costs

Construction costs for mass rapid transit projects are typically expressed in terms of cost per km. These costs include ROW procurement, running-way improvements, stations, maintenance facilities and sometimes vehicles. Construction costs vary greatly, but the effort required to procure and develop the right of way tend to dominate the cost.

LRT/MRT/Monorail costs are higher than those for a typical BRT project as rail based system includes the cost of rails, control systems and complex maintenance yards. Research shows that LRT projects have ranged from INR 675 – 3000 million per km with most of the difference based on local land costs, and the number and design of stations. The use of tunnels and elevated guide-ways also increase the costs for specific projects.

Monorail systems can have station costs and appreciable guide-way costs as well, resulting in construction costs close to INR 3400 million per km. On the other hand, simple one-way loop systems using a single beam and a minimal number of stations can be constructed for as little as INR 750 million per km.

2.2.7 Maintenance Yard Costs

Maintenance yard costs can be a significant component of developing a mass rapid transit system. The rail based MRT modes require unique structures, with guide-ways connecting them to the service lines. While LRT operations typically require maintenance yards costing INR 5.4 - 49 million per vehicle.

2.3 OPERATIONS

The following section describes the operational distinctions between the mass rapid transit modes i.e MRT, LRT & Monorail systems in terms of: Travel Speed, Capacity, Traffic Impacts, Pedestrian Impacts and Operating Costs. (summarized in Table 3 below):

Table 3 Operational Attributes of Alternate Modes

Particulars	MRT	LRT at-grade	Elevated LRT	Monorail
Capacity per Vehicle	72/300	72/300	72/300	70/220 (based on configuration)
Maximum Capacity (PHPDT*)	10,000 - 80,000	4,000 - 25,000	4,000 - 25,000	3,000 - 15,000
Average Speed	35 km/hr	25 km/hr	35 km/hr	32-48 km/hr.
Vehicle Length	18 – 26 m per car, typically 4-8 car trains	26 m per car, typically 2-4 car trains	26 m per car, typically 2-4 car trains	38-120 m trains Typically 2-10 car trains
Vehicle Width	2.62 - 3.05 m	2.74 m (typical)	2.74 m (typical)	2.74 - 3.05 m (typical)
Preferential Traffic Treatments	Not Applicable	Signal priority (non-shared ROW options)	Not Applicable	Not Applicable

SOURCE: National Transit Database, Federal Transit Administration (FTA) 2010, FTA Characteristics of Urban Transportation Systems - Revised Edition September 1992, The Monorail Society, Market Information & IUT Research.

**PHPDT - Per Hour per Direction Traffic.*

2.3.1 Capacity per vehicle

Capacity is the number of passengers a vehicle can carry and is often referred to in terms of seated and crush capacity. Crush capacity is simply the sum of seated and standing room. MRT and Light rail vehicles can hold approximately 300 passengers. Monorail vehicles come in a variety of sizes and configurations. Some are designed to hold 40-50 people; others are able to carry over 200 per car. Because monorails run on exclusive, grade separated rights of way, long trains can consist of anywhere from two to ten cars.

MRT, Light rail and monorail per vehicle crush capacities are higher than the largest BRT vehicle option, even when articulated. This is partially due to larger size as well as the environment in which these modes operate, particularly for monorail. Monorails run on exclusive guide-ways and do not have to factor in city block lengths, as bus and many at-grade LRT systems do.

2.3.2 Average Speed

Average speed is constrained by traffic and stop spacing. On HOV lanes or exclusive rights of way with widely spaced stops, vehicles can expect to achieve top speeds at the posted speed limits. Amid traffic and with more frequent stop spacing, operating speeds will drop considerably. Average speeds across rail based modes are comparable and fall in between 25 and 35 km/hr.

2.3.3 Vehicle Length

As implied by their higher capacities, MRT, light rail and monorail trains are generally longer in length than compared to BRT buses. MRT, light rail and monorail cars are typically comprised of two to eight vehicles. Exclusive, grade separated rights of way allow for longer train lengths because of the absence of grade crossings. LRT length can be constrained by city block length if operated on city streets with stops, since a station stop should not obstruct an intersection. Furthermore, vehicle length and station platform length should also be coordinated to allow multiple door entry and exit, which significantly reduces boarding and exiting times.

2.3.4 Vehicle Width

Vehicle width is comparable across modes. Fixed guide-way services such as MRT, LRT and monorail need very little right of way in addition to their vehicle width.

2.3.5 Transit Impacts on Other Traffic

The right of way will determine the nature and extent of the mass rapid transit mode's impact on other traffic.

Grade separated rights of way create the least amount of impact because transit does not mix with traffic. However, when grade crossings occur, safety measures are put in place that stop other traffic and give preferential treatment to transit.

At-grade rights of way introduce many more impacts on traffic because they are traveling alongside (exclusively) or amid other traffic. Vehicles traveling upon exclusive, at-grade rights of way should receive traffic signal priority to realize truly rapid service. These preferential treatments will impede other traffic to a certain degree. If this exclusive, at grade right of way is on the inside of a road and stations/stops are located on the outside, there will be some degree of impact on normal traffic operations as buses merge across lanes to make stops.

2.3.6 Transit Impacts on Pedestrian Access

As with the traffic impacts discussed in the previous section, pedestrian impacts caused by mass rapid transit will be dependent upon the right of way. Pedestrian access to transit must be considered. Transit that runs on rights of way along a highway or arterial median creates pedestrian access challenges. Pedestrians will have to cross the road by some means—either by traffic signals or elevated walkway. Access for seniors and the disabled also needs to be maintained.

2.3.7 Operating Cost per Revenue Mile

Operating cost per revenue km equals operating cost averaged over revenue km. Revenue km are the number of km vehicles travelled while in passenger service—in other words serving passengers and collecting fares. Operating cost includes costs such as driver's salaries, fuel or electricity, vehicle maintenance, and running way (track) maintenance.

2.3.8 Operating Cost per Revenue Hour

Operating cost per revenue hour equals operating cost averaged over revenue hours—the number of hours vehicles are in passenger service.

SECTION : 3 RISKS IN PROCUREMENT & MITIGATION MEASURES

The procurement of Urban Mass Rapid Transit systems e.g. MRT / LRT / Monorail could be achieved either through a conventional contracting process or through a private sector led PPP format.

3.1 TYPE OF CONTRACTS - CONVENTIONAL

A number of contract types based on compensation arrangements are available and currently practiced in India which provides needed flexibility in acquiring the large variety of materials, services, and construction requirements by City Transport Authorities / Transit Authority / State Government Departments.

The contract types are grouped by pricing arrangement into the two broad categories of fixed-price contracts and cost-reimbursement contracts. These two types vary according to (1) the degree of responsibility and risk assumed by the contractor for the costs of performance, and (2) the amount and nature of the profit incentive offered to the contractor for achieving or exceeding specified standards or goals. The specific contract types range from firm-fixed-price to cost-plus-award-fee. .

3.1.1 FIRM FIXED-PRICE CONTRACTS

A firm-fixed-price (lump sum) contract provides for a price that is not subject to adjustment on the basis of the contractor's cost experience in performing the contract. This is generally the preferred form of contract for City Transport Authorities use. It places maximum risk and full responsibility for all costs and resulting profit or loss on the contractor. It provides maximum incentive for the contractor to control costs and perform effectively and, since the contractor's cost experience is not a factor in determining compensation, it imposes a minimum administrative burden upon the contracting parties.

A firm-fixed-price contract is suitable for acquiring commercial products, construction, or services on the basis of reasonably definite, detailed specifications when the Procurement Officer can establish fair and reasonable prices at the outset, such as when- (1) There is adequate price competition; (2) There are reasonable price comparisons with prior purchases of the same or similar goods or services made on a competitive basis or supported by valid cost or pricing data or; (3) Performance uncertainties can be identified and reasonable estimates of their cost impact can be made, and the contractor is willing to accept a firm-fixed-price representing assumption of the risks involved.

3.1.2 FIXED-UNIT-PRICE CONTRACTS

The provisions of this type of contract provide for the upward or downward revision of the contract price based upon actual quantities of work performed; however, the contract must include an overall Not-to Exceed amount. Estimated quantities are used in the solicitation to provide a competitive basis for determining the successful contractor. Contractors provide fixed-unit prices for each item. During contract performance, the contractor is paid for quantities of work actually performed at the unit prices offered.

Unit-price contracts are used where (1) quantities cannot be determined in advance within limitations that would permit a lump-sum offer without a substantial contingency, (2) quantities can change significantly during performance, or (3) contractors would have to expend unusual effort in making quantity take-offs.

Contracts with unit pricing will include a variation in estimated quantity provision which provides for negotiated adjustments to the unit price of any item for which the actual quantity varies by 15 percent or more from the estimated contract quantity. The total amount of money paid to the contractor for each work item remains indeterminable until completion of the contract.

Administratively, the procurer must provide an adequate field force to verify actual quantities of work performed. If the nature of the "units" to be measured is such that the method of measurement is unclear, then the contract must include language that specifies the method of measurement.

3.1.3 COMBINED FIRM-FIXED/UNIT-PRICE

A variant of the firm-fixed-price (lump sum) contract is the combination firm-fixed-unit-price contract. This type of contract should be used when it is not possible to determine the quantities required with reasonable accuracy prior to performance. The significant characteristic of this type of contract is that firm-fixed (lump-sum) prices are established for identifiable quantities of work and fixed-unit prices are established for only that portion of the work for which quantities are unknown or for which they cannot be reasonably forecast.

If there are undefined areas of work which need to be included in the contract, a specific allowance established by the Authority need to be included. The contract must always include an overall not-to- exceed amount. Price evaluation for this type of contract is performed by multiplying the fixed-unit prices by the estimated quantities and adding the extended price to the lump sum portion of the offer.

The actual final contract price, i.e., the total amount ultimately paid to the successful contractor, is not the proposed price. Payment for the unit-price portion of the contract is made by multiplying the fixed-unit price by the actual quantities required to perform the work. A variation in estimated quantity provision will be included in lump-sum/unit-price contracts. Such a provision provides for an equitable adjustment of the fixed-unit prices to be made where the actual quantity varies by more than 15 percent above or below the estimated quantity stated in the contract.

3.1.4 FIXED-PRICE WITH PRICE ADJUSTMENT

The provisions for this type of contract provide for the upward or downward revision of the contract price upon the occurrence of certain contingencies that are specifically defined in the contract. These contingencies must be beyond the control of the contractor, e.g. industry-wide factors. Use of this type of contract is appropriate when serious doubt exists as to the stability of the market or labor conditions that will exist during an extended period of contract performance. It may also be appropriate when contingencies that would otherwise be included in the contract price can be identified and covered separately by a price adjustment provision. However, the contract must include an overall not-to-exceed amount. Close pricing is obtained by minimizing contingencies through price adjustment provisions; this shifts a portion of the pricing risk to the procurer. In return for the price adjustment provisions, the contractor is expected to eliminate from the price those contingency factors covered by the price adjustment.

3.1.5 TIME-AND-MATERIALS CONTRACTS

The time-and-materials contract provides for the procurement of goods and services on the basis of direct labor hours at specified hourly rates and materials at cost including, when appropriate, material handling charges. The charge for direct labor at specified fixed hourly rates includes wages, overhead, general and administrative expenses, and profit. The materials handling charge will include only costs clearly excluded from the labor hour rate.

This type of contract shall include a ceiling price for each element and for the overall total that the contractor exceeds at its own risk. Although this type of contract provides for the payment of a fixed rate per unit of time, it is clear that unless the rate is insufficient to cover the contractor's costs, the total amount of profit under the contract increases proportionately as the number of hours increase. Therefore, this type of contract is used only after a determination that no other type of contract will suitably serve. It is used when it is not possible at the time of placing the contract to estimate the extent or duration of the work or to anticipate costs with any substantial accuracy.

3.1.6 COST-REIMBURSEMENT CONTRACTS

This generic category of contracts provides for payment to the contractor of allocable and allowable costs. In addition to costs, most cost-reimbursement contracts also provide for the payment of a fee (profit) to the contractor in addition to costs. Cost-reimbursement contracts establish an estimate of total cost for the purpose of obligating funds and establishing a cost ceiling which the contractor may not exceed (except at the contractor's own expense) without the prior approval or subsequent ratification of the procurement manager.

Cost-reimbursement type contracts are suitable for use when the nature and complexity of the procurement are such that the costs of performance cannot be estimated with the accuracy necessary for a fixed-price contract. Since the actual costs of performance are the basis for payment to the contractor, it is essential that prior to contract award, the Procurement manager verify that the contractor's cost accounting system is adequate for the determination of the reimbursable costs. As this type of contract gives a minimum incentive for efficient performance, provision must be made for appropriate surveillance by City Transport Authority's / Transit Authority's personnel to provide reasonable assurance that wasteful methods are not being used. Such contracts are used only after a finding that such method of contracting is likely to be less costly than other methods, and it is impractical to secure the necessary goods or services without the use of this type of contract.

3.1.7 INCENTIVE CONTRACTS

Incentive contracts are designed to harness the profit motive to stimulate the contractor to perform at a lower cost, to produce a better product or service, or to cut down lead time in delivery dates. It is a goal when utilizing incentive contracts to impact the contractor's management decisions throughout the performance of the contract. Care must be taken to ensure that the contract is so structured that any contract options are fair from both the contractor and the City Transport Authority's point of view. The incentive contracts can be categorized in two ways: those in which the contractor's additional profit or losses are determined on an objective basis or those contracts in which the contractor's profit or loss is determined in a subjective manner.

3.1.8 INDEFINITE DELIVERY TASK CONTRACTS

The basic purpose of a Task Contract is to provide an in-place contractual arrangement with a competitively selected Contractor that is ready, willing and able to undertake a number of jobs, or individual tasks, of the nature described in the contract statement of work. The scope of the task contract may be broad but not unlimited. Work beyond the scope or over an authorized price may not be performed under the task contract.

3.2 TYPE OF CONTRACTS - PPP

This Section defines PPPs and describes several types of PPPs applicable to urban mass transit capital projects.

3.2.1 PPP'S DEFINED

PPPs are essentially a form of procurement. Unlike conventional methods of contracting for new construction, in which discrete functions are divided and procured through separate solicitations, PPPs contemplate a single private entity, typically a consortium of private companies, being responsible and financially liable for performing all or a significant number of functions in connection with a project. In transferring responsibility and risk for multiple project elements to the private partner, the project sponsor relaxes its control of the procurement, and the private partner receives the opportunity to earn a financial return commensurate with the risks it has assumed.

Structured in multiple forms, PPPs vary generally according to the scope of responsibility and degree of risk assumed by the private partner with respect to the project. In each case, the private partner assumes financial risk in some form - for example, through an equity investment, liability for indebtedness, a fixed priced contract or a combination thereof.

Accordingly, the term "PPP" does not denote innovative finance as such, but instead, innovative procurements of major capital projects in which private capital is invested. PPPs may be distinguished from other collaborative arrangements between public and private sectors that are not procurements but instead are mechanisms to provide private capital to transit projects. Many transit agencies, for example, are partnering with the private sector in order to promote real estate development in and around transit facilities, which is often referred to as "joint development" or "transit oriented development." These partnerships provide access to additional capital and operating revenues for transit agencies through the receipt of lease payments, access fees, and increased fare revenues, as well as direct private sector funding of capital facilities that promote access between transit and private development. The capital-raising function, however, is but one element of a PPP.

It is important to note that not all innovative contracts referred to as PPPs adopt the principles of PPP project delivery. For example, project sponsors have defeated the purpose of having a single point of accountability and enhanced design constructability provided by a design-build contract by procuring multiple design-build contracts for a single project.

3.2.2 TYPES OF PPP'S

In recent years transit agencies have increasingly turned to PPP in order to procure new or expanded transit services. Agencies use PPP delivery approaches to obtain time savings, cost savings, and more innovative, higher quality projects with reduced risks. This section describes the types of project delivery approaches used for transit projects and the potential benefits associated with these approaches. By way of background, this section begins with a description of the traditional design-bid-build approach to project delivery.

Exhibit 3.1 summarizes some of the major types of PPPs applicable to transit projects, moving from the PPPs that have the greatest private sector role to those with the least private sector role.

Exhibit 3.1 : Major Types of PPPs in Urban Transit

Greater Private Sector Role	▪ Build-Own-Operate (BOO) ▪ Design-Build-Finance-Operate-Maintain (DBFOM) ▪ Design-Build-Finance-Operate (DBFO)
Lesser Private Sector Role	▪ Build-Operate-Transfer (BOT) ▪ Design-Build-Operate-Maintain (DBOM) ▪ Design-Build (DB)

Design-Bid-Build

Design-bid-build ("DBB") is the traditional form of project delivery in which the design and construction of the facility are awarded separately to private sector engineering and contracting firms. As a result, the DBB process is divided into two separate phases for design and construction. In the design phase, the project sponsor either performs the work in-house or contracts with an engineering and design firm to prepare the preliminary engineering plans and environmental clearance, which typically results in a project plan at the 30 percent completion stage, and the final drawings and specifications for the project. Once the design phase is complete, the project sponsor separately contracts with a private construction firm through a competitive bidding process. Under a DBB delivery approach, the project sponsor, not the construction contractor, is solely responsible for the financing, operation, and maintenance of the facility and assumes the risk that the drawings and specifications are complete and free from error. The DBB selection process is based on negotiated terms with the most qualified firm for the design phase; while the award of the construction contract typically is based on the lowest responsible bid price.

Design-Build

Unlike DBB where the design and construction phases of a project are procured using two separate contracts with little or no overlap in the respective project work phases, the design-build ("DB") delivery approach combines the design and construction phases into one, fixed-fee contract. Under a DB contract, the design-builder, not the project sponsor, assumes the risk that the drawings and specifications are free from error. While the design and construction phases are performed under one contract, it is important to note that the design-builder may be one company or a team of companies working together. The DB selection process may be based on a negotiation with one or more contractors or a competitive process based on some combination of price, duration, and qualifications.

The primary advantages associated with DB delivery and other PPP delivery approaches that include a DB component when compared to traditional DBB delivery include:

- **Time savings:** The potential for time savings results from early contractor involvement in the design phase, which increases the constructability of the design plans, the ability to work concurrently on the design and construction phases for portions of the project and the elimination of the bidding process between the design and construction phases that is required of traditional DBB project delivery.

- **Cost savings**: The potential for cost savings results from continued communication between design, engineering, and construction team members throughout the delivery, reduced inspection requirements by the project sponsor because the design and construction risk are the responsibility of the design-builder, reduced change orders due to early involvement of the construction contractors in the design phase and shortened project timeline, which, among other benefits, may reduce construction costs.

- **Shared risks**: Since the potential project risks are shared among the public and private sectors, the risks may be assigned to the party best able to handle them. For ex private sector may be better equipped to handle the risks associated with design quality, construction costs, and adherence to the delivery schedule since it is responsible for both the design and construction of the facility while the public sector may be better able to manage the public risks of environmental clearance, permitting, and right-of-way acquisition. Additional benefits of proper risk allocation are reduced costs and minimization of contingencies.

- **Improved quality**: The potential for improved quality results from the involvement of the design team through the project development and opportunities to incorporate project innovations and new technology that may arise based on project needs and contractor capabilities.

PPPs may include a variety of structures and combinations that result in private participation only in the design and construction phases or also in other aspects of project delivery, including operations, maintenance, and project financing.

Design-Build-Operate-Maintain and Build-Operate-Transfer

Under a design-build-operate-maintain ("DBOM") or build-operate-transfer ("BOT") delivery approach, the selected contractor is responsible for the design, construction and maintenance of the facility for a specified time. The contractor must meet all agreed upon performance standards relating to physical condition, capacity, congestion, and/or ride quality. The potential advantages of the DBOM or BOT approach are the increased incentives for the delivery of a higher quality plan and project because the private partner is responsible for the performance of the facility and for maintaining the project, in its complete and fully operational state, for a specified period of time after construction.

Design-Build-Finance-Operate and Design-Build-Finance-Operate-Maintain

The design-build-finance-operate ("DBFO") and Design-Build-Finance-Operate-Maintain ("DBFOM") delivery approaches are a variation of the DBOM approach. The major difference is that in addition to the design, construction, and operation of the project, the contractor is also responsible for all or a major part of the project's financing. The potential advantages of the DBFO and DBFOM approaches are the same as those under the DBOM approach but also include the transfer of the financial risks to the private partner during the contract period. When the project sponsor retains ownership of the facility, the DBFO and DBFOM approaches attract private financing for the project that can be repaid with revenues generated during the facility's operation. All or a portion of the revenue used to repay the private financing can be generated by the facility itself, but revenue generated by the public sector through taxes or other public source can also be used to repay all or a portion of the private financing. Utilizing long-term public sources of revenue to pay down privately financed projects allows the public sector to enjoy some of the benefits available with a leveraged project without issuing bonds or otherwise incurring debt on its balance sheet.

Build-Own-Operate

Under a build-own-operate (“BOO”) delivery approach, the design, construction, operation, and maintenance of a facility is the responsibility of the contractor. The major difference between BOO and other PPP approaches is that with a BOO approach, the private partner owns the facility and is assigned all operating revenue risk and any surplus revenues for the life of the facility.

3.3 IDENTIFICATION OF RISK MATRICES AND INSTRUMENTS FOR MITIGATION : METRO RAIL VS. MONORAIL

Choosing among the options for private participation depends on the particular needs of a country and the nature of risk sharing between the public and private sectors. The risk to which each party is committed through the contract is to be clearly defined as well as understood so that disputes may not occur and the responsibilities will be based on the assignment spelled out in the contract.

The rule of thumb is that private transit projects work best when project risks and responsibilities are assigned to the party that can best bear them. The private sector is generally better managing commercial risks and responsibilities, such as those associated with construction, operation and financing. In contrast, transit projects (MRT/LRT/BRT/Monorail) may also depend on public participation in areas such as acquisition of right-of-way, political risk and in some cases, traffic and revenue risk. The government considers giving financial support or guarantees if traffic levels in the early years are insufficient.

The main risks involved in urban transit projects are:

- Political Risks
- Construction Risks
- Market and Revenue Risks
- Finance Risks
- Legal Risks

- Operating Risks

In addition, contracts commonly address Force Majeure and legal liability because they have proven to be the serious sources of cost overruns in the urban transit sector.

3.3.1 POLITICAL RISKS:

Political risk concerns government actions that affect the ability to generate earnings. These could include actions that terminate the concession, the imposition of taxes or regulations that severely reduce the value to the investors, restrictions on the ability to collect or raise tolls as specified in the concession agreement etc. Many projects are delayed because of the difficulties of acquiring right-of-way or environmental clearances that both the governments and the operators underestimate. Government generally agrees to compensate investors for political risks, although in practice, governments may cite justifications for their action to delay or prevent such payments. Thus, private investors generally assume the risks that are associated with the dispute resolution and the ability to obtain compensation if the government violates the concession agreement.

3.3.2 CONSTRUCTION RISKS

A common cause of cost overrun stems from design changes and unforeseen weather conditions during the construction phase. The private sector typically bears primary responsibility for the construction uncertainties and attempts to cover it through insurance. The public sector may assume responsibility for risks under its control such as competing complementary facilities or allowing cost increases associated with major design changes.

3.3.3 MARKET AND REVENUE RISKS

Demand uncertainty continues to be a major factor in most of the projects. Traffic and tariff levels may not be sufficient to cover all costs, including construction, operation and maintenance. The private sector fully depends upon the government for the handling of the traffic and revenue risks.

3.3.4 FINANCIAL RISKS:

Financial risk is the risk that project cash flows might be insufficient to cover debt service and then pay an adequate return on sponsor equity. Financial constraints like lack of long-term debt capital hinder the road development projects. Non-availability of local or domestic finance markets may lead to the higher risks for road sector projects which need long-term financing.

Currency risks involve the impact of exchange rate fluctuations on the value of domestic currency. It can subject to the convertibility as the operator may not be allowed to convert the local currency into the foreign currency.

Financial risks are best borne by the private sector but a substantial government risk sharing is required either through revenue or debt guarantees or through participation by state or multilateral development institutions.

3.3.5 LEGAL RISKS:

Regulatory risk stems from the weak implementation of regulatory commitments built into the contracts and the laws or other legal instruments that are relevant to the value of the transactions as it was originally assessed. The major risk lies on the part of the concessionaire like lack of power and capacity.

3.3.6 OPERATING RISKS

Operating risks are the risks that emerge at the time of the operations of the project on the part of operator's default. It can also involve the risks like force majeure risks that are beyond the control of both the public and private partners, such as fire or earthquakes, or other non-political factors such as strikes and industrial disturbances that impair the project's ability to earn revenues. Sometimes private insurance is becoming available for catastrophic risks but generally public sector faced with the need to restructure the project if such disaster or problem occurs.

3.4 INSTRUMENTS FOR MITIGATING URBAN TRANSIT RISKS

3.4.1 EQUITY GUARANTEES

These provide a concessionaire with the option to be bought out by the government at a price that guarantees a minimum return on equity. Although the liability is contingent, the government effectively assumes project risk and reduces the corresponding private sector incentives.

3.4.2 DEBT GUARANTEES

These guarantee that the government will pay any shortfall related to principal and interest payments. Sometimes, the government also guarantees the scheduled refinancing. This creates significant government exposure and reduces private sector incentives, although it may decrease the cost or increase the amount of debt available to the project.

3.4.3 EXCHANGE RATE GUARANTEES

These are the guarantees where the government agrees to compensate the concessionaire for increases in financing costs due to exchange rate effects on foreign financing. Exchange rate guarantee helps in increasing the incentive to use foreign capital.

3.4.4 GRANTS/SUBSIDIES

Government can furnish grants or subordinate loans at project inception, which helps in buying down the size of the project that needs private finance. Generally these grants or subsidies have no provision for repayment.

3.4.5 SUBORDINATED LOANS

These can fill up a gap in the financing structure between senior debt and equity. These types of loans have attractive features that they can be repaid with a return if the project is successful. Subordinated loans improve feasibility by increasing the debt service coverage ratio on senior debt and by reducing the need for private equity that needs higher return.

3.4.6 MINIMUM TRAFFIC AND REVENUE GUARANTEES

In these types of loans government compensates the concessionaire if traffic or revenue falls below a minimum threshold, which is generally set 10 to 30 percent below the expected volume. Traffic and revenue guarantees help in retaining the financial incentives in the project.

3.4.7 SHADOW REVENUE

In this the government contributes a specific payment per passenger to the concessionaire towards any subsidy would like to extend to students / poor passenger, rather than the user. These are the ongoing revenue stream from the government in lieu of an up-front grant or loan and as these are paid over time, these leads to a less burden on the public on the public budget.

3.4.8 CONCESSION EXTENSIONS AND REVENUE ENHANCEMENTS

These provide financial support that involves limited public sector risk, but they do little to support or enhance private financing. A government can firstly extend the concession term if revenue fall below a certain amount and can restrict the competition from the ancillary services.

3.4.9 POLITICAL RISKS - MITIGATION MEASURES

Potential Risk	Exposure of Concession Company & Project Lender	Risk Mitigation Measures.	MRT Vs. Monorail – Comments
Lack of power and capacity of Grantor / Concessioning Authority	Obligations of Grantor to bind the State, and to pay compensation (and/or pay operating charges), are void	Legal due diligence	This risk is same for both MRT and Monorail procurement
Nationalization; discriminatory changes in law; political force majeure event; abandonment of Project by Grantor; default by Grantor	Project is lost or is not viable	Obtain right for Company to compensation from Grantor for project loans, equity and lost profits; exclude right of Grantor to terminate in these circumstances; obtain political risk insurance	-do-
Change in law not specific to the Project; increase in taxes	Returns to Sponsors are less; debt service may be jeopardized	Obtain right for Company to increase tariff; require Sponsors to put in new	-do-

		money; otherwise a project risk	
Breach by the Grantor of exclusivity obligation; failure by the Grantor to meet undertakings to assist	Users may use competing concession facilities; viability of the Project is threatened	If serious enough and not cured obtain right for Company to terminate; otherwise obtain right for Company to claim damages from the Grantor	-do-
Approval of tariff increases is not given	Project is not viable	Obtain right to appeal tariff decision; obtain right to compensation of the Company by the Grantor for cash deficiency; require Sponsors to put in new money; otherwise a project risk	-do-

3.4.10 CONSTRUCTION RISKS – MITIGATION MEASURES

Potential Risk	Exposure of Concession Company & Project Lender	Risk Mitigation Measures.	MRT Vs. Monorail – Comments
Cost overruns; unanticipated variations, time extensions	Delays, increased project debt	Require a lump sum, fixed time construction contract with little scope for variations; claim damages; call performance bonds; draw on standby loans; require Sponsors to put in new money; otherwise a project risk	Possibilities of cost overrun is more in case of Metro Systems as it requires more ROW requiring more space for construction and traffic management.
Contractor is an investor in the Company	Contractor has a conflict of interest and construction contract may be too easy on Contractor	Ensure independent Sponsors and Project Lenders are involved in the negotiation of Construction Contract;	
Contractor/Supplier defaults	Delays	Due diligence on	Monorail carries more

or goes bankrupt		Contractor/ Supplier; claim damages call performance bonds	risks as number of suppliers are limited in number compared to Metro rail systems.
Site acquisition problems; problems with removing squatters	Delays	Ensure there is expropriation legislation	Metro system invites more risks due to more requirement of scarce urban land for a green field project. Shifting of utilities could also aggravate further problems.
Access problems to adjacent areas	Delays	Ensure that Grantor obtains access rights for Company	Independent of both the systems.
Adverse site conditions	Delays, increased costs	Obtain a comprehensive site survey; pass this risk on to the Contractor; require adequate insurance	-do-

Existing environmental damage/ Archaeological remains	Delays	Obtain agreement by the Grantor for compensation payments to the Company, and right to extend the concession period	Metro system invites more risks due to more requirement of scarce urban land for a green field project.
Change in law or Grantor unilaterally requires design changes	Project cost is increased; Project may not be viable; new loans may not be able to be raised; Delays	Obtain agreement of Grantor to accept responsibility for payment of design changes or to authorize tariff to be increased to pay additional finance costs	Independent of both the systems.
Variations and changes in design requested by Company, Contractor or third party	Increased finance costs and delays	Ensure that the Company, the Grantor and the Contractor agree to "back to back claims" principle; require Sponsors to put in new money in the required amount	Independent of both the systems.
Environmental damage and	Delays, increased costs	Require adequate insurance; claim on insurance; obtain	Metro systems bears more risks due to more

force majeure events		right for the Company to terminate the concession or to be granted an extension to concession period	ROW requirements. Moreover, there could be visual intrusion due to heavy structure of Metro systems.

3.4.11 MARKET AND REVENUE RISKS - MITIGATION MEASURES

Potential Risk	**Exposure of Concession Company & Project Lender**	**Risk Mitigation Measures.**	**MRT Vs. Monorail – Comments**
Inadequate ridership / fares are inadequate	Deficiency in debt service and inadequate returns to Sponsors	Due diligence – require sound traffic studies; try to have right to increase tariff; try to have deficiency guarantee or subsidy from Government; increase concession period and refinance loan facilities; Sponsors required to put in subordinated loans;	Independent of both the systems.

		otherwise project risk.	
Consumers do not accept tariff levels and ridership drops off	Deficiency in debt service and inadequate returns to Sponsors	Require Grantor to compensate Company for cash deficiency where due to breach by Grantor of its obligations; otherwise a project risks.	Independent of both the systems.
Concession fees and Grantor's profit shares, are too high	Deficiency in debt service and inadequate returns to Sponsors	Ensure fees and profits are subordinated to debt service payable to Project Lenders	-do-
Authorization for tariff increases is not granted by the Grantor	Deficiency in debt service and inadequate returns to Sponsors	Require Grantor to compensate Company for shortfall (by reference to debt service coverage); require Sponsors to put in new money; otherwise a project risk.	-do-

3.4.12 FINANCE RISKS – MEASURES

Potential Risk	Exposure of Concession Company & Project Lender	Risk Mitigation Measures.	MRT Vs. Monorail – Comments
Borrowings in local currency carry high interest rates and/or loans with long tenors are unavailable and/or there is limited ability to enter into swaps	Increase in debt service	Raise loans in foreign currency; structure with balloon payment at end of loan term repayment of which is guaranteed by multilateral; refinance at end of loan term	Independent of both the systems.
Loans are raised in foreign currency and there is a devaluation of local currency	If foreign currency is borrowed, when converted, there is insufficient money, to pay debt service	Require that Company hedges its forex exposure; obtain right for Company to increase tariff by a percentage related to the rate of devaluation	-do-
Increase in interest rates	Increase in debt service	Fix interest rates; enter into swaps; obtain right to	-do-

		increase tariff by a percentage related to interest rate increase; drawdown of standby loans; require Sponsors to make subordinated loans	
Increases in operating costs due to inflation	Decrease in funds available for debt service	Obtain right to increase tariff based on CPI basis or based on rate of increase in prices of component costs	-do-
Foreign currency is not available	Foreign currency debt is not able to be repaid in foreign currency	Obtain agreement from RBI to procure foreign currency; obtain agreement from Project Lenders to accept equivalent value in local currency	-do-

3.4.13 LEGAL RISKS –MITIGATION MEASURES

Potential Risk	Exposure of Concession Company & Project Lender	Risk Mitigation Measures.	MRT Vs. Monorail – Comments
Concession Company does not have ownership or rights of use of key assets	Security is worthless; viability of Project may be in doubt	Site inspections and legal due diligence; make this an event of default under Loan Agreement	Independent of both the systems.
Concession Company not able to satisfy conditions precedent in Concession Agreement	Concession Contract may be terminated by the Grantor; Sponsors and possibly Project Lenders lose their upfront costs and expenses	Ensure that conditions precedent are within Company's control	-do-
Concession Company breaches Concession Contract	Concession Contract may be terminated by the Grantor; Project Lenders risk loss of principal and interest	Obtain grace periods and step-in rights for the Project Lenders in Concession Contract; obtain debt assumption agreement or obligation to repay the	-do-

		project loans from the Grantor; Sponsors lose their equity	
Concession Company is bankrupt, insolvent or another event of default occurs under Loan Agreement	Concession Contract may be able to be terminated by Grantor; Project Lenders risk loss of principal and interest	Obtain grace periods under Concession Contract; Ensure that Project Lenders have right to enforce security; obtain right for a Substituted Entity to take over the Concession	-do-
Security is not enforceable or is deficient	Project Lenders risk loss of principal and interest	Legal due diligence; obtain guarantees from Sponsors	-do-

3.4.14 OPERATING RISKS – MITIGATION MEASURES

Potential Risk	Exposure of Concession Company & Project Lender	Risk Mitigation Measures.	MRT Vs. Monorail – Comments
Lack of exclusivity to prohibit competing concessions	Inadequate ridership which may lead to a debt service deficiency	Obtain traffic studies and get an exclusivity agreement from the Grantor/other Governmental Agencies	Independent of both the systems.
Lack of interconnection and contribution of existing infrastructure	Inadequate traffic which may lead to a debt service deficiency	Analyze interconnection requirements and get Grantor / Transport Authority to implement them	-do-
Force majeure events	Interruption in operations which may lead to the Grantor being entitled to terminate the concession and to a debt service deficiency	Ensure there is adequate insurance; require the Company to claim on insurance and/or draw on standby loans to pay for the damage repairs; obtain grace periods and right for	-do-

		extension to the concession period in the Concession Contract	
Operator default, or becomes bankrupt	Interruption in operations; Concession Contract may be terminated	Claim on performance bonds; claim damages from Operator; ensure there are grace periods in Concession Contract; terminate O&M Contract; appoint new Operator	-do-
Default by Concession Company under O&M Contract	Operator may claim damages; Concession Contract may be terminated	Ensure there are grace periods in O&M Contract; obtain step-in rights for the Project Lenders	-do-
Strikes and industrial disturbances	Interruption to operations; Concession Contract may be terminated	Ensure that Company obtains the agreement for the Operator to be responsible for this and ensure there is a right to claim damages; obtain grace	-do-

		periods in Concession Contract; obtain step-in rights for the Project Lenders	
Operating costs are too high	Reduction in cash available for debt service	Ensure that there are controls in the O&M Contract; ensure there are termination rights for the Company in the O&M Contract if costs remain high	
Accident Risk & Emergency Evacuation	Interruption to operations; Concession Contract may be terminated	Ensure that proper design is adopted to suit the local Indian requirements.	Risk of derailment is higher in case of Metro systems. However, emergency evacuation in case of Monorail system is more complicated due to system design features.
Failure of "technology"	Interruption to operations;	Due diligence; obtain	Monorail technology is

	Concession Contract may be terminated	technology feasibility reports; ensure there is a right for the Company to claim damages from technology providers	new to the country and hence absorption of technology could pose a bigger threat. There is no ongoing innovation / research process currently undertaken in our country. However, Metro systems in the country are already stabilised as far as technology acceptance and availability of manufacturing infrastructure (for spare parts etc.) in the country.

3.4.15 CONCLUSION

Metro rail and monorail do not substitute for each other. Metro rail is a high capacity mode and monorail is a medium capacity mode. Each has its own limitations and application. Monorail can be introduced in narrow width roads because it uses two beams only and not an elevated deck which would block light and air underneath.

Procurement, construction and operation risks in a monorail are higher than for Metro rail because of limited use (Experience with operation) and new technology.

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