3.2 Suburban – Regional Center Station (Shahdara Station)

There are 24 stations that can be categorized as “Suburban–regional center stations”. Among them, Shahdara Station is selected as a representative of this station type, that is, a station located in the regional center in suburban areas. This station is required a comprehensive development with development of a bus terminal in an integrated manner.

(1) Short-term Measures

Based on the Interview Survey, it is identified the most significant priority issue to improve the connectivity with feeder bus services, as the existing bus terminal is located about 300 meters far from the Shahdara Station. More than half of respondents pointed out the needs of improvement of pedestrians’ safety and comfort levels. Thus, the short-tem improvement shall include these measures at least and some other physical improvement of inter-modality, including the proposed ideas as follows:

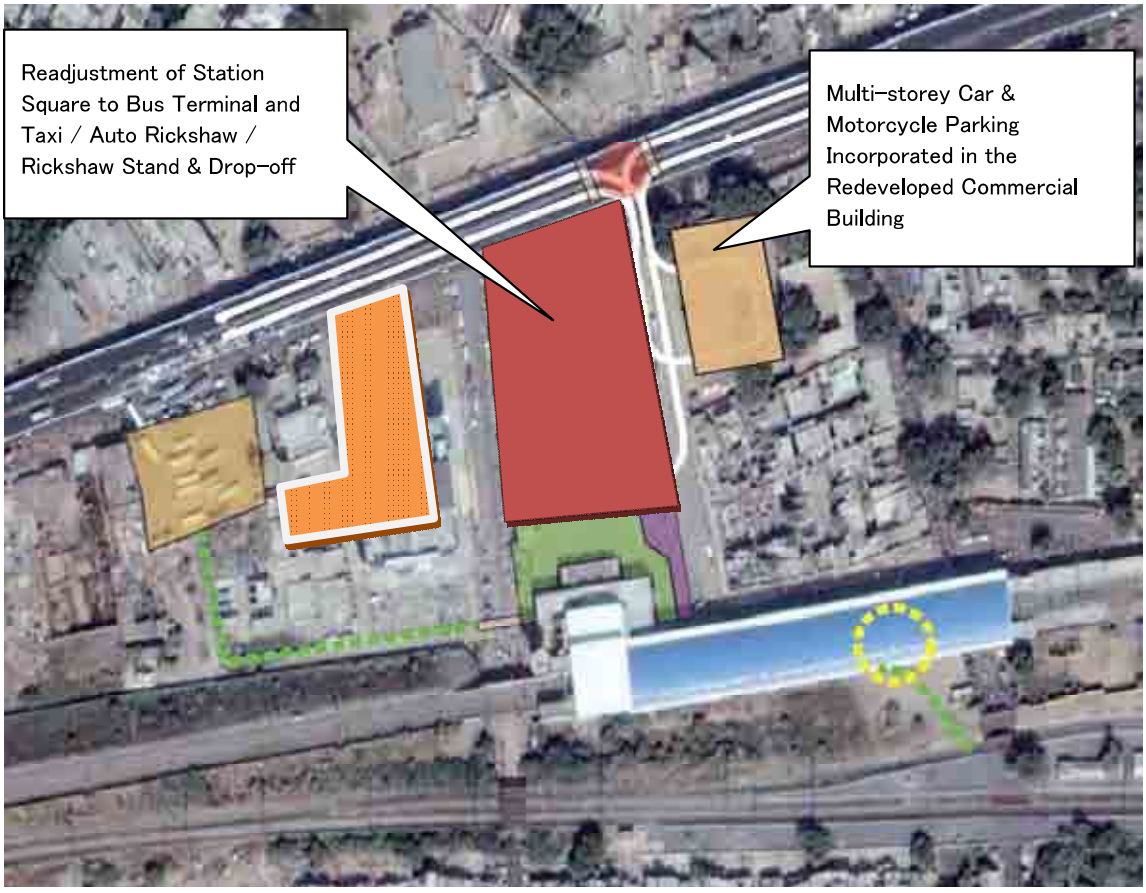
- In order to improve the connectivity with the bus and Metro services, the space for car parking adjacent to the station be partially converted to the bus terminal, including the installation of pedestrian’s crossings and signaling systems on the arterial road to/from the Station;
- The pedestrian path to/from the existing bus terminal (DTC’s facility) be improved with shelter (green shelter) for more comfortable access to the Station;
- Passengers’ drop-off/pick-up apron for cars and motorcycles be placed in front of the Station;
- Rickshaw pools should be collectively placed to mitigate traffic congestions; and
- The entrances/windows for ticketing and security checking be increased in number to mitigate congestions at peak hours.

(2) Medium- and Long-term Measures

The Station Plaza be designed and redeveloped in such a way that usages of public transportation modes are given priority with the following measures (See Figure 3.2):

- Expansion of the bus terminal facilities and taxi/Rickshaw pools;
- Expansion of temporally parking space and drop-off and pick-up aprons; and
- Construction of a Multi-storey Car Parking Building.

Figure 3.2 Shahdara Station Improvement in Medium- and Long-term



Source: JICA Study Team

3.3 City Center Station (Janak Puri West Station)

Janak Puri West Station requires development of spaces for a feeder bus station, private car, auto and cycle Rickshaw parking spaces and other terminal facilities, because it is a station used by many commuters to central areas.

Although there is space to set up bus bays, next to the elevated railway station, there are many rickshaws waiting for customers under the elevated railway station and they become obstacles to the flow of traffic. These rickshaws wait here because there are many rickshaw waiting passengers under the elevated structure and around bus bays, and this becomes an obstacle in the driving lanes of an arterial road. Especially, during peak hours, rickshaws overflow to the driving lanes, and this causes traffic congestions by mixing with route buses that load and unload passengers on the street. The parking areas adjacent to the Delhi Metro station are full of motorcycles and private cars.

Rickshaws pool and Motorbike Parking under underneath the elevated railway track

(1) Short-term Measures

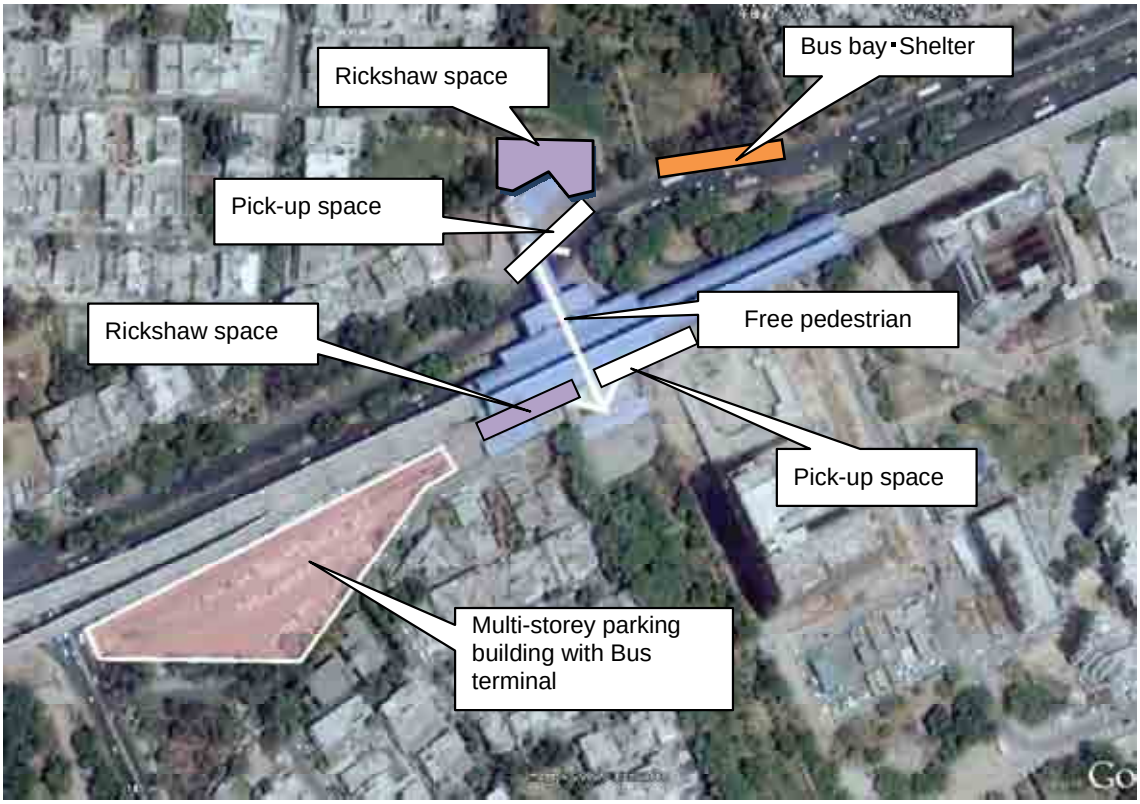
To keep smooth traffic flows on the arterial road, there is a high demand to create spaces for bus-bay and rickshaw parking lots. The following physical improvement is recommended to be carried out.

- To develop bus stops (bus bays with shelters) by using the land owned by DMRC and the right of way of adjacent roads;
- To expand the Rickshaw pools by using the DMRC-owned land;
- To locate a free pedestrian path connecting the north and the south entrances of the Station; and
- To place a drop-off/pick-up apron attached to the Station.

(2) Medium- and Long-term Measures

A comprehensive bus terminal with fully functioning feeder services needs to be developed at this station, taking into account the need highly requested by Delhi Metro users. To this end, the exiting vehicle parking area, of which the land belongs to DMRC, is recommended to be converted to a multi-storey parking building where a bus terminal and commercial facilities shall be located. Even though this project will require a considerable amount of investment, such an intensive use of the limited land will made the investment feasible.

Figure 3.3 Janak Puri West Station Improvement in Medium- and Long-term



3.4 City Station (Uttam Nagar West Station)

This is an elevated railway station above a road located in the suburban area. There are not station plaza and feeder bus services, but vehicle parking lots are available. This is a representative of the stations without surrounding area development by DMRC. Eight (8) other stations belong in this type.

The Uttam Nagar West Station needs a comprehensive development project of the station, including development of access roads, station plaza and the areal development around the station. Development of the intermodal functions of urban railways needs not only development of Metro-related facilities but a more comprehensive development that includes road network development around the Station and feeder bus system.

(1) Short-term Measures

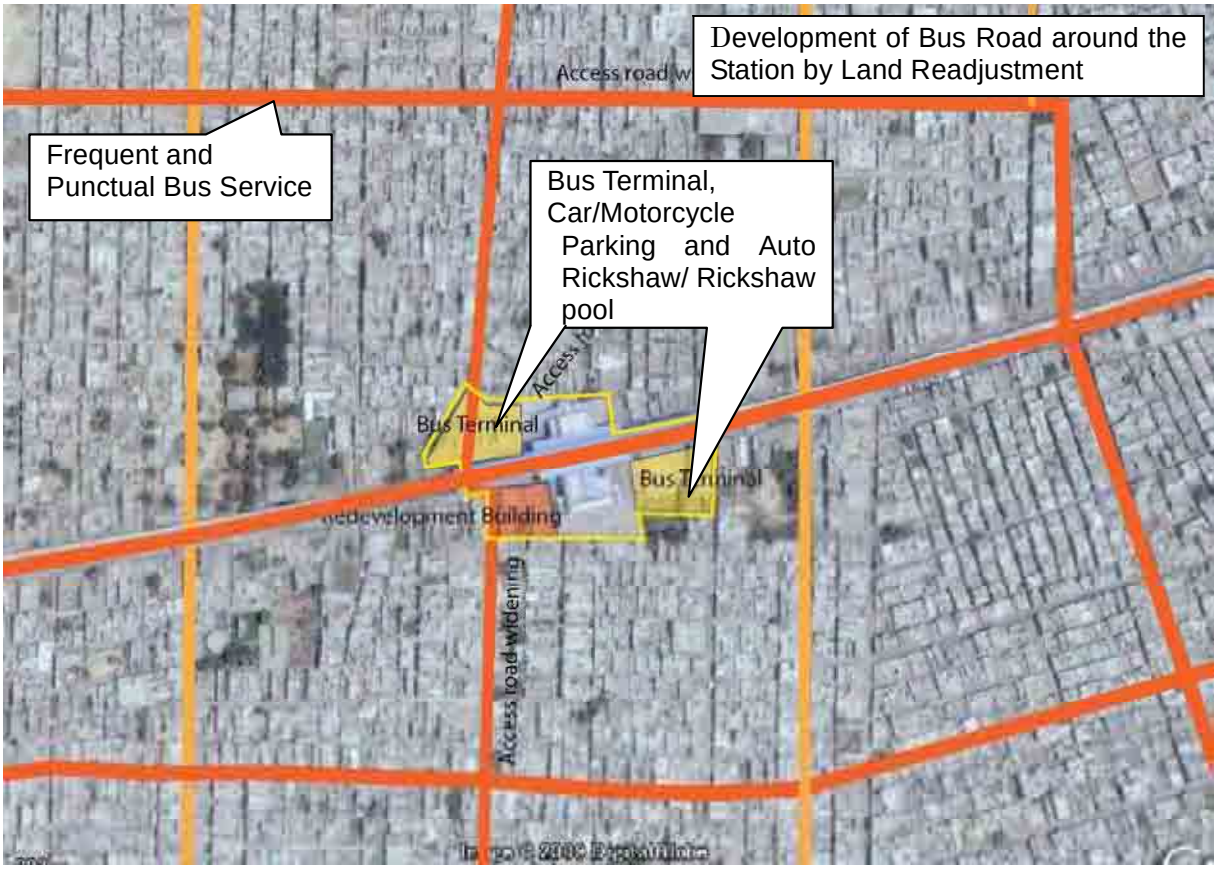
The first priority should be given to the following items:

- Development of Rickshaw pools in the north and the south gates of the Station in association with rules and regulations on usage of the space;
- Installation of an elevated free pedestrian passage connecting with both gates;
- Placement of a car drop-off/pick-up apron at both gates; and
- Construction of elevated bicycles/motorcycles parking facilities.

(2) Medium- and Long-term Measures

In the long-term, a comprehensive redevelopment project, including a station plaza and access roads to the station is required under close coordination with the urban planning department of Delhi City. Also, coordination with different service providers, including route bus services, feeder bus services, taxi services, and auto and cycle rickshaw services, are very important, besides revising the legal system for the development of urban facilities. A proposed structure of the surrounding area redevelopment is delineated on Figure 3.4.

Figure 3.4 Uttam Nagar West Station Improvement in Medium- and Long-term



3.5 Urban Center Station in CBD (Rajiv Chowk Station)

Rajiv Chowk Station is located in the middle of Central Business District (CBD) in Delhi City. It will have the third line in the phase II and become a very important intermodal point of the three Metro lines. Especially, because Rajiv Chowk already has the function as a central park of CBD, it will add a new transit hub function besides the function of a large public space. Currently the ground level is used for parking lots, a shopping center, and the metro station is located underneath the shopping center. Majority of users of the metro are workers engaged in the business sector.

Rajiv Chowk Station shall be a multi functional railway station with a feeder bus terminal and parking spaces for shopping center and business center on the underground level, keeping the parking space in the ground level as it is. To bring the bus terminal and car parking functions in the underground level, horizontal mobility switches to vertical movement and the distance of movement is shortened and comfort of the movement can be secured.

The entrance of the Underground Shopping Arcade

(1) Short-term Measures

It is urgent to strengthen intermodal functions, including the following measures:

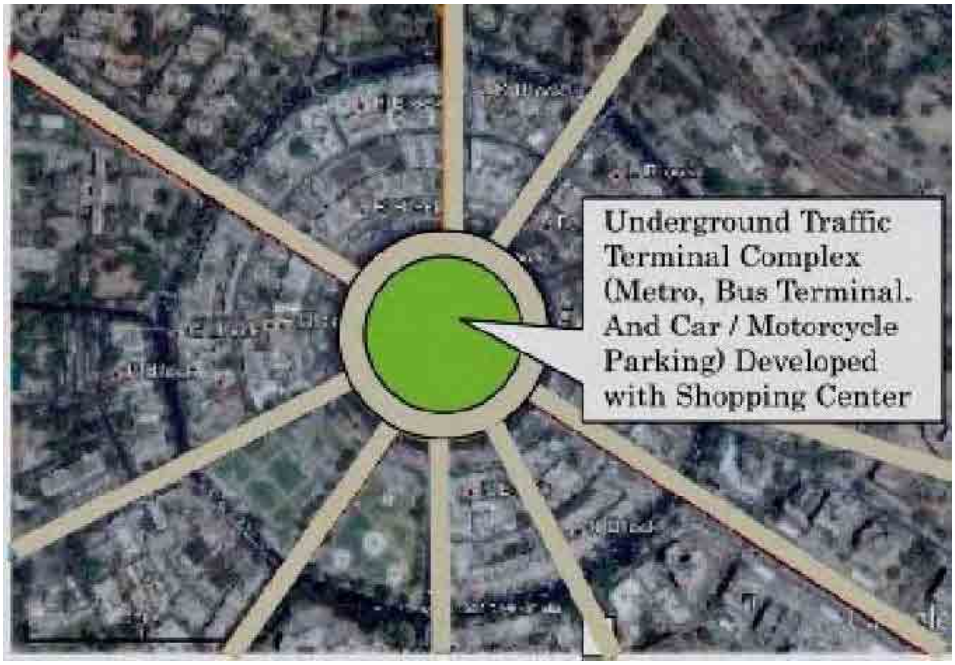
- To alleviate passenger congestions at peak hours, because of less capacity in ticketing and security checking, by increasing the entrances in number;
- To expand feeder transit capacities of, in particular, taxi and auto-rickshaws, because majority of Metro users transfer to these modes;
- To place more pedestrian crossing facilities cum signaling systems for passengers' safety on the inner loop road; and
- To install a bus information system for feeder bus services which are available on the outer loop road.

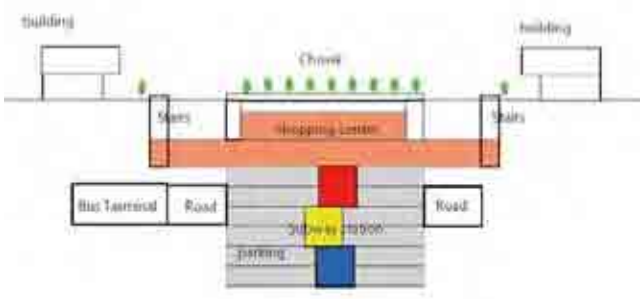
(2) Medium- and Long-term Measures

In the long run, a redevelopment project to strengthen the intermodal functions should be implemented, taking into account the following aspects:

- To relocate the bus terminal currently located on the outer loop road onto places near by the Station;
- To expand the parking capacity of cars and motorcycles, by efficiently integrating dispersed parking lots and provision of a parking information system showing on-time availability of parking lots;
- Simultaneous with construction of the Metro, urban functions, such as private car parking spaces that are required for business areas, can be built. Besides, cultural facilities and service facilities can be established and improved.

Figure 3.5 Rajiv Chowk Station Improvement in Medium- and Long-term





Section of the Rajiv Chowk Station (Use of Underground Space)

4 .Proposed Measures for Improvement of Intermodal Functions

4.1 Short-term Measures

(1) Physical Improvement of Railway Stations

Smooth Movement by Introduction of a Barrier-free System: A barrier-free system needs to be introduced for ensuring smooth movement of passengers or handicapped people in particular. Their vertical movements should be supported by elevators and/or escalators in order to make their transfer from one transport mode to another as easy as possible.

Commercial Utilization for Space of Concourse: It is often observed in the world that many large-scale railway stations are renovated to function as a multi-functional commercial center in addition to their transport function. A wide variety of shops, restaurants and urban services like banks, nursery service facilities, government information desks, post offices, etc. are located at the concourse of the stations. This provides daily conveniences for passengers on one hand, and financial profits to the station management on the other hand.

(2) Improvement of Intermodal Facilities

Since the railway is a network utility, the intermodal transfer system at railway stations should be improved to ensure the convenience of transfer from one public transport mode to another with less impedance on passengers. The following measures deserve to be implemented for this purpose:

- To improve the user-friendliness of the transport facilities, by providing pedestrian walks, car parking lots and other transport services;
- To upgrade the convenience level for transferring activities, by improving physical conditions such as shortening the walking distance for transferring from the metro to another mode and provision of Information on timetables and operational conditions;
- To prepare the safe and comfortable waiting space for transferring passengers.

(3) Uplifting of Feeder Bus Services

According to the result of the Household Interview Survey by JICA, more than half of the metro users residing in suburban areas desire the improvement of feeder bus services in terms of: 1) Accessibility to bus service; 2) frequency of the services; and 3) punctuality of the operation. This is the most vital point to strengthen the intermodal system of the overall public transport network.

4.2 Medium- and Long-term Measures

(1) Integration and Coherence with Urban Development Plans in Metropolitan Area

Needless to say, the establishment of a functional public transport network is one of the most important planning issues in urban development planning for the Metropolitan Area. The following should be addressed in this regard:

- **Integration with Transportation System and Appropriate Land Use:** In order to effectively use public transportation as a means to combat urban traffic problems, one should not only improve the railway system, but also ensure that the surrounding land is used in such a way as to encourage the use of the metro system. Both land use and transport infrastructures should be integrated under a concept of "**Transit Oriented Development** (TOD)", and the promotion of high-density commercial land use for around metro stations will benefit both the urban economy and the operation business of the metro system as a whole.
- **Establishment of A Comprehensive Urban Transport Development Master Plan:** The functional public transport system in the metropolitan area requires an integration of the CBD and suburban areas with a seamless transport network which is structured with trunk and feeder systems. For the materialization of this total mechanism, the deliberate development activities shall be conducted under of a comprehensive urban transport master plan, coherent with the urban land use plan on a long-term vision.

(2) Measures and Directions for Station and its Vicinity Area Development

Spatially functional connectivity between a station and its vicinity area should be assured through the following measures:

- **Station Surrounding Area Development:** The station itself is a traffic generator and attractor, thereby contributing to commercial and business development in its surrounding area, where the land values and real estate values are often highly appreciated, because of its latent economic potentials. The urban development is likely to be stimulated by a station's impact. Thus, making use of such an economic function endowed with a railway station, its vicinity should be deliberately developed.
- **Formulation of a Consensus Building Process among Stakeholders:** A number of stakeholders should be involved in the improvement of the intermodal facilities, that is, those are the government authorities in charge of transportation, urban planning and environmental administrations, public transport operators, related business entities and users. Therefore, it is essential that a process of consensus building among these stakeholders from the stage of planning of development targets to the implementation of measures and projects/programs be clearly established for the station and its surrounding area in particular.

(3) Area Development along Railway Corridors Initiated by the Railway Operator

A classic concept is that the railway operator is purely responsible for providing safe and comfortable railway transport service for users. However, today, it has been recognized that the railway operator also has a responsibility for the urban development along with the railway service corridor. This may bring another business opportunity for the operator to gain off-rail business revenues to ease its financial constraints. In this regard, the railway operator may take part directly and indirectly in urban development projects such as:

- **Station's Vicinity Area Development**: As mentioned above, the station and its vicinity areas possess great opportunities for commercial, business, industrial and some socio-cultural development. The operator may construct a station plaza building at its own land property, and/or connect the station with development projects implemented at its surrounding area.
- **Housing Development along Railway Corridor Areas**: The more residents live in the areas accessible to the Metro service, the more Metro ridership can be expected. Housing development is an effective tool to increase the latent demand for the Metro system. Given good access roads, feeder bus services and park-and-ride facilities, the housing projects will be further attractive, thereby facilitating both private and public-initiated housing projects. It is a rational business strategy that the railway operator takes part in these projects.

(4) Possible Model of the Operator's Participation in Development Projects

The Metro service should be financially sustainable, and the Metro operator shall be financially robust. The real estate properties, if it owns, should be economically utilized to make money to fulfill a financial gap between the fare revenues and the necessary cost for sustainable operation. For this purpose, one of possible and expansive strategies is to establish a joint venture business relation with private developers who have sufficient know-how on real estate projects and financial capability.

(5) Shared Budgetary System for Project Implementation

Several kinds of physical and engineering works should be implemented for strengthening the intermodal system. To this end, a rational and sustainable budgetary system needs to be pursued. The following Japanese system is recommended to be explored in India:

- **Tripartite Sharing for Station Plaza**: Since a station plaza is regarded as a vital urban facility to be addressed by the city planning policy, the cost of the station plaza are shared equally with three parties, that is, the railway operator, the local government and the central government. So, the railway operator shall owe one third of the total project cost.
- **Bilateral Sharing for Road Flyover** : Since a road flyover to cross over railway will benefit both sides of users, the construction cost shall shared with two parties, that is, the railway operator and the road administrator. So, the railway operator shall owe half of the total project cost.

- **Earmarked Budgetary System**: Surcharge on fuel, tax related to car ownership, fine of traffic violation are all earmarked for the development of transport facilities such as roads, traffic management, safety facilities and railway-related facilities of station parking, park-and-ride facility, so on.
- **Finance from CDM**: It has been widely recognized over the world that the railway system is an environment-friendly transportation mode, and effective for reduction of CO2 in the transport sector. Reforming of the urban structure with some railways has been more popular in many cities, taking into account energy-saving and the global environment. In this connection, the projects to enhance the Metro service can be recognized as a CDM (Clean Development Mechanism) project, therefore, its deduction of CO2 can be finically traded.

4.3 Organizational Mechanism

The intermodal mobility is uplifted by not only the physical improvement such as station plaza, car parking and bus terminal development, but also the introduction of soft components such as a common ticketing system, an integrated operation with timetable adjustment to minimize transferring time loss. This has been proven in many cities in Europe and Japan. Based on this recognition, it is proposed to establish two organizations to facilitate both the hard and soft components for the integrated intermodal mechanism as follows:

(1) Establishment of the "Delhi Metro Intermodal Transport Committee (DMITC)"

Objectives: DMITC is an institutionally recognized place to confer on policies and strategies for the enhancement of intermodal functions of the Delhi Metro in association with the urban planning polices, and to concretize the projects to implement the strategies.

Members: The members of DMITC are representatives of the metropolitan planning-related authorities (the government side) and the railway-based public transport operators (the railway side). Table 4.1 presents stakeholder groups who shall take part in discussions at DMITC. As basic directions and strategies be identified at DMITC, taking into account users' needs, some representatives of citizen's groups are as well to be involved in DMIC.

Functions: The basic function of DMITC is to identify priority projects/programs based on necessary policies, strategies and measures based on citizen's needs to improve the inter-modality of the railway system. Important is that those are linked and coherent with urban planning orientations launched by local governments in the Delhi Metropolitan Area. DMITC should be practical rather than debate-oriented. It is a vital task for DMITC to identify the project owner/executer of the priority project in such a way that a concrete action to materialize the project may be smoothly and promptly taken.

Table 4.1 Proposed Stakeholder Groups for the "Delhi Metro Intermodal Transport Conference (DMITC)"

Stakeholders		Responsibility
Government Side	Ministry of Urban Development, GOI	Transport & Urban Development Policy
	Delhi Gov.	Transport & Urban Development Policy in Delhi
	Delhi Municipal Corporation	Urban Transport Planning & Urban Development
	New Delhi Municipal Corporation	Urban Transport Planning & Urban Development
	Delhi Police	Traffic Management & Regulation
Railway Side	DMRC	Development of Railway Transfer Functions
	Indian Railway	Development of Railway Transfer Functions

Source: JICA Study Team

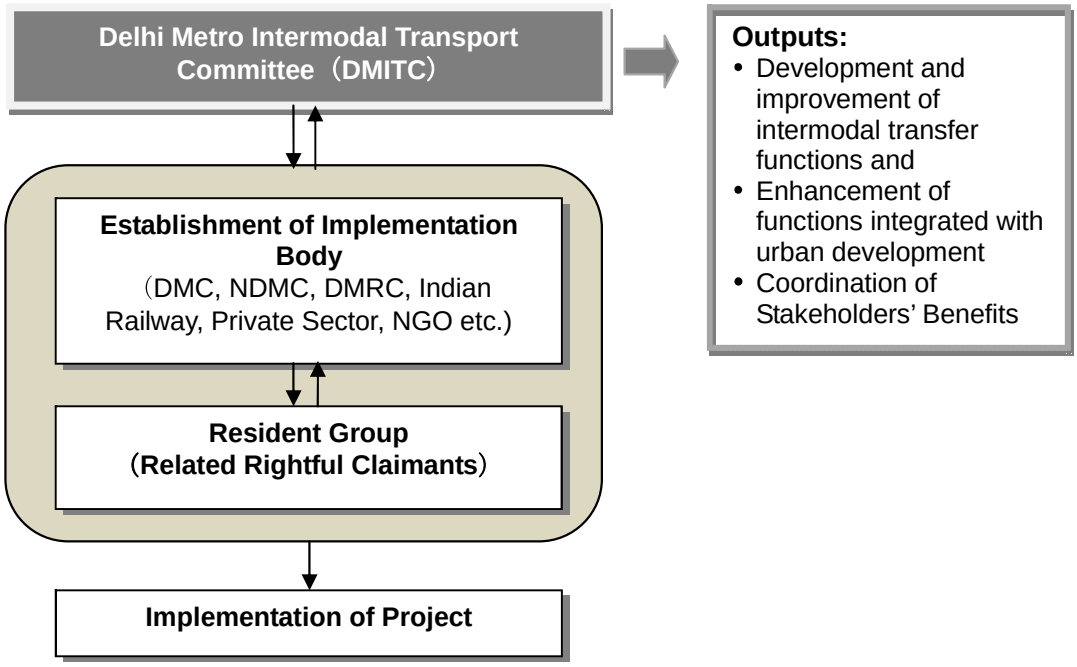


Figure 4.1 Proposed Functional Structure of DMITC

(2) Establishment of the "Delhi Transport Alliance (DTA)"

Objectives: A smooth and seamless public transport network is an ideal structure, and to this end, it is also ideal that all public transport modes are managed in an integrated fashion for operation and ticketing. DTA shall function as a monogenetic coordinating organization to introduce common technologies and systems to uplift the inter-modality of the public transportations in the Delhi Metropolitan Area.

Members: All public transport operators and their associations such as Indian railway, Delhi Metro, bus, taxi and other important organizations of para-transit, are the members of DTA.

Functions: DTA's major function is to facilitate joint efforts with public transport operators to optimize their profits and modernize the management of their organizations, through maximization of users' benefits. Under this recognition, DTA shall tackle with the following issues:

- Proposal of a rational fare structure for each public transportation with introduction of a joint-ticketing and/or integrated system;
- Reviewing of rational and efficient bus service routes in consideration of the Metro System, including adjustment of operation timetables to minimize transferring time loss;
- Promotion of a public campaign for promotion of users' manners/norms/rules;
- Proposal of justifiable subsidies and various support of the government; and
- Other current issues arising at the operation sites.

In order to materialize an integrated system, the government sector is also significant in terms of provision of policies, regulations and subsidies on operators. Figure 4.2 shows a basic concept of the functional framework. The underlying concept of "**Transport Alliance**" is popular in France and Germany. A similar concept has been successfully applied in other countries in Asia like Japan and Singapore. An organization like the DTA should be explored to be introduced for Delhi.

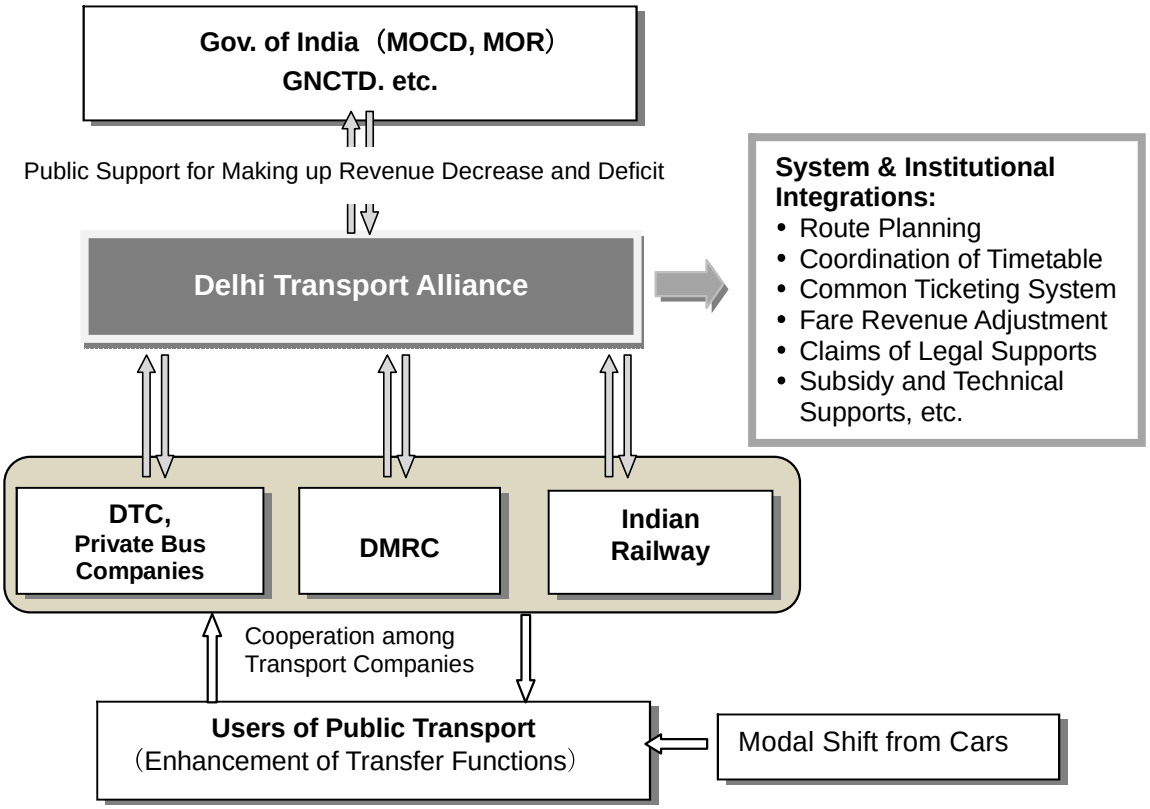


Figure 4.2 Proposed Integrated Management System of Public Transportation

4.4 Rational Fare and Integrated Ticketing Systems

According to the interview survey to non-Metro users at four stations, it is noted that 31% of respondents pointed out the expensiveness of the Metro fare as the main reason why they do not use the Metro. The fare must be a vital factor to promote Metro users.

At present, DMRC has installed the automatic ticketing system with the issuance of prepaid cards, and offers a 10% discount for the prepaid card users. This modern system has been applied only for the Metro service, not for other transportation modes being operated by different operators such as bus and parking. The Metro card users can receive a privilege for free bicycle parking, by showing the card. DMRC has a plan to apply a similar system for car and motorcycle parking services.

Introduction of a more systematic integrated ticketing system with Indian Railway, DTC bus and private buses have become a vital issue today. Through a common ticketing system, users will be able to get more attractive services like fare discount for transferred mode and mitigation of time loss for ticket purchase.

As one of the feasible fare integration systems, **a zone fare system** deserves to be studied for its possible introduction. This system is a simple mechanism that a fare even for using different transport modes is the same as long as the travel is made within the same zone, and that such an integrated fare will be increased when the travel is made to another zone.

Under such an integrated fare system, a fare revenue sharing method shall be established among the public transport operators that take part in the system. As mentioned earlier, the Delhi Public Transportation Operators Union (DPTOU) will function as the coordinating entity for establishing a rational system as well as the fare revenue sharing method.

4.5 Government Interventions for Strengthening Inter-modality of Public Transport

Governmental support is essential to improve the entire intermodal system in the Delhi Metropolitan Area, in terms of administrative and financial support for both physical and institutional development.

(1) Physical Improvement

As for the physical improvement, the intermodal transfer facilities such as bus terminal, car parking, taxi stand, para-transit waiting pool and pedestrian path need to be developed not only for the Metro station, but also in linkage with the urban development in the surrounding area. It is noted that the station plaza, therefore, is often recognized as an urban service facility, not a part of the station.

In Japan, the project of development of a station plaza, aiming to strengthen intermodal linkage with different modes, is fully subsidized in the urban planning institutions by the government sector, and several measures for the project implementation have been linked with a legal framework such as "Land Readjustment System (LRS)". LRS is often applied for the land development with infrastructure development at a certain target district. For financing the station plaza project, a budget sharing mechanism is also regulated in such a way that the project cost shall be shared equally by three parties of the railway operator, the local government and the central government, that is, each party shall share one third of the total cost. This Japanese experience may be introduced in India.

(2) Financial Supports

Introduction of the integrated ticketing system with special discount will require governmental financial support to make up for the operator's loss, if it happens. The manner of the government support depends on the social norm and/or common understanding of the society on the public transport system. In France, the budget for supporting public transportation operators has been earmarked through the public transport tax. In Japan, it is accepted by citizens that the quality service of public transport systems may be supported by tax money, or additional financial burdens of individuals and companies. Discussions on justifiable and rational financial support and subsides need to be further facilitated in the Indian society, too.

(3) Encouragement of CDM-driven Projects

There is another issue related to the global environment, or mitigation of CO_2 emission from the transport sector. The Delhi Metro is installed with a power renewable braking system (braking itself regenerates power), thereby saving on electric power by 33%. This system has been first registered as a CDM (Clean Development Mechanism) project in the transport sector over the world. By the introduction of this system, 200,000 tons of CO_2 are reduced in five (5) years. Thus, the governmental support will be justified from an environmental policy point of view.

(4) Establishment of Monitoring System to Identify Citizen's Needs

The improvement of the intermodal transfer system of the Delhi Metro aims to increase its ridership, by maximizing users' utility and uplifting its satisfactory level of mobility by public transport systems. To this end, people's needs should be continuously grasped and assessed through a user monitoring system, and appropriate, admissible and timely measures should be formulated based on the needs assessment.

5 Recommendations

5.1 Intermodal Development at New Stations in Phases 3 and 4

Many existing stations were constructed on elevated structures on busy arterial roads. Such a location condition is likely to causes traffic congestions due to mixture of access-traffic to the station and through-traffic. A station plaza needs to be deliberately planned and constructed to accommodate intermodal facilities and better accessibility to the station. For stations to be newly constructed in the next Phases 3 and 4 of the Delhi Metro Extension Project, some recommendations were made, learning from other experiences as well as based on assessment of the current situation as follow:

(1) Land Acquisition for Station Plaza Development

The station plaza is a key to strengthen the intermodal functions, providing feeder transportation services and urban services which are convenient for users. The land acquisition, however, is always a problem in practice. In order to secure the land for the station plaza, a concept of "transport-led urban development" needs to be employed in integration with an urban development project. It is a rough idea that a well-functional station plaza requires more or less 4,000 - 5,000 m^2, accommodating feeder bus services and space for its traffic circulation.

(2) Formulation of Station Vicinity Transport Plan

The system of traffic flows and circulations in the station vicinity areas should be thoughtfully designed. It is often observed in stations constructed in Phases 1 and 2 that the entrances of the station face directly with an arterial road, thereby interrupting smooth traffic flows on the arterial road. Such traffic struggles in front of the station should be avoided for stations to newly be constructed in Phases 3 and 4.

A transport assessment study, taking into account traffic impacts by the station, should be conducted for each station, prior to the design work. Based on the traffic demand foretastes, a traffic management system at the vicinity areas should also be planned in such a way that many different mode traffics can be properly managed with less traffic congestions.

(3) Development of Bus Terminals

According to the Interview Survey, the most desired facility/service of users is to improve the accessibility to/from the Metro stations with feeder buses. It should be noted that the convenient usage of bus services linked with the Metro is particularly important. Bus terminals are expected to be developed, attached to the Metro station, based on the Station Vicinity Transport Plan, as mentioned above.

(4) Effective Utilization of Available Public Space

Locations of new stations for Phases 3 and 4 should carefully be determined at the sites where exist spacious land available along roads, sidewalks and publicly owned land areas. These land areas can be converted for station plazas to locate a feeder bus terminal, or parking space for feeder transport modes, including para-transits.

(5) Smooth Traffic Flows and Circulations

A smooth traffic circulation system should be designed for in-coming and out-going traffics at the station plaza, installing a reliable signaling system and right/left-turn dedicated lanes at main intersections for access to the station. The available space within the right of way is utilized at maximum level for engineering of such a traffic management.

(6) Provision of Different Types of Parking Space

Many stations along the Delhi Metro have placed parking lots for cars and motorbikes, but not sufficient enough. In order to encourage car/motorbike users to shift to the Metro system, inter-connectivity between cars and the Metro needs to be ensured, providing with different types of parking and/or pick-up facilities for Park-and-Ride and Kiss-and-Ride Systems. These facilities are convenient for those who are commuting-time conscious, residing in suburban areas and working in the central business district.

(7) Placement of Rickshaw Pools and Loading Zones

Although it is the fact that rickshaws' occupation at the station is one of hampers against smooth traffic flows, it is not recommended to push them out of the station, taking into account its significance as a feeder mode. An orderly layout of rickshaw pools and loading zones should be designed, and at the same time, rules and regulations for rickshaws' operation and usage at the station space should be built, making a consensus with the Rickshaw Drivers Association, DMRC, Police Department and City Government.

(8) Securement of Venders' Space

It is often observed in existing stations that many venders occupy the road space, thereby causing traffic congestions and chaotic situation at peak-hours. The space for venders should be deliberately prepared so as not to occupy roads and traffic space. Thus, a comprehensive land use plan, or a zoning system is necessary to be prepared for each station.

(9) Uplifting of Passengers' Convenience Level at Station

In general, the quality level of station facilities and equipment is assessed high, having escalators and modern lighting and signs. Making use of the station's function as an activity center, the station's space may be fully utilized for provision of a wide variety of public and commercial services. The station building, providing rental floors, may be developed as a business center, a commercial center, a culture center and/or a governmental center. Active promotion of such real estate business and commercial operations deserves to be pursued as a

measure to strengthen the financial basis of DMRC.

5.2 Planning Issues on New Stations Integrated with Urban Development

(1) Ridership Estimate at New Stations

For forthcoming phases 3 and 4, a number of stations will be newly constructed at virgin areas where urban development will be accelerated, once the station and the Metro service is available. The numbers of passengers getting on and off at all stations needs to be projected as a rational reference for engineering design and spatial planning of the stations. Planning indicators for transportation such as ridership of the Metro system and usage of feeder bus services and other modes are obtained through a Person Trip Survey, and the demand analysis is subject to conditions of human settlements and economic activities to be performed in the service catchment area of the station. Therefore, it is recommended that a comprehensive station plan should be formulated at each station, based on such a rational data basis, derived from transport behavior surveys.

(2) A Priori Development of Access Roads

A critical factor must be development of access roads to new stations in practice. Road construction will become more difficult after construction of a station than before. The land acquisition of the access road, if is necessary, should be undertaken as soon as possible and it is recommended that the access road is constructed even before the station comes.

(3) Establishment of Executing Body for Station Plaza Development

At present, the station plazas are developed and maintained by the Metro operators, DMRC. However, as mentioned repeatedly, the responsibility for intermodal facilities shall be assumed by both the rail operator and the urban development manager, because the quality of intermodality affects urban mobility, or the urban economy a whole. A demarcation system of financial and administrative responsibilities for the station plaza needs to be established, and maintained under a functional management body which involves urban development-related authorities and its stakeholders as well as DMRC. In this regard, it is recommended that the **Delhi Metro Intermodal Transport Committee** (DMITC) is established as soon as possible.

5.3 Coherence of Rail and Urban Development

The urban railway network project is always expected to be implemented in association with urban development projects related to or supported by the new transport network. Give a coherence of the two, investments on both sectors are economically effective and beneficial to each other. In this sense, the following four (4) measures are recommended to be undertaken by the authority relevant to urban planning and development as well as DMRC. JICA's assistance is further expected to support the execution of these measures.

(1) Needs to Build a Comprehensive Urban Transport Master Plan

It is often observed in the Delhi Metro that no sufficient linkage between the Metro and feeder transport services have taken place. In other cities such as Metro Manila and Bangkok, the urban railway systems are being developed under a master plan addressing land use cum transport systems on long-term perspectives.

Needless to say, the Metro system shall function as a public transport corridor in the entire public transport network, because of its massive transport capacity, at the same time, the Metro shall be a trunk axis of the entire urbanization structure, which will affect economic potentials along the axis. Therefore, without coherence of development strategies between the Metro system and the urban development, economic rationales of both investments are not assured. Therefore, an integrated implementation in close coordination with urban planning-related authorities of both central and local governments is essential to achieve more beneficial outcomes from the project.

(2) Periodical Monitoring for Integrated Project Implementation

The development of the Metro system is time- and money-consuming work in a long term, therefore, socioeconomic conditions at the time when the project was planned and designed are greatly changed when the project is completed. It is natural that a gap between the plan and the reality takes place in the course of the project implementation. A flexible system to adjust the project to meet a practical realty needs to be established at the implementing body, DMRC, under close consultation with relevant authorities. For this purpose, an appropriate monitoring system should be formed from the technical and financial viewpoints.

This is a substantial need of JICA as well which is providing financial supports. The intermediate monitoring and technical assistance from a financer's point of view shall be undertaken periodically, and some amendment of the investment scheme, if is necessary, shall be timely made in such a way that economic benefits of the investment will be maximized. In this sense, if the necessity of an additional investment for a sub-project relevant to strengthening of intermodal functions is identified on a rational basis, JICA shall be flexible to amend the bilateral agreement. It is often seen that a related project, which requires a small investment, may bring a great benefit on the entire project.

(3) Establishment of Holistic Urban Transport Database for Delhi Metropolitan Area

In order to justify such a huge public investment for the Metro system, a holistic urban transport database should be developed to facilitate a rational project evaluation. Without reliable and updated data/information on residents' transport behaviors, any quantitative analysis to depict a rational investment scheme cannot be made, and long-term perspectives on urban changes by impacts of the Metro system cannot be predicted on a scientific basis. This means that given no reliable database, all decision-making cannot help being subjective, controversial and/or politicized. Currently the Delhi Metro is the case.

It is strongly recommended that a Comprehensive Urban Transport Master Plan in the Delhi

Metropolitan Area (CUTMAP-DMA) be conducted, including the holistic transport data base building. The basic urban structure addressed by CUTMAP-DMA should keep a basic consistency and coherence with the existing Delhi Metropolitan Area Master Plan, but the transport sector should be deepened in consideration of the integrated public transport network system. This study needs to justify projects in the forthcoming phases 3 and 4, and a technical and financial assistance of JICA is expected for its conduct which is organically linked with the financial assistance for Phases 3 and 4.


JICA