Mongolia: Ulaanbaatar Urban Planning Improvement
(Financed by the Japan Fund for Poverty Reduction)


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Japan

For: Municipality of Ulaanbaatar

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Asian Development Bank
5. Urban Transportation

5.1 Rationale

(1) Aims and Objectives of Urban Transportation Planning

Transportation in large urban areas is increasingly becoming vital for sustainable urban development and growth. It plays an important role in economic, industrial, social, environmental, and cultural development of the city. The inadequate transportation facilities and services become a hindrance to the process of socio-economic development and bring about varied negative impacts on land use and environment. Urban planning is intended to promote sustainable growth and development of a city through its consented vision, strategies, coordinated plans and exercise of institutional arrangements to regulate and guide wide range of development activities. Ultimate goal of urban planning is to achieve that the city becomes economically competitive, livable, environmentally sustainable and ensure quality of life for all including the poor. Toward this goal of sustainable development, urban planning will farther elaborate overall development strategies in integration with related subsectors including transportation as shown in Figure 5.1.1.

Although everything is related to everything in urban system, transportation is particularly interrelated to landuse and environment as shown in Figure 5.1.2. Transportation infrastructure and facilities requires 10-20% of urban land, their construction work often requires resettlement of existing households, transportation affects locations of housing, offices, schools, public facilities etc. Transportation generate various emissions which affect negatively air quality, construction work may also harm environment. Quality of vehicles becomes an environmental concern too. Transportation planning must step in the process in a way to maximize the benefits of transportation development while minimize their negative impacts. Primary purpose of transportation planning is to integrate land use and transport system to ensure the highest degree of mobility, accessibility, and safety for all types of users. The equitability of the services received from different groups and types of users should also be taken into account because available space for transport in large urban areas is always constrained and how to share the limited space among them becomes a critical concern of the society and policy decision of the Government.

Source: ADB Project Team

Figure 5.1.2 Integrated planning of Transportation, Landuse and Environment

Figure 5.1.1 Role of Transportation Planning in Overall Urban Planning Context
Urban problems derived from transportation are complex and complicated. For example, traffic congestions are visible and easily identified by everyone but measures are often unsuccessful because of the complexity of the nature and the difficulties in planning and implementation of integrated approach. In this chapter, following topics are explained:

(i) General urban transportation process
(ii) Transport network planning
(iii) Transport modeling for demand forecast
(iv) Public transport planning
(v) TOD (Transit Oriented Development)
(vi) An approach to strategic transport-landuse-environment planning for Ulaanbaatar city.
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5.2 Urban Transportation Planning Process

(1) Approach to Ulaanbaatar

Urban transportation planning in a large urban area such as Ulaanbaatar is not an easy task for planners and more difficult for implementing bodies, especially in the process of growing population and expansion of urban areas in sprawling manner. Strong appetite to own private vehicles hardly reduce, even though city authorities are intent to do so. There is no quick fix. Ulaanbaatar needs an updated long-term perspective that will integrate transportation, land use and environment (hazard risk mitigation, eco-preservation, pollution reduction and climate change response), medium-term strategies, and doable concrete short-term actions.

In spite of the recognition that transportation is an integral part of urban system, urban transport plans are often prepared without due consideration on socio-economic and land use. On the other hand, urban plans lack in-depth analysis on the impacts of transportation facilities and services on urban form and land use.

Planning requires a systematic and logical process to formulate workable plans, which can guide or enforce effective implementation of policies and projects. Prior to planning, questions were posed on how transportation plan for Ulaanbaatar city is prepared:

- Are projects evaluated properly and prioritized?
- Are funding and resources allocated properly to projects and actions?

(2) Urban Transportation Planning Steps

Although planning process is not one way linear activities, but requires feedbacks between planning steps and cross-sector coordination, it is conceptually illustrated as shown in Figure 5.2.1.

- Is an updated database available?
- Is the situation analyzed adequately?
- Are adequate planning tools provided?
- Are the planning goals properly laid out?
- Does UB City have a consented transport plan and strategies?
- Is transportation plan coordinated with other urban sector plans?
- Are projects and actions identified and designed in a way with guaranteed expected outcomes?
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(iv) Prioritized projects/actions which attend to urgent issues and at the same time promote medium to long-term development objectives: Projects must be designed strategically in synergy with other related projects and actions.

(v) Implementation plan: Implementation plan is intended to elaborate road map farther in terms of required resource (financial, technologies, man power), institutional arrangement (implementation organization, related regulations), and social and environmental considerations (resettlement and environment impacts).

(3) Step 1: Determine Scope of Transport Planning

Key elements that must be taken into account in plan formulation at its onset include the following:

(a) Themes and Types of Transport Plan: Themes for planning include, among others, (i) Comprehensive master plan; (ii) Road network plan; (iii) Traffic management plan (corridor/area traffic management, parking, traffic signal, etc.); (iv) Public transport system plan (metro network, metro line, bus system etc.); (v) Traffic safety plan; (vi) NMT (non-motorized transport) plan; and (vii) Walking environment plan.

(b) About Transport Network Plan: Main objectives of transportation planning are to propose a basic multi-mode transport system for the future urban area, arrange the transport network in accordance with the proposed systems, show the location of major transportation facilities, and clarify their functions and services. Network planning may include several components: a road network and public transport systems. The road network is composed of several types of roads: Expressway for long-distance travel and freight movement, and local streets for residents to access main roads.

(c) Spatial Levels of Planning: Spatial levels and coverage for planning must also be determined whether it is intended for region (metropolitan area) or urban area (entire area, CBD, corridor, site). The study area should contain the area that is affected by planning objective and scope.

![Figure 5.2.2 Stages of Transport Planning](image)

Source: ADB Project Team

Figure 5.2.2  Stages of Transport Planning

(d) Planning Time Horizon: While long-term plan is prepared to define the vision and goals for a city is intended to achieve, the process must be elaborated in medium-term plan and short-term plan as shown in Figure 5.2.2. Long-term plan is rather strategic, while short-term plan is concrete and doable. The medium-term plan provides the bridge between the two. The plans should not be rigid, but flexible and involve repetitive processes in each planning stage and between them.

(4) Step 2: Collection of Data, Surveys and Database Building

At the first onset, it is important to discuss and identify initially problems and issues facing the city. This process will help to elaborate the scope of planning work, and specify the data to be collected, and the types of surveys to be conducted. At present, many cities own various plans and studies conducted and experiences made in the past. Any new planning work must be conducted based on the thorough review of the outputs and past achievements.

Necessary information (statistics, studies, plans, among others) were collected from organizations and members taking part in taskforces, relevant agencies, and stakeholders. A list of existing data was prepared that contained the data attributes (time, format, etc.) so as to formulate and share the database.
Collection of data is carried out on the items as shown in Table 5.2.1 though it depends on the planning scope. This is an important stage of transport planning because it is costly in terms of money as well as manpower. Among the necessary data, there are those on traffic flow, transport facilities, and transport demand, which are directly connected with transport. There are also data on socio-economic activities, land-use, public facilities and policies related to them. Data should be collected as extensively as possible, covering not only the present situation but also the past and expected in the future. Particularly for those cities where there are many fluctuating and uncertain factors, it is important to place emphasis on grasping the direction of changes of major fluctuating factors in the collection of data.

Base map is prepared for the whole planning area in sizes adequate for both analysis and presentation. Specific zones in the base map can be magnified, such as the central business district (CBD) to ensure higher accuracy. GIS can be used to formulate the base map at more flexible scales that can be magnified on demand between 1/2000 – 1/10,000 depending on the scale of study area.

Supplemental traffic/transport surveys are more specifically shown in Table 5.2.2.

<table>
<thead>
<tr>
<th>Study Area / Aspect</th>
<th>Existing Data with Related Agencies and Organizations</th>
</tr>
</thead>
</table>
| Socio-economic Conditions | • Government statistics  
|                      | • National/regional economy: GDP by sector  
|                      | • Industry: structure by sector, enterprises  
|                      | • Employment: labor force, employment by sector, unemployment rate, wage level, etc.  
|                      | • Consumption: household expenditure, price index, etc.  
|                      | • Population: households, structure by age and sex, literacy rate, etc.  
|                      | • Poverty: definition, population, income, accessibility to urban services, etc.  
|                      | • Gender: job opportunity, working hours, comparison of indices between men & women, etc.  
|                      | • Vehicle ownership: registered vehicle by type, price and taxes by type  |
| Present Conditions | • Present land use  
| | • Distribution of slums and squatters  
| | • Urban services (solid waste disposal, flood control, drainage, water supply, electricity, communication, etc.)  
| | • Land-use plan of related local governments  
| | • Large-scale urban development  |
| Urban Planning & Urban Development | • Topography, geology, earthquake  
| | • Meteorology, water/river system  |
| Natural Conditions | • Air pollution, noise, environmental standard, monitoring system  
| | • Historical buildings, landscape  |
| Environment | • National Socio-economic Development Strategy,  
| Review of Existing Studies & Plans | • Five-year Socio-economic Development Plan,  
| | • National Transport Development Strategy  |
| National Plan | • Regional Master Plan  
| | • City Master Plan  
| | • City's Socio-economic Development Plan  |
| Regional/Urban Plan | • Available urban traffic studies  
| | • Plans for any transport sub-sector  
| | • Pre-F/S and F/S of transport projects  |
| Transport Plans | • Transport-related organizations and their administrative coverage, authority and capacity  
| | • Tax system, budgeting system, municipal finance  |
| Institutions and Policies, Transport Funding | • Existing policies: public transport policies, parking policies  
| | • Demand management: car restraint, pricing.  |
| Urban Transport Policies | • Population, households  
| | • Pupil/Student (at residence and school)  
| | • Workers (at residence and workplace)  
| | • Existing traffic count survey results  |
| Demand Analysis | • Road data (road width, traffic terminal)  
| | • Public transport data (route, bus station, fare level)  
| | • Node data (intersections, bus stations, airport, port)  |
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Study Area / Aspect | Existing Data with Related Agencies and Organizations
--- | ---
Road Network | • Road inventory (including bridge and pedestrian overpass)
| • Transport terminal inventory: port, airport, railway, bus, truck, etc.
| • Maintenance and operation system
| • Design standard
Traffic Management | • Traffic flow control, traffic law enforcement, traffic signals
| • Education, campaign
| • Traffic accident statistics
Parking | • Existing parking facilities
| • Operation and management system
Public Transport | • Route coverage: stops, passengers carried, length, speed, frequency, vehicles, carrying capacity.
| • Ridership: volume, custom satisfaction
| • Vehicles: size, age, aircon/non-aircon, conditions, etc.
| • Operators: business type, maintenance, operating routes, income and expenditure, subsidy, etc.
| • Licensing/registration: entry, operation, exit
Pedestrian | • Sidewalk conditions
Intermodal facilities | • Bus terminal, port, airport, inland waterway port,
| • Location and scale of industrial park
Economic/Financial Analysis | • Construction cost (foreign and local), unit price of construction
| • Tax system (fuel, vehicle registration, etc.)
| • Vehicle operating cost

Source: ADB Project Team

In often cases of transport planning, a new set of updated data need to be collected for in-depth analysis of planning issues and scope. The specific surveys must be designed in terms of “survey form” which cover needed information and survey implementation plan including “survey scale and coverage”, “survey method”, “survey organization” and “survey costs”. The collected data must be checked and processed in the proper form of database which is not only for the use of particular planning work but also shared with other planning activities.

Table 5.2.2 Outline of Types Transport and Social Surveys

<table>
<thead>
<tr>
<th>Survey</th>
<th>Objectives</th>
<th>Method</th>
</tr>
</thead>
</table>
| 1. Person Trip Survey (Household Interview Survey) | • Socio-economic profile and trip information of residents
| • Perception of residents on transport services and environment | • Direct interview with household head and members |
| 2. Cordon Line Survey | • Traffic volume on cordon line (vehicle/passenger)
| • Socio-economic profile and trip information of residents outside the study area | • Direct interview with drivers/passengers at roadside
| • Traffic count (vehicle) | • 24 and 12 hours |
| 3. Screen Line Survey | • Traffic volume on screen line (vehicle/passenger) | • Traffic count (vehicle/passenger)
| • Traffic count (vehicle) | • 24 and 12 hours |
| 4. Traffic Count Survey | • Traffic volume at major road sections | • Traffic count (vehicle) |
| • 24 and 12 hours |
| 5. Intersection Traffic Count Survey | • Traffic volume at congested intersections by turning direction | • Traffic count (vehicle) |
| • 3 hours by period |
| 6. Travel Speed Survey | • Travel speed on major routes by section
| • Bottleneck sections | • Floating car method
| • 2 round trips by period by vehicle type |
| 7. Public Transport Passenger Interview Survey | • Travel characteristics
| • Perception of users on existing and proposed public transport services | • Direct interview with public transport passengers
| • 12 hours |
| 8. Public Transport Terminal Survey | • Capacity and utilization of terminals
| • Characteristics of bus/feeder service operation | • Facility inventory survey
| • Counting frequencies and passengers by route
| • 18 hours |
| 9. Public Transport On-board Survey | • Boarding and alighting passengers by route section | • On-board observation
| • 2 round trips by period by route |
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<table>
<thead>
<tr>
<th>Survey</th>
<th>Objectives</th>
<th>Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>10. Public Transport Operator Survey</td>
<td>• Operational and financial characteristics of public transport operators</td>
<td>• Direct interview</td>
</tr>
<tr>
<td>11. Private Mode User Interview Survey</td>
<td>• Travel route choice</td>
<td>• Direct interview with users</td>
</tr>
<tr>
<td></td>
<td>• Perception on road services and willingness- to-use of public transport</td>
<td>• 12 hours</td>
</tr>
<tr>
<td>12. Parking Survey</td>
<td>• Parking capacity and utilization</td>
<td>• Facility inventory survey</td>
</tr>
<tr>
<td></td>
<td>• Perception of users on parking services</td>
<td>• Utilization survey</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Direct interview with users</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 18 hours</td>
</tr>
<tr>
<td>13. Freight Transport Survey</td>
<td>• Characteristics of freight vehicle transport</td>
<td>• Direct interview with operators</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Traffic count and OD interview at gates</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• 24 hours</td>
</tr>
<tr>
<td>14. People’s Perception of Traffic Accessibility</td>
<td>• Perception on traffic accessibility and service level that should be provided</td>
<td>• Added to the Person Trip Survey</td>
</tr>
<tr>
<td>15. Mobility of Traffic-vulnerable People</td>
<td>• Traffic needs and constraints of traffic-vulnerable people</td>
<td>• Focus group discussion</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Interview survey</td>
</tr>
<tr>
<td>16. Case Study on Resettlement Project</td>
<td>• Post evaluation of resettlement projects</td>
<td>• Interview with executing agency and affected people</td>
</tr>
<tr>
<td>17. Case Study on Social Impact of Transport Project</td>
<td>• Social impact on communities along a transport project</td>
<td>• Field survey</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Interview survey</td>
</tr>
</tbody>
</table>

Source: ADB Project Team

(5) Step 3: Situation Analysis

On the basis of data and information collected, the current situation should be analyzed systematically and objectively. Besides to share understanding on the existing situation among stakeholders, it is also important to specifically identify the nature and causes of the problems. Key aspects that must be considered include:

(i) Mobility: Whether or not people own transportation means or are provided with access to public transportation.
(ii) Accessibility: Whether or not people can access to destinations with acceptable travel time and cost.
(iii) Safety and Amenity: Whether or not people can travel safely in adequate environmental conditions.
(iv) Equity: Whether or not mobility, accessibility and, safety are ensured for all, including low income group and disabled.
(v) Management Capacity: Whether or not transportation organizations (public and private) are capable of managing the services.

The initial assessment on the current situation must be further translated into selected objective and subjective indicators that should be commonly applied to subsequent planning steps. The approach is shown in Table 5.2.3.

(6) Step 4: Issues Identification

On the basis of the situation analysis undertaken in Step 3, the current situation must comprehensively discuss where the gaps between demand and supply exist, what opportunities and constraints to narrow or fill the gaps, and how to identify the issues that must be prioritized. For example, traffic congestions are always pointed out as one of the most serious problem in the city, but it is not properly examined with specific indicators in terms of type of road users, area/corridor, purpose of travel, income class of the people, and gender. Capacities of roads against demand, traffic management capacity, attitude of road users, etc. should also be clarified. Otherwise, it is difficult to share understanding on traffic congestions among stakeholders and design proper measures and actions. In addition, reduction of traffic congestions is considered
short-term policy attention, but actually requires continuous efforts over long-term intervention. Issues must be identified with regard to expected function of urban transportation such as mobility, accessibility, safety/amenity, equity, and management capacity. Conducting SWOT analysis is also useful to consolidate the issue.

Table 5.2.3 Approach to Situation Analysis and General Transport/Traffic Performance Indicators (Example)

<table>
<thead>
<tr>
<th>Scope</th>
<th>Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Function</td>
<td></td>
</tr>
<tr>
<td>Mobility</td>
<td>• No. of vehicles owned /household or person</td>
</tr>
<tr>
<td></td>
<td>• Availability of public transport services within walking distance</td>
</tr>
<tr>
<td></td>
<td>• Walking environment</td>
</tr>
<tr>
<td>Accessibility</td>
<td>• Travel time to office/school</td>
</tr>
<tr>
<td></td>
<td>• Availability of public services within acceptable walking distances</td>
</tr>
<tr>
<td>Safety/Amenity</td>
<td>• No. and type of accidents</td>
</tr>
<tr>
<td></td>
<td>• Assessment of users on public transport services</td>
</tr>
<tr>
<td></td>
<td>• Emissions, impact on air quality</td>
</tr>
<tr>
<td>Equity</td>
<td>• Expenditure of household for transport services by income group</td>
</tr>
<tr>
<td>Management Capability</td>
<td>• Availability of city budget for transport sector</td>
</tr>
<tr>
<td></td>
<td>• No. of traffic enforcers</td>
</tr>
<tr>
<td></td>
<td>• Availability of rules/regulation</td>
</tr>
<tr>
<td>Theme</td>
<td></td>
</tr>
<tr>
<td>Road Network</td>
<td>• Road coverage (% of road space in urban area, length of roads/person and vehicle)</td>
</tr>
<tr>
<td></td>
<td>• Road conditions (% of paved)</td>
</tr>
<tr>
<td></td>
<td>• Locations of congested sections, bottlenecks (v/c ratio, average travel speed)</td>
</tr>
<tr>
<td>Sidewalk/Walkability</td>
<td>• Coverage of sidewalk</td>
</tr>
<tr>
<td></td>
<td>• Assessment of users on walking conditions (pavement, street lights, street trees etc.)</td>
</tr>
<tr>
<td>Public Transport</td>
<td>• Time for access and waiting</td>
</tr>
<tr>
<td></td>
<td>• On-board conditions (comfort, safety)</td>
</tr>
<tr>
<td></td>
<td>• Affordability (fare)</td>
</tr>
</tbody>
</table>

Source: ADB Project Team

(7) Step 5: Setting Transport Goals

In compliance with the overall city vision, transport sector goals and objectives must be worked out. They must be defined in hierarchy whereby vision, goals, and objectives are closely connected. Transport sector goals must focus on mobility, accessibility, safety, and amenity as well as equity and affordability. Goals must also be elaborated with regard to operation and management of transport supply and demand. They will provide visible targets or directions city stakeholders will aim for.

(8) Step 6: Elaborating Objective-Strategies

Goals set must be farther translated into more concrete objectives and strategies that interact each other. Strategies must be clear and serve as a platform in designing sub-sector planning and/or projects/actions. Unless basic strategies to achieve the set goals are consulted among stakeholders, alternatives and options in formulating specific plans may diffuse.
### Table 5.2.4 Basic Strategies-Objectives in Urban Transport

<table>
<thead>
<tr>
<th>Goals</th>
<th>Objectives</th>
<th>Strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensuring:</td>
<td>To strengthen inter-modal connectivity</td>
<td>To coordinate with Central Government and related provinces to strengthen inter-city connectivity</td>
</tr>
<tr>
<td>Mobility</td>
<td>To provide a competitive and adequate access</td>
<td>To develop competitive logistic centers to facilitate distribution of goods at regional level</td>
</tr>
<tr>
<td>Accessibility</td>
<td>To develop adequate transport infrastructure</td>
<td>To develop bypass to segregate through-traffic from urban traffic</td>
</tr>
<tr>
<td>Safety and amenity</td>
<td>To provide attractive and environment-friendly public transportation</td>
<td>To develop urban road network in functional hierarchy (primary, secondary, tertiary)</td>
</tr>
<tr>
<td>Equity</td>
<td>To design transportation facilities in harmony with envisioned land use</td>
<td>To develop public transport corridors as backbone of urban transport and feeder services</td>
</tr>
<tr>
<td>Good management</td>
<td>To establish competent management capacity</td>
<td>To introduce TOD and urban design guideline for urban development along transport corridors</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To introduce low emission vehicles (car, bus, M/C, bicycles, etc.)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To establish proper user charge system</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To strengthen traffic management capacity and enhance awareness of the people</td>
</tr>
</tbody>
</table>

Source: ADB Project Team

### (8) Step 7: Transport Plans

Plans are prepared to elaborate strategies. Broad categories for plan formulation include following:

(a) Transport infrastructure and facilities: They include, among others, roads, rails, terminals, parking, pedestrian and safety facilities.

(b) Transport services: Transport infrastructure and facilities provide foundation for provision of needed services especially for public transport including access transport.

(c) Management: This is to maximize the use of available transport infrastructure and capacity of services to satisfy the demand in the most efficient and effective manner, including wide planning scope such as maintenance of infrastructure/facilities, traffic management.

### (9) Step 8: Identification of Prioritized Projects and Actions

Projects and actions are to fill the gap between the current situation and future goal. They are concrete tools to promote and realize the plan. Projects and actions must be identified and designed in compliance to the defined strategies-objectives as shown in Figure 5.2.3. It is important that short-term projects should not be with short life but should lead to contribute to long-term solutions.

For each identified project and action, project profile in adequate form must be prepared, including, among others, following data:

(i) Name, location

(ii) Description: outline and rationale

(iii) Costs/Inputs: financial, technological, etc

Source: ADB Project Team

### Figure 5.2.3 Identification of Projects

- City Vision
- Transport Development Strategies
- Transport Sector Goals
- Long-term Solutions
- Short-term Projects/Actions

Source: ADB Project Team
Identified projects and actions are rapidly evaluated to assess their preliminary feasibility and priorities. They must be evaluated from the viewpoints of economic, social, environmental and management sustainability. Compliance to higher level policy must also considered as shown in Table 5.2.5.

### Table 5.2.5 Rapid Evaluation of Projects

<table>
<thead>
<tr>
<th>Scope</th>
<th>Main Criteria</th>
<th>Scoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Overall Policy</td>
<td>• Compliance to overall city development policy</td>
<td>Affirmative impact</td>
</tr>
<tr>
<td></td>
<td>• Enhancement of city image and identity</td>
<td>Neutral</td>
</tr>
<tr>
<td></td>
<td>• Contribution to climate change</td>
<td>Negative impact</td>
</tr>
<tr>
<td>B. Economic Aspect</td>
<td>• Contribution to city’s economic growth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Cost-effectiveness</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Increase in employment opportunities</td>
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</tr>
<tr>
<td>C. Social Impact</td>
<td>• Reduction in poverty</td>
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</tr>
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<td></td>
<td>• Impact on resettlement</td>
<td></td>
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<tr>
<td></td>
<td>• Improvement of living environment</td>
<td></td>
</tr>
<tr>
<td>D. Environmental Aspect</td>
<td>• Removal/ reduction in pollutions</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Preservation of natural environment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Prevention of natural disasters</td>
<td></td>
</tr>
<tr>
<td>E. Implementation and Management</td>
<td>• Maturity of projects including funding</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Availability of implementing mechanism</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Urgency of projects/actions</td>
<td></td>
</tr>
</tbody>
</table>

Source: ADB Project Team

**(10) Step 9: Implementation Plan**

Any plan is intended for implementation. Implementation plan includes a package of projects and actions that promote realization of the projects/actions in compliance with transport sector objectives and strategies. In the preparation of an implementation plan, a number of factors must be duly considered, especially funding and capacity to implement the projects in time. Many cities in the region struggle with these two issues very critical issues. At least good planning can help make better use of limited fund. Projects must be listed and ranked according to the priority as shown in Figure 5.2.4. Projects are selected within the estimated available budget envelop.

The priority projects included in the implementation plan shall be elaborated in the time table as shown in Table 5.2.5. This will provide a basis to mobilize the amount and time of funding as well as monitor the progress of the projects.

Source: ADB Project Team

### Figure 5.2.4 Selection of Projects for Implementation

### Table 5.2.5 Project Implementation Plan

<table>
<thead>
<tr>
<th>Selected Projects</th>
<th>Year 2016-2020</th>
<th>Year 2021-2025</th>
<th>Year 2026-2030</th>
<th>Project Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>2.</td>
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<td></td>
</tr>
<tr>
<td>3.</td>
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</table>

Source: ADB Project Team
(11) **Step 10: Plan Monitoring**

Monitoring provides a systematic feedback mechanism during plan implementation through programs and projects. The output of this step is to develop a system for management and monitoring for plan implementation. Main activities include: (i) Identify a system of political management documents such as laws and decrees on planning and construction investment to abide by during the management and monitoring of transportation investment and construction as planned; (ii) Develop data for plans, programs, and project standards, (iii) Identify criteria for input, output information, and proposed plan results, and (iv) Identify project implementation time frame on the bases of transportation plan maps using GIS.
5.3 Transport Network Planning

1) General
This step is a main component of any urban transportation study. Provision of transport infrastructure such as roads, rails, and inter-model facilities requires a large amount of public funding and time for implementation. Main transport network determines the form of urban space and affect land use patterns and locations of socio-economic activities which will farther bring about impacts on environment. In cities with growing population, the way to develop main transport network in integration with land use an urban development is the most critical planning issue to promote sustainable growth and maximize the use of limited public fund. In addition to the medium to long-term network development, network planning is helpful to identify bottlenecks in existing network and formulate cost-effective short-term projects and actions. Discussions and analysis of options and alternatives in the process of network planning can also facilitate the analysis of cross-sector issues such as traffic management, pricing, private car restraint etc.

Source: ADB Project Team

Figure 5.3.1 Conceptual Framework on Transport Network Planning
2) **Overall Transport Network Planning Process**

Propose of network planning is to compare capacities of transport network against transport demand, then to evaluate the two in the most cost effective, socially acceptable, financially viable and environmentally sustainable manner over the period of time as conceptually shown in Figure 5.3.1. Main points to note are as follows:

(a) **Overall urban and regional development plan:** This provides a basis for estimating future demand and related transport sub-sector plans and projects, though the results of transport network plan provide feedback to urban plan for improved integration of landuse and transport.

(b) **Planning at Different Spatial Level:** Transport network planning can be conducted at different spatial levels, ranging from city-region, city, corridor, CBD, specific areas, and sites. Though needed data inputs and analytical techniques vary, there are sufficient number of cases and experiences conducted in many cities across the region. Various types of tested software and models are also available.

(c) **Planning Horizon:** Overall transport network plan, being an integral component of urban master plan, provides guidance for transport network development over short to medium term, as well as a basis to formulate projects and assess their priorities. In this process, bottlenecks and weakness of existing network are specifically identified.

(d) **Preparation of Alternative Plans:** It is important to prepare alternatives and options in network planning because it is difficult to predict transport land use interactions under a situation of weak capacity to control urban development. Future land use plan, even though officially approved, should not be treated as a given condition. It is practical to start with the following scenarios:

(i) **Baseline (Do Nothing) Scenario:** This assumes what would be the situation if nothing is done in the future or until what level the demand-supply gap would widen. The results of the baseline analysis provide the locations of bottlenecks.

(ii) **Committed Network Scenario:** This is to assess demand-supply gap of the network including committed projects against future demand; planners can find out where bottlenecks will appear farther.

(iii) **Planned Network Scenario:** This assumes that all planned projects identified in the official plans will be in place in the target year. The demand-supply gap of the network would be assessed and provide a basis for farther development. In this process, it is important to formulate a number of sub-scenarios in reflection of transport policies. They include:

- **Choice of optimal transport modes** among urban expressway (toll road), urban roads, urban rail (MRT, LRT, AGT, etc), BRT and bus: This must seek for the most adequate combination of modes.

- **Priority on on-infra measures:** When the focus is more on improvement of non-infra component, measures to expand capacities of traffic management and bus services are planned and assessed followed by low cost infrastructure development. This approach is appropriate for short to medium-term network planning.

(e) **Proposed Network Scenario:** On the basis of the analysis of the aforementioned scenarios, a number of scenarios shall be formulated to finally select the most sustainable network. This means that the proposed network is economically feasible, financially acceptable, socially equitable, and environmentally sustainable. Although the proposed transport network alone could not achieve overall sustainable urban development goal, it must be noted that its development can facilitate and function as a key driver for sustainable urban development.
Assessment of the scenarios is an important element in network planning. The assessment should be undertaken at different levels—both quantitatively and qualitatively. The analysis using transport network model can provide a series of useful indicators based on which the expected level of network performance can be measured as shown in Table 5.3.1.
### Table 5.3.1 Specific Transport/Traffic Performance Indicators by Classified Area (Example)

<table>
<thead>
<tr>
<th>Indicator</th>
<th>City Centre</th>
<th>Corridor</th>
<th>Other Areas</th>
<th>Study Area Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Travel Demand</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Person</td>
<td>Person kms</td>
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<tr>
<td>Person hours</td>
<td></td>
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<tr>
<td>Vehicle</td>
<td>PCU(^1) kms</td>
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<tr>
<td>PCU hours</td>
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<tr>
<td><strong>Network Performance</strong></td>
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<tr>
<td>V/C (Volume Capacity) Ratio</td>
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<tr>
<td>Average Travel Speed (km/h)</td>
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<tr>
<td><strong>Urban Rail</strong></td>
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<tr>
<td>Profile</td>
<td>Total Route Length (km)</td>
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<td></td>
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<tr>
<td>No of Boarding/day</td>
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<tr>
<td>Passenger kms</td>
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<tr>
<td>Average Trip Length (km)</td>
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<tr>
<td>Passenger Hours</td>
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<tr>
<td><strong>Network Performance</strong></td>
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<tr>
<td>PPHPD(^2)</td>
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<tr>
<td>Traffic Density</td>
<td>No of Pax /Route km</td>
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<tr>
<td>Pax km /Route km</td>
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<tr>
<td><strong>Economic</strong></td>
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<tr>
<td>Transport Cost</td>
<td>Total Generalized cost</td>
<td>VOC(^3)</td>
<td>TTC(^4)</td>
<td>EIRR(^5)</td>
</tr>
<tr>
<td><strong>Financial</strong></td>
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<tr>
<td>Transport Revenue</td>
<td>Road</td>
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<tr>
<td>Parking fee</td>
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<tr>
<td>Transport Taxes</td>
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<tr>
<td>Public Transport Fare</td>
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<td>Total Transport revenue</td>
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<tr>
<td><strong>Social</strong></td>
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<tr>
<td>Coverage of public transport</td>
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<tr>
<td>% of public transport demand</td>
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<tr>
<td>Average travel time of public transport users</td>
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<tr>
<td>Average transport expenditure</td>
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<tr>
<td><strong>Environment</strong></td>
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<td>Emission</td>
<td>NOx</td>
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<tr>
<td>CO(_2)</td>
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<tr>
<td>Magnitude of affected households</td>
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<td>Impact on hazard risks</td>
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</table>

Source: ADB Project Team

1) PCU: Passenger Car Unit
2) PPHPD: Passengers per hour per direction
3) VOC: Vehicle Operating Cost
4) TTC: Travel Time Cost
5) EIRR: Economic Internal Rate of Return
Box 5.3.1 Results of Transport Network Performance Analysts

The results of transport network performance are shown in Table 5.3.1 including a set of indicators that can be derived from the transport models, they can also be translated in visual forms which facilitate understanding among the experts as well as stakeholders. The Figure A shows the level of congestions (volume capacity ratio) on road sections under different scenarios, while Figure B shows the extent of the area people can reach within 30 minutes and one hour from the city centre. The exercise was conducted for Ho Chi Minh City in Vietnam.

Figure A
Volume Capacity Ratio of Traffic Assignment

- 1.0
- 1.0-1.5
- 1.5-2.0
- >2.0

Figure B
Area Coverage by Travel Time to/from City Centre

Source: Results of the simulation conducted in Hochiminh city Vietnam

3) Use of Software: While workable software for the demand analysis and network assessment exists, knowing its usage is important. The software outputs the results automatically as long as compatible data are inputted. Behavior of models must be fully understood to interpret the results properly. Accuracy of input data and adequacy of assumptions is important. It is useful and advisable that the model is calibrated as to the current situation, meaning, up to what extent the model can explain the current situation. With this, users can become familiar the software and feel more confident in subsequent analysis during the planning stage.

4) Micro Simulation for Network Analysis: Network planning at district level or specified area level can be conducted using various software available in market.
5.4 Transport Modelling for Demand Forecast

1) Outline of Transport Modelling

(a) Structure of Conventional Model

General structure of transport model was developed in 1960s and has remained or less the same although modeling techniques and performance of computer have been significantly improved. The general form of the model is shown in Figure 5.4.1. The approach starts by a zoning and network system and the collection and coding of planning, calibration and validation data. Although the four-stage sequential model comprising sub-models of trip generation, distribution, modal splits and assignment is the most common in transport network planning; there are other approaches such as:

(i) “Modal split” stage is put before “trip distribution” stage,
(ii) “Distribution” and “mode choice” are performed simultaneously. It is also to note that the conventional model makes “trip generation” inelastic, that is, independent level of service provided in the transport system. The interaction between the transport service level and location of population and socio-economic activities must be considered but may not be practical in actual planning work.

(b) Zoning

The method of zoning and the size of the zone depend on the purpose of the survey. There is no general principle or theoretical foundation for zoning. Accordingly, the number of zones has to be determined in the light of purpose of the survey, accuracy requirements, area of zones, costs, man power and time require. In the case of a city with a population of 100,000-600,000, for instance, 80 or 120 zones are said to be necessary. It will be convenient for collecting data if the smallest administrative unit is used for zoning.

(2) Person Trips of Survey

An important input to demand analysis based on modelling is to collect data on travel characteristics of the residents and non-residents who move within and to/from the city as shown in Figure 5.4.2.
and time of departure at origin and that of arrival at destination.

- **Data to be obtained from Household Interview Survey**
  - Personal characteristics: gender, age, occupation, vehicle ownership, etc...
  - OD: Origin and Destination
  - Time: departure time, arrival time.
  - Purpose: to work, to school, business, private, to home.
  - Mode: walk, bicycle, motorcycle, car, taxi, xe om, bus, truck, etc.,
  - Satisfaction.

**Figure 5.4.3 Concept of Trip**

Information on the trips are collected by household interview survey to be conducted for the residents at 2-3% of the sampling rate for a city size of Ulaanbaatar.\(^1\) Depending on how survey form is designed wide range of information and data on socio-economic characteristics and environmental conditions of the people and the area can be obtained and used for the analysis of transport-landuse-environment collectively.\(^2\)

For those who reside outside the survey area (non-residents), interview surveys are conducted at the points of transport network which cross the survey area boundary or called cordon line. Sample vehicles stopped and passengers are interviewed on their trips.

(a) Trip Generation for Entire City (Study Area):

Trip Production

Trip production is defined here as the total number of trips made by those residing within the survey area. Together with those trips made within the area by non-residents, they constitute the total trips in the area. Generally, trip production can be estimated based on per capita or per vehicle trip production rate which is relatively stable. In the case of Japanese cities, per capita trip is stable at around 2.5 trips per day, though it varies according to the person's characteristics regarding age, sex, occupation and car ownership. In future, it is expected to fluctuate because of the possible change in lifestyle due to an increase in free time and the life-oriented concept of value. Further, fluctuations due to the above-mentioned factors are larger with trip production rate classified by trip purpose. Accordingly, for the purpose of forecasting the future trip production forecast is made by the use of trip production rates by population characteristics and by trip purpose or the regression model of the trip production rate by purpose explained by relevant independent factors.

(b) Trip Generation by Zone

---

1. In UBUPS the first HIS was conducted in 2006 to which cover a total of 4,600 households
2. Survey forms include 1) Household information, 2) Current Living Condition of Households, 3) Household member information, 4) Daily Activity Information, and 5) People’s Assessment / Satisfaction on Living Environment.
The normal method of estimating trip generating and attraction (number of trip ends) in each zone is to develop a model based on land use or socio-economic activities as independent variables. There are basically three estimation methods, i.e., the method of using the average trip rate classified by characteristics of the household (multiple cross-classification method or category analysis); the method of using regression model of household level; and the method of using regression model of zone level.

The method of using regression models of zone level has been used widely. Using each zone as an analytical unit, it explains trip generation (or attraction) in each zone by a regression model with the mean income, mean vehicle ownership, number of households, population the number of employees and other factors in each zone as independent variables.

(c) Trip Distribution

This stage concerns the estimation of inter-zonal trips based on the trip generation and attraction of each zone. There are basically two methods of estimation: (i) present pattern method (growth rate method); and (ii) synthesized model method. The present pattern method is based on the assumption that the present pattern of trip flow between zones will remain the same in future. Thus, it is assumed that the volume of interzonal trips in future will increase according to the growth rate of total generation and attraction in each zone. In this case, the simplest form is to apply the growth rate as the mean growth rate of the whole survey area to all the zone pairs (uniform growth rate method). It is also possible to use the mean growth rate of the origin zone and the destination zone (mean growth rate method) or the relative growth rate. In either case it is necessary to repeat adjustment until the summation of interzonal trips by zone converges to the trip generation and attraction by zone which has already been estimated. The most widely used method is called the Frater method.

The present pattern method does not have allowance for changes in interzonal resistance due to improvement of transport system. Further, it cannot express changes in the interzonal flow pattern due to large-scale development. Consequently, it is necessary to make corrections in these cases. (For instance, a similar pattern can be used for the zone where the pattern is expected to change. The model method may also be applied, or a certain distribution pattern may be assumed for those zones with large change.)

These methods such as the Frater method used in the present pattern method can be regarded as a kind of error correction procedures in that the estimated value is corrected so as to converge to the control total (i.e. predicted zonal trip generation and attraction) under the restriction of the same initial pattern.
5. Urban Transportation

Figure 5.4.5 Desire Line

In this step, it is important to calibrate OD movement by comparing broadly assigned traffic volume against actual traffic volume on screen lines. Based on which initially prepared OD table is adjusted

(d) Modal Split

This stage is to find out which mode of transport is used by trips of each zone pair for each purpose. Among the models for estimating modal split, the trip end model is used to estimate trip distribution by transport mode by obtaining the ratio for each mode at the time of estimating trip generation and attraction of each zone. There is also the trip interchange model to estimate the model split after obtaining the trip distribution, which is described below.

The OD table in terms of person trips will also be converted to that of vehicle trips wherein different types of vehicles are consolidated in PCU (passenger car unit) as shown in Figure 5.4.6.

(e) Traffic Assignment

This stage concerns estimation of route selection or choice by interzonal trips for each transport modes. Basically it is to estimate the route, first by obtaining route evaluation values of alternative routes based on service variables such as travel time and costs which are likely to be considered by the user in route selection decision and then by comparing them between alternative routes. With regard to factors for route evaluation, fares, travel time, transfers and congestion level are used for railways, and travel distance, time and fares for road.
5. Urban Transportation

5.5 Public Transport

1) Important Role of Public Transport

Public transport is an integral part of any urban transport system and is widely recognized as a critical means for ensuring not only sustainability of urban transport but also that of the whole urban system. Public transport is space and energy efficient and affordable for the people. However, the share of public transport in many cities is very low, largely due to inadequate and poor quality of public transport system and services. Many cities fail to establish an adequate infrastructure and institution platform to promote sustainable public transport. Growing appetite of car ownership has been significant and becoming a threat to compete in the use of limited road space between private vehicles and road-based public transport modes, especially buses.

A comprehensive “Person Trip Survey” was conducted in 2007 in JICA-assisted UBMPS, public transport modes shared about 43% of the total demand in terms of number of person trips, followed by 31% of walking and 26% of private vehicles. Of the 43% bus including standard bus, minibus and trolley bus shared 33% while taxi shared 10%. When walking is excluded, the shares between private and public modes are 37% and 63%, respectively. Public transport modes played an important role in meeting the demand. However, the increasing ownership of private vehicles has been a constant threat to decrease in the use of public transport modes of which the quality of services was not satisfactory. Supply-demand gap in road space is always tight and the gap has been widening, the shift to private transport aggravate road traffic congestions which then reduce operational efficiency of public transport modes.

At the onset of public transport planning, it is useful to revisit what types of transport modes are obtainable for a city as shown in Figure 5.5.1. They are all technically and commercially available and in operation in many cities in the world as shown in Figure 5.5.2.

**Figure 5.5.1 Spectrum of Obtainable Urban Transport Modes**

At the onset of public transport planning, it is useful to revisit what types of transport modes are obtainable for a city as shown in Figure 5.5.1. They are all technically and commercially available and in operation in many cities in the world as shown in Figure 5.5.2.

![MRT (Tokyo, Japan)](image1)
![LRT (Bangkok, Thailand)](image2)
![Monorail (Tokyo, Japan)](image3)
![Guide Way Bus (Nagoya, Japan)](image4)
![Bus Priority (Critiba, Brazil)](image5)
![BRT (Changzhou, China)](image6)

Source: Various Sources

**Figure 5.5.2 Wide Spectrum of Urban Public Transport Modes**
2) Approach

Under the situation where road space is limited for vehicles, a policy decision on how best the space should be shared among different modes, especially between private cars and public transport modes. Without this politically difficult decision, it is difficult to provide adequate public transport services in heavily trafficked urban corridors. In order to ensure sustainable of public transport, main points of considerations are as follows:

(a) Demand and needs: Analysis on characteristics of public transport demand and needs can provide useful input and base for planning. The information can be the best obtained from the aforementioned “person trip survey” and supplementary survey on the assessment and opinions of sample households. For example, the survey conducted in UBMPS provides following:

(i) The reasons for choosing buses vary. In general, people do not have any other choice but to use public transportation (42%), followed by cost (20%) and convenience (19%). In addition, trolley buses and minibuses are chosen due to the low fares and faster travel time, respectively;

(ii) In general, people are relatively satisfied with the route network, operating hours, frequency, bus speed, accessibility to bus stops. On the other hand, although they are dissatisfied with driver/conductor behavior, on-board security and comfort, as well as with the waiting and transfer conditions; and

(iii) The number one cause of dissatisfaction among customer of large buses and minibuses is “driver/conductor attitude” and that of trolley bus is “bus speed”. On the other hand, the number one cause of satisfaction is “bus fare”, “frequency”, and “bus speed”, respectively.

Although the situation has been changing due to various factors including replacement of old buses, increasing traffic congestions; it is important to regularly conduct market survey.

(b) Combination of public transport modes: In many cities where formal bus services are unable to meet the demand, other types of public transport services in paratransit category emerge and play important roles such as minibus in Ulaanbaatar as well as jeepneys, bike taxi, shared taxi, etc in other cities. While the Government often focus on the expansion and improvement of formal bus services, it is also important to consider paratransit modes to supplement and expand the coverage of bus services.

(c) Funding and management capacity: In order to ensure affordability of the people and at the same time provide adequate level of services, how to mobilize funding for infrastructure, facilities, vehicles, operations and maintenance is critical. Initial success for subsidized bus operation may turn to increasing financial burden of the city when demand increase and corresponding supplies expand. Although there are many cases where buses and minibuses are being operated in meeting demand without subsidy, the level of services is not necessarily high and often generate external diseconomy such as air and noise pollution and traffic safety. The service level is not so high to encourage a shift from private transport users. Under the rapid motorization which is associated with income growth, patronage of current public transport will decrease unless the quality of public transport services is much enhanced. As the city grows, introduction of urban rail is becoming policy option in many cities. However, the cost is so high that its introduction requires critical feasibility assessment in comparison with other options such as LRT, BRT, etc. In provision of public transport services, fare setting and regulatory control are also important points. Fare is normally set low to ensure affordability of users, so that operators may not be able to reinvest to increase quality of services. Excessive regulatory control on public transport operators may
5. Urban Transportation
discourage to entry of private sector in the market and fail to meet demand of the people.

3) Development of Overall Public Transport Network

Public transport system must be configured in hierarchy for efficient operation of related public transport modes and better movement of public transport users. Where demand is large, systems with higher capacity must be provided. When the space lacks absolutely in major corridors, the trunk public transport system must be provided with segregated space like BRT or grade separated LRT/MRT. For a large urban area, public transport network must be planned with due consideration of following:

(i) Commitment to development of public transport based compact urban area: This must be ensured in urban master plan as well as urban development control institution, because the integrated development is beneficial both for transport, land use and environment.

(ii) Development of public transport network in hierarchy: Public transport network must be planned in hierarchy considering local conditions. The network will comprise lines which expand the service coverage and strengthen the network and feeder services to farther ensure connectivity of the network and accessibility of users. The backbone systems will include urban rails, and BRT (fully segregated as shown in Figure 5.5.3), the secondary systems include standard bus, and feeder services are provided by other types of public and private transport modes. At this level, walking and access by NMT (non-motorized transport) are also important.

4) Introduction of Urban Rail and BRT

Introduction of urban rail and BRT is becoming a concern of large cities. However, they have not necessarily been smoothly implemented in many cities, urban rail requires a large amount of investment costs which are usually sourced from ODA. In addition to funding, urban rail projects are facing various issues such as resettlement, cost overruns, provision of appropriate intermodal facilities, lack of integrated local urban development and loss in value capture opportunities. With this construction period becomes long and effects of urban rail reduce. BRT is much advantages in terms of investment cost, but also suffer from similar problems. A critical issue is that BRT must be provided with segregated space in congested main roads.

In order to facilitate the development of MRT and BRT complementarily and in synergy with urban development following approach is proposed.

(i) Conduct a comprehensive feasibility study covering the urban railway system, integrated land use/urban development opportunities and impact on sustainable urban development

(ii) Define the ROW for the railway and TOD (intermodal facilities)

(iii) Designate the ROW in the legal urban plan or equivalent document with legal binding

(iv) Introduce high quality bus services along the new urban rail route

(v) Promote urban development at and around the stations and in the station catchment area

(vi) In parallel to the above, acquire the lands through various schemes such as land readjustment, contribution from developers, etc.

(vii) Conduct the detailed design when the land for construction becomes more or less available

(viii) Construction of the project.

Source: ADB Project Team

Figure 5.5.3 Mass Transit Modes by Capacity
5.6 Approach to Transit Oriented Development (TOD)

1) What is TOD?

TOD is the consolidated and sustainable development approach aiming for the promotion of public transportation with the multiplier effects through the integration of transport development with mixed use development such as residential, commercial and office development. Such integration enables to foster smart growth of the entire city including the sound socio-economic development in the influence areas of Urban Mass Rapid Transit (UMRT) such as UB Metro currently under planning.

![Figure 5.6.1 Conceptual Approach of TOD](source)

Consequently, the agglomeration of residences, businesses, schools etc. in the transit corridor promotes ridership and supports sustainable operation of the transit. In other words, when TOD is adequately planned and implemented, it has significant potential to provide positive impacts not only on traffic, but also land use and environment for the sustainable urban development.

2) Roles of TOD in Various Scale

Roles of TOD varies according to the influence areas in different scale by transit development as shown in Figure 5.6.2.

![Figure 5.6.2 Spatial Structure of TOD](source)

(1) City-scale

In City-scale, major role of TOD is to provide convenient and comfort access between the city center and sub centers (district and neighborhood center). Supplemental transport system such as feeder bus service should be introduced to enhance the link to the stations. Necessary road improvements to mitigate traffic congestion also have to be implemented in accordance with the establishment of the public transport system. Potential for integrated large-scale residential and mixed use development should be explored to maximize the potential of public transport development. Such comprehensive development approach promotes smart growth of urban area.

(2) District – Neighborhood Scale

In District to Neighborhood-scale, main focus of TOD is the pedestrians and provision of convenient and safe access for them. Accessibility and mobility should be closely analyzed to expand the walkable area to the feasible extent and necessary improvements on traffic need to be implemented. Through the analysis, potential for the mixed use development should also be explored to create the vibrant, attractive urban environment.

(3) Site Scale (Station Area)

In Site-scale at the station area, 1. Accessibility to the station, 2. Transfer to the feeder transport system, and 3. Integrated mixed use development, are supposed to be highlighted. In terms of the accessibility, universal design should be adopted for the internal and external access from/to the station as well as relevant station facilities (station plaza, parking etc.) designed to provide necessary transfer, comfort rest and vibrant interaction.

(4) Good Practice of TOD in Various Scale

City – Regional Scale

Denen-Toshi (Garden City) Development, Japan

Tokyu Cooperation is a major private railway company operating 8 lines in the Tokyo Metropolitan Area. Key success factor of Tokyu is its diversity in business. As Figure 5.6.3 indicates, revenue from the railway business is less than 20% of total revenue and majority of the revenue has been generated from the integrated development. In particular, new town development (approximately 5,000ha) along Denen Toshi Line is a well-known good practice to attract 600,000
residents (as of 2011) along the entire railway corridor that generate sufficient ridership to sustain the sound operation of the railway. Convenient feeder transport system shown in Figure 5.6.3 also supports the accumulation of population along the railway corridor.

**District – Neighborhood Scale**

**Freiburg, Germany**

Freiburg has both Light rail (Tramway) and Heavy rail with comprehensive feeder transport service as shown in Figure 5.6.4.

City of Freiburg regulates the entry of the private vehicle within the designated private vehicular free zone in the Central Business District (CBD) to secure pedestrian safety and convenient access to the stations as shown in Figure 5.6.4. Parking in the city center is not allowed except for the residents in the area. 18 Park and ride facilities are located periphery of the city with convenient access to the bus or tramway stations. Since the City adopted a single, common fare system for all kinds of public transportation by zones according to the distance from CBD. This convenient system also supports to promote public transportation.

**Site Scale (Station Area)**

**Shinjuku Station, Tokyo, Japan**

Shinjuku Station has the largest number of passengers (3.35 million/day, 2013) in the world through 5 private and public railway lines. Since

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![Figure 5.6.3 Denen Toshi Line and Business of Tokyu Corporation](source)

![Figure 5.6.4 Public Transportation of Freiburg (left) and CBD in Freiburg (right)](source)
many express bus terminals use to be scattered in Shinjuku area, they were consolidated and integrated as a 4-story intermodal facility to improve accessibility as shown in Figure 5.6.5. Due to this facility, transfer time was shortened from 14 minutes maximum to 1 minute. Other relevant station facilities such as station plaza are also included in the intermodal facility. Taxi bay, which was used to be located along Route 20 becoming a source of traffic congestion by occupying an entire single lane in front of the station, was also relocated to the intermodal facility and this relocation has significantly reduced the traffic congestion in the station area. The intermodal facility is combined with the mixed use building that enhances the connectivity with the adjacent commercial and office buildings to create multiplier effects by the integrated development.

Other access improvements projects such as construction of pedestrian deck have been implemented at Shinjuku station area. Widening of pedestrian road as shown in Figure 5.6.6 is one of the basic approach to provide safe and comfort access in an effective manner.

3) Intermodal Facility

Intermodal Facility is a key facility in station area that ensures passenger’s safe, convenient and comfort access from/to a station as shown in Figure 5.6.7. Necessary transfer facilities such as bus/taxi bay and private vehicular drop-off/pick-up can be integrated with station plaza where sufficient space is available. For the station area with difficulty for land acquisition (e.g. the area in CBD), multi-story intermodal facility such as the case study previously introduced at Shinjuku station would be an option. As currently BRT project is under implementation by ADB, transfer between UB Metro and BRT should be considered in addition to the transfer to the exiting public transport.
Since car parking usually takes a large area, multi-story parking facility should be considered especially for the station areas in CBD where land availability is limited. Unused urban areas such as the space under the viaduct and flyover/overpass can be utilized for bicycle parking as shown in Figure 5.6.8. In order to maximize the benefits by the UB Metro Development, various technique should be adopted to develop necessary intermodal facilities in the station area.

### 4) Main Components of TOD

As previously described, TOD has various roles and components in different scales. TOD includes traffic management, access road improvement, and integrated urban development in addition to intermodal facility as summarized in Figure 5.6.9. Since every component requires appropriate operation and management (O&M), institutional arrangements and establishment of TOD O&M system for each component is essential for the successful TOD. As O&M system affects the design of each component, analysis for O&M system should be integrated with the design of UB Metro from the early planning stage in order to ensure the sustainable O&M of UB Metro. In order to ensure financial sustainability, active coordination with private entity such as Public-Private Partnership (PPP) and Private Finance Initiative (PFI) should be explored.
5) Benefits of TOD

Since TOD provides a significant opportunity to increase the land value through integrated development and improvements on access etc., strategic value capture by the initiative of governmental entities and transit agency is essential to distribute the benefits of TOD for sustainable urban development, operation and management including sound transit investment. While land value capture scheme requires considerable understanding and coordination among central and local government, transit agencies, private developers and investors, land owners, local residents etc., it can maximize the premium once it is well adapted to local context based on the strong collaboration between government entities and transit agency. As shown in Figure 5.6.11, strategic land acquisition based on the TOD plan prior to the construction of the transit is necessary to establish the source of the value capture. New town areas developed along Denen-toshi line previously introduced were also

land, legal framework needs to be amended especially for zoning code to intensify the land use as shown in Figure 5.6.12. Such incentive scheme invites a developer to invest for the integrated development. In order to secure the benefits of TOD in terms of social and environmental aspects, government entities should include the development of public facilities and open/green spaces as the requirement for the involvement of the integrated development. Since private developers tend to ignore the social and environmental aspects such as universal design and energy efficiency, government entities need to prepare a design guideline to control the quality of the integrated development. Such continuous and holistic monitoring for the entire planning and implementation stages by the government entities maximize the benefits of the integrated development not only for the major stakeholders listed in Figure 5.6.12, but also for all users including passengers of the transit.

Figure 5.6.11 Roadmap for Development-based Value Capture Implementation
5. Urban Transportation

Figure 5.6.12 Value Capture Scheme of Integrated Development, Stakeholder Contributions and Benefits (according to Urban Redevelopment Law in Japan)

<table>
<thead>
<tr>
<th>Stakeholders</th>
<th>Contribution</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landholders (A, B, C, D, E, F, &amp; G)</td>
<td>Land parcel for the new building</td>
<td>Joint ownership of land for the new building (sections A, B, C, D, E, F, &amp; G) with higher access and better local infrastructure and service provision</td>
</tr>
<tr>
<td>Building owners (a, b, c, d, &amp; f)</td>
<td>Old buildings and housing units</td>
<td>Ownership of the new building (sections a, b, c, d, &amp; f) with higher access and better local infrastructure and service provision</td>
</tr>
<tr>
<td>Developer</td>
<td>Capital and property development expertise</td>
<td>Profit from section X &amp; from surplus FAR</td>
</tr>
<tr>
<td>Transit agency</td>
<td>Construction of transit station</td>
<td>Transit-supportive environment/increased ridership</td>
</tr>
<tr>
<td>National government</td>
<td>Subsidies for land assemblage and road construction</td>
<td>Save road and other public infrastructure construction costs</td>
</tr>
<tr>
<td>Local government</td>
<td>Change in zoning codes (from single use to mixed use with higher FAR)</td>
<td>Yields higher property tax revenue; promotes local economic development; builds townships resilient to natural disasters</td>
</tr>
</tbody>
</table>

Note: FAR = floor area ratio.

Source: World Bank, Financing Transit-Oriented Development with Land Values, MILT, Japan
5.7  Approach to Strategic Transport-Landuse-Environmental Planning

1)  Context

This part is prepared on the basis of presentation and discussion held in the "Workshop on Strategic Urban Planning and Development" on 6th November 2015 in Ulaanbaatar. The main theme of the paper is whether or not the city can embrace a dream plan which enable to solve transport, landuse and environment problems, at the same time, in integrated manner. Main points of discussion taken up at the first onset are:

(i) What are the main problems facing Ulaanbaatar City?
(ii) What sort of interventions must be made to put the growth of Ulaanbaatar city is sustainable path?

Can transport take a lead of sustainable growth of Ulaanbaatar city? If yes, what are the strategies that can be justified in the light of sustainability?

2)  Core Urban Problems

According to the questionnaire survey conducted in the project for counterpart officials, main urban problems facing the city were summarized into the following five areas: (i) environmental degradation related to pollution of air, water, soil, solid waste as well as decrease in green area, (ii) worsening traffic situation for both vehicles and pedestrian due to traffic congestions, lack of parking areas, and poor traffic management, (iii) expansion of Ger areas, (iv) lack of affordable housing and (v) degrading amenity and landscape. They are all considered serious and Vice Mayor of the city pointed out three core urban problems including lack of access to urban infrastructure, affordable housing and air pollution. Demand for transport network and utilities has been exceeding available engineering capacities. Increasing migrants and citizens are unable to get affordable housing. Increase in coal consumption aggravates air pollution. These urban problems are not only closely interrelated each other but also with other factors, and lead to the damage of image and sustainability of the city as shown in Figure 5.7.1. The negative chain aggravates the situation.

![Vicious Cycle of Interactive Urban Problems](source: ADB Project Team)
While urban situation has been aggravated, real threats yet to arise. There are three main external factors which will affect sustainable growth of the city negatively.

(i) Population increase: It is estimated that the population of Ulaanbaatar city will increase from 1.3 million to 1.8 – 2.0 million by 2030 due to partly natural growth and more significantly immigration.

(ii) Economic growth: It is expected that economy will grow and per capita GDP will increase by 3.5 times by 2030.

(iii) Motorization: Appetite to own private cars will grow as household income increases.

Combined impacts will bring about enormous pressure on future sustainable development of the city as briefly explained as follows:

(i) Worsening traffic situation; Traffic congestions worsen and road traffic safety and walkability decrease. The situation will be aggravated much faster than people expect. Traffic demand will increase not only due to population growth. As people become more affluent, average no of trips/person/day will increase. As urban area expands, average trip length will become longer. As income grows, there will be a modal shift such as from walking to vehicles, and from public transport to private vehicles. When these factors are compounded, the impact on road traffic will be enormous. It is for sure that provision of road space to accommodate future road traffic demand is hardly possible. Under the situation expansion of bus system will be constrained as long as bus shares the same limited road space with other vehicles.

(ii) Impact on land use: Urban area has been expanding in sprawling manner and encroaching to eco sensitive areas as well as hazard risk areas. Particularly expansion of areas spoils efficient use of urban lands, makes provision of necessary infrastructure very much costly and affects environment negatively. The outcome of this type of urban growth ends at poor living conditions for the people, high public expenditure for infrastructure provision and high cost to environment. Piecemeal improvement of Ger area will not be a solution to promote rational landuse.

(iii) Environment impact: Accelerating motorization and expansion of Ger area will farther aggravate environment in many ways: air, water and soil pollution will increase, eco systems are eroded, natural hazard risks increase, landscape degrades, and climate change issues are poorly responded.

As they are closely interrelated, there is a need to solve the three issues at the same time.

3) Proposed Approach to Sustainable Growth of the City

Ulaanbaatar city started in 2030 Master Plan six priority agenda for future development as shown in Table 5.7.1. They cover environment, living conditions, management, spatial structure, tourism as economic growth engine and global city. To meet the priority agenda, they are translated to three strategic initiatives as briefly follows:

(i) Development of compact and energy efficient green urban area: Ger housing from environmentally sensitive and high hazard risk areas must be resettled in adequate living quarters provided with infrastructure and affordable housing. Possibility of planned new town integrated with high quality mass transit to accommodate them must be formed. At the same time, the households residing in the remaining Ger areas must also be encouraged to move to the planned new towns. Farther sprawl of urban areas must also be controlled both by regulatory enforcement and incentives to located in planned urban areas.

(ii) Promotion of globally competitive tourism: Ulaanbaatar city is the gateway to world class tourism destinations spread in the country. The city itself also embraces rich tourism attractions. However, current urban situation involving air pollution and degrading urban landscape affect negatively international inbound tourism. Large potential of tourism is largely dependent on urban development of Ulaanbaatar city. Impact of tourism on economic growth is also significant in Mongolia. In 2015, for example, tourism receipt from 393,000 international tourists, shares about 4% of GDP. Assuming that contribution of tourism sector to GDP will reach as high as 20%. Considering new international airport, growing worldwide tourism market and strategic location of Mongolia, the target is not unrealistic if matching marketing strategies and urban
environment of Ulaanbaatar city as the gateway and destination are in place.

(iii) Promotion of management capacity: Promoting sustainable urban development requires abilities to manage urban sector as a whole and subsector. Provision of infrastructure and establishment of regulations and institutions, availability of lands for green filed planned development, and opportunity to redevelop industrial zone for higher value urban development need to be sorted out.

Table 5.7.1 Development priorities of UB city stated in 2030 Master Plan

- **Priority 1**: Safe, healthy and green city with capacity to overcome and adapt to climate change and potential future disasters (*Environment*)
- **Priority 2**: City with proper land arrangement, infrastructure, and apartment provision that provides convenient and well living conditions (*Livability*)
- **Priority 3**: City with good governance and improved legal environment that involve citizens, public and private organizations in state service (*Management*)
- **Priority 4**: City based on proper structure of population settlement with intensively developing satellite cities and settlements (*Spatial structure*)
- **Priority 5**: City, one of the Asian tourism city centres that attracts national and international tourists (*Tourism as economic growth engine*)
- **Priority 6**: City, an international business centre with competitive advantages, satisfies standard of developed countries capital cities (*Global city*)

Source: ADB Project Team

The concept is shown in Figure 5.7.2 and explained as follows:

(i) High quality and high capacity public transport lines (MRT, LRT, BRT) will from east-west and north-south transit backbone. The backbone transit must be as much as grade separated from the existing roads to increase overall transport capacities of the corridors because future demand is high.

(ii) Large-scale new towns with mixed use including affordable resettlement housing from Ger areas will be developed in outer areas where lands are available and environmental conditions are better. Redevelopment of industrial areas for high value urban mixed use development has an opportunity to develop new internationally competitive urban district. Key for success is these new large-scale (300-500 ha) new developments must be integrated firmly with the aforementioned mass transit lines, though innovative TOD at all special levels.

(iii) Once these backbone infrastructure and new towns are in place, the citizens who suffer from poor living conditions not only Ger area but also in existing urban areas as well as migrants can find affordable housing provided with improved living environment, public services, and good accessibility to employment, school, and other services. Urban redevelopment opportunities at and around the transit stations become also high and promising wherein private sector can be participated in synergy with development framework to be set by the Government.

![Figure 5.7.2 Concept of Transit based “Compact City”](image-url)
4) Impact of the Proposed Concept

When the propose concept is realized the impacts on future urban growth and development are so significant as briefly explained as follows:

(i) Impact on Transport: Proposed east-west and north-south mass transit can divert massive public transport users from road to transit. Together with other road network plan3), the road traffic situation in 2030 with and without two transit lines are so different as shown in Figure 5.7.4. With transit lines, there will be no serious traffic congestion on the roads. Estimated saving in VOC (Vehicle operating cost) will reach US$ 7 million in 2030 alone, indicating high economic return is ensured.

- VOC (Vehicle Operating Cost):
  - Do nothing: USD 26.5 min
  - With Metro: USD 24.5 min
  - With Metro + Expressway: USD 21.0 min

- Saving in VOC in 2030
  - With Metro (2 lines): USD 700 million/year

Impact on Ger Area: It is assumed that of the total number of 780,000 people living in Ger area (16,400 ha), about a half of them (392,000 people or 110,000 households) will be resettled in proposed new towns which will be newly developed in possibly four locations; two at both ends of east-west line, southern end of north-south line and current to be redeveloped industrial zone. In addition to these, there are more possible locations across the city for wider choice of resettlement households. A preliminary analysis was made to compare the following two situations:

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3) Additional roads include secondary roads and elevated east-west urban expressway on the roads along Mongolian Railway.
5. Urban Transportation

Assumption:
- Of the total number of 780,000 people (2013) living in ger area (16,400 ha) 952,000 people (110,000 households) will be resettled in new towns.

Possible Location of New Town/SETtlement Areas

Source: ADB Project Team

Figure 5.7.5 New Town Resettlement Concept Program

(ii) Economic cost without resettlement: This assumes that existing Ger areas remain in the future. Economic cost of the situation refers to additional infrastructures/utilities such as road, water, drainage, power, solid waste etc, will be provided by the government to improve living environment, health damage, soil contamination, poor access to urban services and other inconveniences. It is roughly estimated that a total of US$ 8-9 billion is required for infrastructure provision, and additional economic and environmental US$ 4-5 billion may accrue due to social and environmental loss for coming 20 years. Farther expansion of Ger area towards outer and environmentally sensitive areas will increase these costs farther. On the other hand, development of planned new towns to accommodate 110,000 households require roughly US$ 8-9 billion for infrastructure and US$ 4.3 billion for housing\(^3\), or a total of 12-13 billion. Land costs are excluded in both cases. As the housing costs can be entirely or partly shouldered by resettlement households by selling their properties owned in Ger area, advantage of planned new towns is significant. Moreover, when the Ger area spread in undesirable, landuse area is removed, green areas can be recovered, air pollution, water and soil contamination be reduced, urban landscape be enhanced, as summarized in Table 5.7.2.

<table>
<thead>
<tr>
<th>Costs</th>
<th>Ger Area Improvement</th>
<th>New Town</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing</td>
<td>Lower</td>
<td>Higher</td>
</tr>
<tr>
<td>Infrastructure service</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>Environment</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>Living environment</td>
<td>Higher</td>
<td>Lower</td>
</tr>
<tr>
<td>Land scape</td>
<td>Higher</td>
<td>Lower</td>
</tr>
</tbody>
</table>

Source: ADB Project Team

Table 5.7.2 Relative Comparison of Costs Between Ger Area Improvement and New Town Development

5) Way forward

It is preliminary conducted that the proposed integrated development is likely economically, socially, financially and environmentally feasible. There are also ample opportunities for private sector participation on different forms of PPP as well as to exercise value capture to cross subsidy Metro system.

\(^3\) Housing cost is assumed as follows: 110,000 units*60m\(^2\)/unit*US$650/m\(^2\) (1.3 million tugriks) = US$ 4.3 billion (8,580 billion tugriks)
6. Urban Design

6.1 Rationale

Urban Design (UD) is a tool to transform policy and planning into physical form. Therefore, UD should indicate a concrete approach to implement the contents of policy and planning. While quite often urban design tends to be highlighted only aesthetic aspects, it includes fundamental social components such as Health, Safety and Welfare (HSW) as shown in Figure 6.1.1. Protection of HWS is clearly defined as the major obligation of the professions relevant to UD such as Architects and Landscape Architects in many countries.

Preservation of natural and cultural/historic resources is also significant role of UD. Since such precious resources tend to be neglected and demolished due to the rapid urbanization, close coordination and collaboration among relevant stakeholders in both private and public sector are necessary.

Some of the elements of the city serve multiple roles including these fundamental aspects. For example, parks promote healthy urban life and enhance the green network to preserve natural resources. In addition, they provide amenity as well as evacuation space in case of disaster. While such versatile urban elements should be highly considered as the primary UD elements, other elements also should be designed to play multiple roles to maximize the benefits of the development.

Once the planning is materialized by UD, it needs to be properly managed to maintain in a sustainable manner. Therefore, UD should be integrated with the Urban Management System. Significant roles of the Urban Management System indicate the importance of the consideration for the maintenance issues in UD process.
6. Urban Design

6.2 Key Topics

1) Elements and Process of Urban Design
UD is supposed to be analyzed at least in two different scales; site scale and city scale and both scale have different elements and design processes. City scale analysis is supposed to clarify the fundamental urban spatial characteristics through the identification of major axes and cores in terms of socio-economic, historic/cultural, and environmental aspects. Urban spatial characteristics will be elaborated into spatial structure. Analysis on the landscape importance for structures, trees, public facilities etc. and zones to be preserved will identify the UD elements in city scale such as landscape district and green network including parks and open spaces.

In site scale analysis, urban transect should be clarified in accordance with the intensity of urban development in order to determine appropriate design guideline and zoning code. Major elements of UD in site scale (street, building façade, station plaza etc.) also should be identified for the formulation of design guideline and zoning code.

2) Health, Safety and Welfare in Urban Design
As previously described, health, safety and welfare (HSW) is the prioritized aspects requiring various consideration through UD. In addition to the application of Universal Design, consideration for crime prevention, disaster relief and prevention needs to be integrated into UD to secure HSW.

3) Natural Resources Preservation
Tuul river is a major UD element that forms an environmental axis in the central area of UB City. Since Tuul river is managed by River Basin Authority (RBA) that consists of representatives of local administration and local authority, specialized inspection authority, citizens of soum, district, water user, scientists, researcher and representative of water professional institution, coordination between RBA and UB City is essential to determine optimal waterfront design. In addition to the institutional arrangements, educational aspects need to be considered to raise awareness for sustainable development. Similar approach should be applied to Bogdkhaan Mountain Special Protected Area (SPA). Since SPA is managed by Ministry of Environment, Green Development and Tourism (MEGDT), close coordination between UB City and MEGDT is required to preserve the area from various illegal developments. In order to raise awareness for environmental preservation, Education for Sustainable Development (ESD) should be integrated into signage design. Since currently all signs along the trail in Bogdkhaan SPA are in Mongolian, at least English translation should be added. Such consideration for Universal Design should be applied for the entire trail.

4) Cultural/Historic Resources Preservation
Although there are many cultural/historic heritages in the central UB area, majority of them are not well preserved and maintained. Since they have significant potential to attract a number of visitors, improvements on access and signage as well as integrated development of small-scale retails (survivor shops, cafes, etc.) should be considered. As preservation of cultural/historic resources always faces financial difficulty, sustainable financial scheme based on the integration with tourism needs to be established.

5) Urban Design Towards Sustainable Eco City
UD is a powerful tool to promote sustainable eco city through the integration with major development projects such as transport and tourism development as well as Ger Area redevelopment. Since these developments include various stakeholders in central government (e.g. Ministry of Road and Transport, MEGDT, Ministry of Construction and Urban Development etc.), active coordination with these ministries by UB City is desirable.

Active participation of UB City is also expected for international initiatives to promote sustainable eco city to share knowledge and experience with other cities. Adoption of assessment programs/index for environmental performance consistent with national policy is also effective to promote sustainable eco city. In addition to these initiatives by the government entities, operation and management system by the local land and business owners such as Business Improvement District also should be considered to ensure sustainable eco city development.
6.3 Elements and Process of Urban Design

Elements of Urban Design in City-Scale

While UD tends to be focused on the site-scale design, it should be considered in the city-scale first to clarify the characteristics of the city and enhance the vision of the city. Since the development vision has clearly stated in the Ulaanbaatar Master Plan, key phrases such as “Nomadic Heritage”, “Environmentally Friendly”, and “Smart City” need to be integrated in UD to materialize the development vision and establish the attractive, consistent and legible urban image.

In order to visualize the image of the city, the significant areas for UD with specific characters as well as iconic buildings, structures, trees etc. need to be identified. Figure 6.3.1 illustrates the major elements of UD in city-scale controlled by the relevant laws and regulations in Japan. In Japan, Landscape Law has been enforced since 2004. Prior to the enforcement of the law, UD was generally controlled by city ordinance. However, city ordinance is not able to impose strictly penalty without laws in conformity to. Therefore, conformity with relevant laws such as Urban Planning Law also needed to be considered. In response to these necessities to control UD in an efficient and effective manner, Landscape Law was formulated. Since relatively strict control can be enforced within the Urban Planning Area due to the validity of Urban Planning Law, “Landscape District” can be designated in the Urban Planning Area for the area needs strict control under both Urban Planning Law and Landscape Law. Landscape Planning Area encompasses all major UD elements in city-scale as shown in Figure 6.3.1.

Through the identification of elements of UD in city-scale, appropriate level of control needs to be considered as well as the implementation system since the strict control of UD requires significant commitment by the local stakeholders.

Source: Ministry of Land, Infrastructure, Transport and Tourism (MLIT), Japan

Figure 6.3.1 Elements of Urban Design in City Scale
Process of Urban Design in City-Scale

As previously mentioned, holistic vision of urban development needs to be clarified through the review of relevant policy and planning as the first step for UD. Based on the review and site reconnaissance, overall physical structure of the city can be revealed through the essential characters in terms of socioeconomic, environmental, and historic/cultural aspects. For example, Central Area of UB consists of the following 3 major axes shown in Figure 6.3.2.

1. Urban Axis
   North-South and East-West direction with Urban Core (Sukhbaatar Square) as a node.

2. Historic/Cultural Axis
   North-South direction with Gandant Monastery area (including Gandan Temple) as a focal point.

3. Environmental Buffer/Axis
   North of Bogdhaan Mountain along Tuul River.

The preliminary analysis can be elaborated through the identification of sub-urban and commercial centers etc. as shown in Figure 6.3.3. Once the analysis becomes deep enough to identify the major elements of UD in city-scale (the areas and structures/buildings need to be controlled and/or preserved; see Figure 6.3.1), the areas should be delineated and structures/buildings should be designated as shown in Figure 6.3.4.

Once the areas and structures/buildings are identified, the approaches to control them need to be analyzed. As previously mentioned, level of control can be varied according to the relevant laws and regulations and that affects the necessary documents and institutional arrangements need to be prepared. Therefore, the stakeholders to be involved in implementation as well as management of UD should be identified at this stage since they are closely related to the feasibility of UD. In other words, analysis on implementation system at early stage is the key for the successful implementation of appropriate UD.

Source: M.A.D. Investment Solutions (photo left), Project Team (photo middle and right, diagram)

Figure 6.3.2 Major Axes and Urban, Historic/Cultural Core in UB City
Process of Urban Design in City-Scale

Figure 6.3.3  Future Urban Structure in UB City

Figure 6.3.4  Major City-Scale UD Elements in UB City
Elements of Urban Design in Site-Scale

UD elements in city-scale consists of the site-scale components according to the street patterns, topography etc. Kevin Lynch introduced 5 major elements of the city, 1. Paths, 2. Edges, 3. Districts, 4. Nodes, which shape the fundamental structure of the city.

Therefore, design of these elements according to the development vision is essential to establish the attractive, consistent and legible urban image. UD elements in site-scale are supposed to be designed in accordance with the design principles (overall vision, character to be preserved and/or enhanced, desirable level of control etc.) of the areas they are located as previously described. Degree of urbanization also needs to be considered. For example, river, a major element of the city playing a role as a path and edge, should be designed suitable for the urbanization of the adjacent areas as shown in Figure 6.3.6. Design Guideline is often prepared to share these principles in a concrete manner among stakeholders. In addition, design code is formulated for the areas need relatively strict control.
6. Urban Design

Process of Urban Design in Site-Scale

The areas and structures/buildings identified as the important ones for UD through the analysis in city-scale should be further analyzed in site-scale according to the degree of urbanization as previously described. The analysis designates the certain zonings as shown in Figure 6.3.8 with Design Guideline to control UD. For the zonings need relatively strict control in accordance with relevant laws and regulations, Design Guideline should be prepared as “Zoning Code” similar to the codes formulated for the other designated zonings in urban planning area. In other words, consistency and coordination with the existing relevant laws and regulations should be considered in order to enhance the control of UD.

“Smart Code” is a transect-based planning and zoning approach based on environmental analysis. It aims to minimize the environmental impact and implement sustainable urban development through the promotion of compact, walkable and mixed-use development. The original Smart Code was released by Duany, Plater-Zyberk & Company (DPZ) in 2003 and it has been updated by numerous disciplines as completely open source, free of charge (current version is 9.2 and available from http://transect.org/codes.html). Since Smart Code includes all kinds of aspects and elements of UD in the templates of zoning codes for each zone, it needs to be modified suitable for the existing local conditions and legal framework.

In concurrence with preparation of Design Guideline/Zoning Code, implementation system should be established. Since the major stakeholders are already identified through the analysis in city-scale, specific organization to enhance collaboration among the stakeholders to prepare and implement the Design Guideline and/or Zoning Code should be established. In Japan, Landscape Council can be established by the local administration (Landscape Administrative Organization) and/or manager of a public facility designated as an important UD asset etc. to support the preparation and implementation of the Design Guideline and/or Zoning Code. Landscape Administrative Organization may also designate a cooperation in public interest or NPO as a Landscape Management Organization.

Source: Duany Plater-Zyberk & Company

Figure 6.3.8 Urban Transects
Good Practice of Urban Design

Ise City, Mie Prefecture, Japan

Ise City is famous for the Ise Shrine, one of the most sacred architecture in Japanese Shintoism. While Ise Shrine steadily attracts 6-8 million visitors per year, number of visitors for the adjacent commercial areas was decreasing (around 0.3 million per year in early 90's) due to the motorization and decrease of the visitors walking around the Ise Shrine. In order to revitalize the area, local private company invested 14 billion yen (approximately 130 million USD) to construct the core facilities and improve the existing façades and billboards in 1993. This Renovation included some public projects such as relocation of overhead power lines and became a catalyst for the holistic improvements on UD in the City and succeeded in attracting more than 10 times of visitors as shown in Figure 6.3.9.

Urban Design in City-Scale

In order to disseminate this private-led UD planning and implementation to city-wide, Ise City became a Local Administrative Organization in 2008 and formulated a city landscape plan in 2009. As shown in Figure 6.3.11, the City designated Landscape Districts that consist of Landscape Improvement Areas and Streetscape Improvement Areas including 15m wide strips from Right of Way (ROW).

These areas were designated based on the analysis on UD in city-scale to clarify the major cores and axes forming the City as shown in Figure 6.3.10.

Urban transects was also analyzed to clarify the local environmental, socioeconomic conditions and optimal land use/zoning as shown in Figure 6.3.12. Each zoning has UD principles as a general guidance of UD in site-scale.

No. of Visitors (main approach road to Ise Shrine)

Source: MILT, Japan

Figure 6.3.9 Landscape and Urban Design Improvements along the Approach Road to Ise Shrine, Japan

Figure 6.3.10 Major UD Structure of Ise City

Source: Ise City, Japan
Urban Design in Site-Scale

Based on the analysis and designated areas/zonings, further study was conducted for the preparation of a Design Guideline to control site-scale design. Design Guideline was tailored to control 1. Architectural/Structural Design (incl. billboards and lightings), 2. External Design, 3. Grading, 4. Quarrying and Mining, and 5. Construction Waste Management. In order to implement the sustainable UD, preparation of Design Guideline to manage all aspects of construction process is essential.

Application of the items listed in the Design Guideline varies according to the zonings shown in Figure 6.3.12. For example, regulation for the location of façade applies to all areas except for Environmental Zone while regulations for the design of façade and color apply to all zones (see Figure 6.3.13).

Figure 6.3.11 Landscape Planning Area and Landscape Districts in Ise City

Source: Ise City, Japan

Figure 6.3.12 Land Use/Zoning in Landscape Planning Area

Source: Ise City
6. Urban Design

Figure 6.3.13  Example of Design Guideline for Location of Façade (left) and Design of Façade (right)

Location of façade should be aligned.

Façade should be designed with consideration for introduction of human scale.

Façade should be located with setback to provide space for pedestrians.

Façade design should include consideration for harmony and balance.

Source: Ise City

Figure 6.3.14  Design Guideline for Color Code

Source: Ise City
6.4 Health, Safety, and Welfare (HSW) in Urban Design

Universal Design

Universal Design is a basic approach to secure HSW; fundamental aspects need to be implemented in Urban Design. While Barrier-free Design focuses on mobility/accessibility and mainly targets elderly and disabled people, Universal Design aims for normalization by targeting everyone. 7 principles of Universal Design developed by North Carolina State University summarize the essence of Universal Design as follows;

1. Equitable Use: The design is useful and marketable to people with diverse abilities.

2. Flexibility in Use: The design accommodates a wide range of individual preference and abilities.

3. Simple and Intuitive Use: Use of the design is easy to understand, regardless of the user’s experience, knowledge, language skills, or current concentration level.

4. Tolerance for Error: The design minimizes hazards and the adverse consequences of accidental or unintended actions.

5. Size and Space for Approach and Use: Appropriate size and space are provided for approach, reach, manipulation, and use regardless of user’s body size, posture, or mobility.

6. Perceptible Information: The design communicates necessary information effectively to the user, regardless of ambient conditions or the user’s sensory abilities.

7. Low Physical Effort: The design can be used efficiently and comfortably and with a minimum of fatigue.

In terms of Barrier-free design (normalization in mobility/accessibility) considered as a part of Universal Design, Government of Mongolia formulated the construction codes (Planning and Construction Norms and Regulations of Cities and Towns: CNR30.01.04) in 2004. The codes set maximum
internal and external slope, minimum width of hallway and sidewalk etc., to secure accessibility and mobility within the buildings and sidewalks.

While the codes apply to the individual design elements (slope, sidewalk, parking lot, entrance of the building etc.), they do not secure the accessibility and mobility among the major facilities as shown in Figure 6.4.5. In Japan, “Act on Promotion of Smooth Transportation etc. of Elderly and Disabled Persons etc.” has been enforced since 2006 to fill the gap in accessibility between these major facilities and secure the accessibility and mobility in the entire community.

As shown in Figure 6.4.6, integration with Information Communication Technology (ICT) to improve safety and comfort of access has also been studied and started to be implemented in Japan. Such holistic approach to secure universal access needs to be adopted in Mongolia and necessary legal framework and financial scheme should be established for the implementation.
Ensuring Safety by Urban Design

While level of safety can be significantly improved by the implementation of Universal Design through the prevention of physical injury, other aspects should also be considered to ensure safety by Urban Design (UD).

Crime Prevention

Interior and exterior design significantly influences sense of security. Crime Prevention through Environmental Design (CEPTED) is a common technique to minimize the risk of crime through proper UD. “Natural Severance” is one of the fundamental principles of CEPTED and necessary to be considered in various kinds of UD elements such as planting, fence, and lighting as shown in Figure 6.4.7. For example, continuous, minimum of 5-10 Lux¹ is desirable for the lighting along sidewalk not only for physical accessibility during night but also for crime prevention with psychological comfort.

Disaster Relief and Prevention

Parks play an important role not only for enhancement of ecological system and amenity in the city but also for provision of a space for evacuation and prevention of spreading fire in case of disaster. Therefore, integration of disaster relief function with park is important as shown in Figure 6.4.8.

![Figure 6.4.7 Plans with and without consideration for CEPTED](source: Redland City Council, Australia)

¹ Unit of illuminance and luminous emittance. Equal to one lumen per square meter.

![Figure 6.4.8 Outdoor Furniture with Disaster Relief Functions (Bench with built-in stove and Transformable pergola with tent)](source: Ibaraki City, Japan (left), Showa Industry Co., Ltd. (right))

Low Impact Development (LID) is a strategy to utilize the natural hydrologic patterns such as infiltration into soil to mitigate flooding. Raingarden, storm-water planter/bio-retention with curb-cuts, and permeable/grass pavement etc. are the major LID strategies and should be integrate with UD to minimize the risk of flooding. As Figure 6.4.9 illustrates, LID also contributes to purification of storm-water through its natural filtration system.

![Figure 6.4.9 3D View of Storm-water Planter](source: City of Philadelphia, U.S.A.)
Integration of Health, Safety, and Welfare (HSW) in Urban Design

Urban streets play multiple roles both in terms of transport and environment. Due to its linear, continuous shape, street planting has significant potential to improve urban environment/health and enhance urban ecosystem by removal of air pollutants, linkage of the existing parks, provision of shades for pedestrians etc. It is also able to provide multimodal transport functions by securing sidewalk, bike-lane, and bus-lane etc. In order to maximize its potential and benefits, HSW needs to be further integrated in addition to the consideration for the aspects previously introduced (universal design, crime prevention, disaster relief and prevention). Such integrated, multi-functional streets are called “Complete Streets” and design guidelines have been prepared in many cities all over the world.

Some LID strategies are introduced for successful Complete Street as shown in Figure 6.4.10. In addition to these consideration for flood mitigation, selection of native species is also essential to enhance urban ecosystem and to minimize maintenance. In terms of safety, branches of trees should be trimmed at least 1.5-2.0m height from the ground to secure clear visibility as shown in Figure 6.4.7 as well as to prevent injuries of pedestrians by lower branches. Not only permeability but also appropriate roughness (non-slippery, no-stumbling) should be considered for the selection of pavement materials to secure the safety of pedestrians. For the safety of drivers, street tree planting should be avoided at the corner of intersection to secure driver’s visibility as shown in Figure 6.4.11.

Source: Boston Complete Streets, City of Boston, U.S.A.

Figure 6.4.10  Elements of Complete Streets

Since desirable urban street design varies according to the intensity of urban development, integration with urban transect based planning and zoning previously introduced should be considered for appropriate scale and contents of complete street. For example, streets in Urban Center Zone should have sufficient frontage area in sidewalk such as open cafe to create vibrant interaction with commercial and business activities.
6.5 Preservation of Natural Resources

Riparian corridor along Tuul River forms significant UD element in city-scale as an environmental axis of UB city (see Figure 6.3.2). Majority of water supply in UB city has been taken from the underground flow of Tuul River. Tuul River Basin covers 7 districts of UB city, 37 soums of 5 aimags and occupies a total area of 49,774 km$^2$ as shown in Figure 6.5.1. While the basin area occupies only 3.2% of total national land area, basin population (1.15 million) comprises approximately 40% of total population. Since 4 water sources exist in the vicinity of central area of UB as shown in Figure 6.5.2, sound use of the resource within its carrying capacity is essential considering such significant role as an urban infrastructure blessed by the natural resources. Although Law of Mongolia on Water specify the following zones to regulate construction, cultivation, mineral exploration and exploitation, cutting plants and washing livestock etc., appropriate waterfront design has not been applied to enforce the law.

(1) Special Protected Zone: the area at least 50m from the bank of water storage and at river flood plain
(2) Ordinary Protected Zone: the area at least 200m from the bank of water basin area
(3) Hygiene Zone: the area at least 100m from the water supply source

The Law of Mongolia on Water was amended in 2012 and established River Basin Authority (RBA) to coordinate relevant central and local government as well as civil society (River Basin Council) for the implementation of Integrated Water Resources Management (IWRM). ADB has assisted capacity enhancement on Tuul RBA through the demonstration of rehabilitation of the Tuul River in the Ulaanbaatar area (Tuul River Improvement Project; Jan. 2014-Dec. 2016 (planned)) by Japan Fund for Poverty Reduction. In spite of such international cooperation, coordination for the sustainable water front design along Tuul River among relevant stakeholders is not

Source: Tuul River Basin Integrated Water Management Plan (revision added by Project Team)

Figure 6.5.1  Administrative units and Special Protected Areas in Tuul River Basin
sufficient and further active involvement by UB city is necessary since the design will affect the UB City as well as the entire river basin. In order to maintain the sound balance among the use of water resource for urban amenity, infrastructure and ecosystem, aspects of Education for Sustainable Development (ESD) need to be included to raise awareness for the significant roles of water resources and appropriate use of waterfront area. Therefore, universal information/education boards with devices such as audio guidance and braille should be located at certain intervals along the river. Although proximity to water is desirable, accessible areas should be carefully designed from the viewpoint of safety and protection of water sources as shown in Figure 6.5.3.

Integration with ESD should also be considered for the trail design in Bogdkhaan Mountain SPA. While the SPA has significant potential to be a major retreat for the residents and visitors of UB city due to its proximity, its access should to be carefully designed since it is designated as Strictly Protected Area, which is the most strictly regulated SPA in Mongolia. Furthermore, it is adjacent to Tuul River as shown in Figure 6.5.1. Although several signs are currently locate along the trail, they are described in Mongolian only and further improvement for universal design should be implemented. Since SPAs are managed by Ministry of Environment, Green Development and Tourism (MEGDT), active coordination between MEGDT and UB City is desirable.
6.6 Preservation of Cultural/Historic Resources

In addition to the Gandan Temple, which forms cultural/historic core and axis as shown in Figure 6.3.2, two other national cultural/historic heritages (Genser Monastery and Dambadarjaa Monastery) and 44 city level heritages are located in the vicinity of central UB (see Figure 6.6.1). In spite of these precious cultural/historic resources with high potential to attract number of visitors, they have not been fully utilized and integrated with urban design. For example, although Gandantegchinlen Monastery has a symbolic approach road, specific design is not applied to entertain visitors such as information signage, gallery and shops along the approach road etc. Good practice in Ise as shown in Figure 6.3.9 was also implemented along the approach road to Ise shrine and became a catalyst to attract number of visitors.

Since preservation of cultural and historic resources always faces the financial difficulties, integration with tourism should be considered to establish a sustainable system to secure necessary fund for the preservation from the revenue by the tourists. As national cultural/historic heritages are managed by the central government, active coordination between central government and UB City is desirable to establish the necessary implementation system including the legal framework.
Convenient excursion also should be considered to increase the number of visitors. Kyoto City in Japan posted a map in English on City’s homepage with a link to the detailed information of each shrine and temple including access information by public transportation (see Figure 6.6.2). Since UB City is currently committed to tourism promotion according to its policy planning called “Hospitality UB”, improvements on information dissemination and enhancement of the link among major cultural and historic heritages by public transportation should be implemented.

Except for the cultural/historic heritages that require traditional preservation, other cultural and historic elements need to coexist with modern design and need to be integrated in UD. Therefore, appropriate design guideline should be prepared in accordance with the urban transect and context introduced in 6.3. In Paris, France has many good examples of integration of historic and modern urban elements as shown in Figure 6.4.13. On the contrary, coordination between the historic facades and modern architecture has been often neglected in the central area of UB city.

In order to inherit the historic context and reflect on UD in a consistent manner, master architect/landscape architect/urban designer can be appointed. Nihonbashi district is a historic center of Tokyo, Japan and still has many historic buildings as shown in Figure 6.6.4. For the implementation of the urban redevelopment project in the district, implementation entity (Mitsui Fudosan Co., Ltd.) hired a master architect/design architect. Since the land use was supposed to be intensified through the redevelopment to secure sufficient open spaces, one of the challenge was to harmonize the existing historic buildings and new high-rise buildings. The master architect/design architect formulated a guideline to design the lower portion of the high-rise buildings similar to the historic buildings and connected to the higher portion with certain setback as shown in Figure 6.6.4. This strategy created the visual consistency for the pedestrians and reduced the visual impact of high-rise buildings. Since urban redevelopment projects in Japan need to be reflected on urban planning and approved by the central government, coordination among central and local government as well as private stakeholders is essential to implement consistent UD harmonized with the existing cultural/historic context.
6.7 Urban Design towards Sustainable Eco City

1) Integration with TOD

Public transportation is a fundamental element of UD that forms backbone of the city. As stated in Chapter 5.6, Transit Oriented Development (TOD) has significant potential to maximize the benefits of public transportation developments such as UB Metro through various integrated urban developments. As described in Figure 6.7.1, pedestrian is the primary focus for the access improvements, which is the major component of TOD. Therefore, aspects of Health, Safety and Warfare (HSW) should be ensured through UD for access improvements by TOD.

Pedestrian deck is an effective UD element to secure safe and comfort access by providing vehicular-free pedestrian walkway as shown in Figure 6.7.2. In addition to the stairways and/or escalator, elevator needs to be installed to provide universal access as shown in Figure 6.7.3.

Although elevators have direct call system in case of emergency, consideration for the people with disability in hearing and speaking is limited. Therefore, Yokohama City, Japan established the system connecting to the maintenance center in case of emergency by both phone and e-mail. The note in the elevator introducing the system assures people with disability in hearing and speaking through the instruction to access to the main tenance center by e-mail in case of emergency.

Since accessibility for bicyclists also should be considered as bicycles are the prioritized means of transport for TOD and they promote healthy urban life and reduction of CO2 emissions. Bicycle sharing system started to be successfully introduced in many...
countries as shown in Figure 6.7.4. Therefore, this system can be an option to be integrated with the intermodal facility described in Chapter 5.6.

Smooth transfer between different transport systems should also be implemented by UD with consideration for HSW. Since currently major transport development projects such as UB Metro and BRT are under planning and implementation, holistic approach is desirable to integrate various transport modes for better transfer.

Since UB Metro is planned to have underground stations, accessibility between ground and underground level also needs to be considered. Similar to the pedestrian deck previously introduced, elevators should be installed at certain interval.

Sapporo City is located in Hokkaido, northern island of Japan at similar latitude to UB. Due to its cold climate during winter, Sapporo City developed underground pedestrian walkway not only for transfer between heavy rail and subway (Metro), but also for shopping, event, gallery etc. through the utilization of underground spaces. Approximately 1.5km long, north-south underground pedestrian walkway provides safe, comfort and convenient access all year round by connecting 3 Metro stations and mixed-use developments in the underground spaces as well as in the adjacent buildings. In order to secure safety in such a large underground space, guidelines for evacuation are prepared in addition to the necessary disaster prevention and relief equipment as well as regulations for the construction materials with sufficient incombustibility to be used for the underground space. For better implementation of HSW, environmental aspects are also considered in the underground spaces. As shown in Figure 6.7.6, skylights are installed to enjoy natural sunlight in the underground space and planting is encouraged in feasible void spaces (e.g. dry area).
2) Integration with Tourism

Tourism has significant potential to promote city branding and become a major industry fostering sustainable development. Therefore, tourism promotion to make UB as an Asia’s tourist destination has been listed as one of the prioritized UB development approaches for 2030 in the UB Master Plan. National government also formulated Tourism Development National Program by the initiative of MEGDT that was approved by the parliament in 2015. According to the statistics introduced by MEGDT, expense of tourists for MICE (Meeting, Incentive, Convention/Conference, and Exhibition /Event) is 6 times more than the average expense of the individual leisure tourist. Therefore, promotion of business tourism is essential not only for city branding but also for securing sufficient budget for sustainable management of tourism resources. Establishment of cross-subsidiary system enables to utilize the revenue from business tourism for the preservation of natural and cultural/historic resources. In order to promote business tourism including MICE, increase in attractiveness of UB City is necessary.

UD is a powerful tool to promote city branding and attract visitors once it is appropriately designed based on a consistent theme. Since UB City development vision clearly states the respect for the nomadic heritage and MEDGT also adopts “Nomadic with Nature” as a catchphrase of its tourism promotion, integration with nomadic culture is a key for successful UD. For example, airport design requires both hospitality and sense of culture as it determines the first impression of the county for the visitors.

Street design also includes various opportunities to integrate cultural aspects through pavement, lighting, banner and signage design etc.

Hosting the events with cultural elements such as fashion show and concert of traditional music are also effective for both city branding and increase of city attractiveness. Therefore, it is important to secure versatile public open spaces for various events both on ground and underground level considering seasonality. Such open spaces can be ordinary used for social interaction and for evacuation in case of emergency.

3) Integration with Ger Area Redevelopment

Currently Ger Areas have been expanded on the periphery of the central area of UB City and caused various environmental issues such as air and water
pollution due to the lack of basic infrastructure. While population density of built up area in the central area of UB City (approximately 6,000 hectare) is around 270 per hectare, Ger Area is only around 30 people per hectare although it occupies more than 3 times of the area (approximately 22,000 hectare). Such inefficient land use spur on the environmental degradation and makes more difficult to access basic infrastructure. However, many residents in Ger Area still stick to their single family housing (ger or wooden detached house) in spite of their low quality living environment. Therefore, benefits of multi-family housing should be clearly highlighted by appropriate UD and introduced in a manner easy to understand in order to change the current residents' perception.

Enhancement of land use efficiency through introduction of multi-family housing allows to reduce the footprint of the housing and to secure sufficient open/green space for amenity, ecological integrity, health, and disaster relief. In order to maximize these versatile functions, HSW aspects should be fully considered as previously stated in 6.4. Efficiency of infrastructure such as water, sewer, solid waste collection etc. also improves through the accumulation of housing units. Figure 6.7.11 illustrates the efficiency of heating system by the layout of housing units. Improvements on efficiency of infrastructure not only mitigates air and water pollution but also increases the opportunity to introduce renewable energy such as solar power system.

Setagaya Fukasawa Symbiotic Housing Complex is a good practice of residential redevelopment from single family to multi-family housing through the collaboration between Setagaya City and the residents. 39 old detached houses were redeveloped into five mixed-use multi-family housing accommodating 70 dwelling units with a variety of public facilities such as elderly nursing care center and community center. Since the complex was designed under the consistent theme of “Environmentally Symbiotic Housing”, various strategies to harmonize with nature such as utilization of wind and solar energy were adopted as shown in Figure 6.7.12. The mixed-use multi-family housing buildings and outdoor spaces were certified as CASBEE1 rank A for their performance to mitigate environmental impact including improvements on energy efficiency. The voluntary residents' association has established a forum to discuss and decide all kinds of management issues such as cleaning and gardening rota. Residents have been actively involved since conceptual planning stage of the complex and this participatory planning process has raised the awareness of the residents for the environmental sustainability.

1 Green Building certification program in Japan similar to LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method).
4) System to Promote Sustainable Eco City

Mongolia Sustainable Development Vision 2030 approved by the Parliament of Mongolia in 2016 has ensured the consistent, long-term policies to promote sustainable development beyond the governmental regime. The vision states several implementation goals with quantitative index. For example, Environmental Performance Index (EPI) ranks countries’ performance on high-priority environmental issues in two areas; protection of human health and protection of ecosystem and the government of Mongolia aims to raise the ranking from 111 in 2014 to 90 in 2030. Global Green Economy Index (GGEI) is defined by 32 underlying indicators and datasets, each contained within one of the four main dimensions shown in Figure 6.7.13. Mongolia has started to join the assessment by GGEI since 2014 and although its ranking in 2014 was 60 (lowest) due to the lack of data for the fair assessment, Mongolian government is trying to be ranked in the first 30 countries by 2030. Since consistent evaluation criteria is necessary for the promotion of sustainable UD, adoption of these indices is desirable to achieve these national goal through sustainable development in an efficient and effective manner with the multiplier effects on the national and local governmental policies.

Green Building certification programs such as LEED, BREEAM and CASBEE are also major rating systems to assess environmental performance of the buildings and surrounding outdoor spaces. Recently new approach such as LEED-ND (Neighborhood Development) has been established to assess not only the buildings but also entire community. LEED-ND has various evaluation criteria for UD from neighborhood scale to site scale in terms of economic, social and environmental aspects including universal access, preservation of natural and cultural/historic resources as shown in Figure 6.7.14. Total possible maximum score is 110 (including up to 10 special “innovation” and “regional priority” bonus points) and the project should meet all prerequisites and earn at least 40 points by achieving various credits. Beyond basic certification, projects may achieve Silver (50 points), Gold (60 points), or Platinum (80+ points) certification for increasingly high performance. Since registration process for LEED-ND requires relatively long time and certain cost, it may not be feasible to register all kinds of sustainable eco city projects at the beginning. However, these evaluation criteria of LEED-ND surely can be adopted for the environmental assessment scheme to promote sustainable eco city such as tax incentive.

International sustainable urban planning initiatives are also effective tool to promote sustainable eco city through sharing knowledge and experience with other countries. As introduced in Table 6.7.1, currently various initiatives are underway and international networks have been established to enhance collaboration. Since many of these initiatives are led by a city-level rather than a country level, active participation by UB City is desirable as the leader of promotion of Eco City in Mongolia.

<table>
<thead>
<tr>
<th>Name</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>CITYNET</td>
<td>Established in 1987 aiming for the improvements on urban sustainability focusing on infrastructure development, disaster prevention, MDGs, and climate change. City-level initiative with the members from more than 70 cities in 23 countries, NGOs, private companies etc.</td>
</tr>
<tr>
<td>CAI-Asia</td>
<td>Established in 2001 by ADB, USAID, and WB aiming for the reduction of pollutants and CO2 from transport and energy sector. Consists of 45 cities in 11 countries, 8 individual county network, NGOs, private companies etc.</td>
</tr>
<tr>
<td>Eco2 City</td>
<td>Established in 2009 by WB aiming for expansion of economic opportunities in an inclusive, sustainable, and resource-efficient way, while also protecting and nurturing the local ecology and environment.</td>
</tr>
</tbody>
</table>

Source: IGES White Paper, WB website (http://web.worldbank.org/)

Figure 6.7.13 Performance Index of GGEI

Source: Dual Citizens LLC

Table 6.7.1 Major Initiatives Promoting Sustainable Eco City
In order to ensure sustainability of the city, appropriate operation and management (O&M) is essential. Continuous improvements (known as KAIZEN in Japanese) is necessary on O&M to implement sustainable urban development and PDCA (Plan, Do, Check and Act) Cycle should be adopted with consistent evaluation system.

While quite often such O&M is considered as a role of public entities, there are many O&M system led by the local residents and land owners especially in good practices. Business Improvement District (BID) is one of the major bottom-up O&M systems by land and business owners. Tasks of BID range from regular maintenance such as cleaning and patrolling to strategic marketing for attraction of business, visioning, capital investment, planning and UD etc. as shown in Figure 6.7.15. Since generally land value increases significantly by these holistic efforts, land and business owners are willing pay for the cost of these tasks based on beneficiary pays principle.

Similar major O&M approach in residential area is Homeowner’s Association (HOA). HOAs are established not only for multi-family housing but also single-family housing community such as gated community in the United States. Various maintenance activities are controlled by the detailed guideline and the cost for them are shared by the residents. Design of the house including color and shape is also regulated by the guideline to increase the property value as an entire community.

While ownership of the property itself is relatively new concept for Mongolia, the owners should be aware of the opportunities for their value capture by increasing their property value through appropriate UD and O&M system. Even if the motivation stems from their financial benefits, these active bottom-up approach based on beneficiary pays principle would surely promote community improvements towards sustainable eco city.
7. Environment and Disaster Management

7.1 Rationale

(1) General

The Municipality of Ulaanbaatar (MUB) urbanized rapidly after its shift to market economy, attracting many immigrants. This rapid urbanization has accumulated a large tract of ger area sprawl that has degraded living environment and brought about various urban problems especially on the environment such as air pollution, water pollution, soil contamination, and so on. This also led to critical damage by natural disasters. Figure 7.1.1 summarizes the relationship between urban development and environmental damage.

![Urban Development and Environmental Damage](image)

Figure 7.1.1  Urban Development and Environmental Damage

One of the common key aspects in defining urban development goals directs “environmental sustainability” to establish a pollution-free, disaster-resistant, and environmentally rich urban system. Consideration on environmental protection, that is improvement of environmental policy, plan, and programs, should be urged in urban development process.

(2) Environmental Protection

It is clear that inadequate urban development caused by rapid and uncontrolled migration, not only has impacts on both urban and natural environmental qualities, but also raises social conflicts between those who do and do not benefit from development. An approach to a “wise-use” of environment or balance between urban development and environmental protection is, consequently, very important.

Any development activities have a risk to degrade environmental quality in UB City and generate and/or accumulate other impacts. Therefore, it is essential to incorporate *environmental protection approaches into urban development* to avoid or mitigate any adverse environmental impacts likely to be caused by urban development activities. In addition, environment-friendly developments that encourage wise-use of environmental resources in urban development must be approached. In other words, sustainable urban development activities, which can create an environmentally rich urban system is encouraged.

(3) Disaster management

Natural disaster management could be also an important factor on sustainable urban development. Though natural disasters are difficult to avoid, it could be possible to mitigate the damage.

The approach to disaster management may be: (a) high disaster-resistant design and construction methodologies, (b) land use control in high-risk areas, and (c) disaster prevention activities. Disaster management should be linked with urban development as guide for appropriate designs of both construction of infrastructure and buildings and land use.
7. Environment and Disaster Management

(4) Triangle Approach
Environmental problems in urban areas are complex. In the past, environmental or pollution problems showed a simple aspect that “Polluter = Industry” and “Victim = Citizens”. Nowadays, it is difficult to distinguish between polluter and victim in urban environmental problems like air pollution caused by transportation, waste and sewage from everyday life, etc. Environmental management in the past focused on technologies and process of “how to mitigate impact by pollutions.” However, rapidly increasing population and mass consumption brought about by the change of lifestyle drastically accelerated environmental degradation. Coping with technique and process alone can no longer solve the aggravation of pollution; it is important to introduce adequate measures on “reduction of pollution load from the sources,” “recycle and reuse of resources,” and effective “resource use and preservation.”

Adoption of multiple approaches that involve communities and the private sector is highly suggested. The multiple approaches, or “Triangle Approaches” consist of: 1) Physical/Engineering Approach, 2) Institutional Approach, and 3) Social approach.

(a) Physical / Engineering Approach:
There is no denying that the “hard approach” is the most important action for environment management. As such, it is vital to develop physical infrastructures in order to create a comfortable and safe environment and improve environmental conditions.

(b) Institutional Approach:
A proper and clear legal and institutional system is also very important to balance development and environmental protection. The succeeding concepts were proposed to be introduced in order to enhance efficient exercise of the legal system and incentives for environmental protection.

- Polluter-Pay-Principle
- Strengthen a tax preference system for installing environment-friendly system and penalties for illegal activities

Besides capacity building of the government to be able to plan sustainable development and lead citizens to an environmentally friendly society, it is important to inspect and monitor development activities that cause environmental disruption.

(c) Social Approach:
A top-down approach by the government has limited power to create a truly comfortable and safe environment for citizens, so a plan that involves the public is necessary. The following social approaches must be taken:

- Public involvement at the early stage based on the concept of Strategic Environmental Assessment (SEA)
- Public awareness-raising through public enlightenment and environmental education

A social approach shall be employed, not only by the government and/or developers, but also by citizens and stakeholders. The stakeholders should not be passive to the environmental policy, but active towards development and environmental protection and, more importantly, responsible. To this end, public enlightenment and education are definitely important.

Figure 7.1.2 Concept of Triangle Approaches
7.2 Key Topics

As indicated in the figure below, the results of questionnaire survey conducted in the UBMP Study show that "air pollution" was the top priority. Water pollution (including soil pollution) and lack of green areas were also concerns of UB City citizens.

Moreover, the needs-assessment survey also indicated that government officers engaged in city development give strong attention to those issues. Thus, this chapter will focus mainly on air pollution, water pollution, and greenery.

UB City faces severe degradation of environmental quality due to recent rapid population growth and urbanization that could accelerate damages on living conditions, health problems, and conflicts among citizens. Ger areas, for instance, has been sprawling without sufficient infrastructures.

Needless to say, environmental improvement plans shall be promoted in urban development being that urban development, which aims at economic development, could generate and/or accelerate other environmental risks.

In this chapter, the following are the five key topics:

(1) **Air Quality Control**

Air pollution is one of the worst environmental problems MUB faces that is caused mostly by stove smoke from the ger area during winter and exhausts from the increasing number of vehicles. Air pollution control is an imminent issue most of the citizens want to tackle.

(2) **Water resources and Soil quality control**

Water resource of MUB is limited. The city suffers from short-supply of water for the citizens even though people living in ger area consume less than 10 liters of water per person against 200 liters of water of apartment dwellers. Even worse, quality of underground water is contaminated because of poor sanitation in the ger area. Provision of sufficient and clean water to present and future citizens, water resources management, and soil pollution control are imminent.

(3) **Green and open space**

Green and open space have good effects to urban life. It is one of the important items to be planned. With the urbanization of MUB and expansion of its ger area, the green and open space around the city has been encroached on and degraded. The city fails to meet its target to provide city parks to the citizens. Green and open space should be discussed.

(4) **Risk management and safe guard policy on environmental and social impacts**

A city development master plan may harm its natural environmental quality and social environment if it is made in an improper manner without consideration to the opinions and ideas of stakeholders. A safeguard policy shall be adopted to avoid such a chaotic situation and minimize adverse effects on plan-making, environmental conditions, and social stability and peace.

(5) **Disaster Management**

Disaster management is one of the important aspects of city planning since MUB often suffers from floods. Active seismic faults were also discovered near the apartment area where there are many old buildings and at the ger area with simple houses. These structures are not seismic-resistant enough against a possible earthquake in the city.
7. Environment and Disaster Management

7.3 Air quality control, monitoring and management

Issues and Objectives

As shown in the figure, air pollution is one of the most critical environmental problems in UB City. It was said that air pollution is more crucial in the winter season due to smog generated by heating system as indicated from the questionnaire survey results conducted in the UBMP Project. The manual guides sufficient integration of air pollution abatement with city development.

![Scenery of Ulaanbaatar in winter](image1)

![Scenery of Ulaanbaatar in summer](image2)

Figure 7.3.1  Air Pollution in MUB

Figure 7.3.2  Critical Urban Problems in MUB
Approaches

(1) Current Air Quality Condition

Air pollution is one of the most critical environmental problems, which affects urban development in UB City. The main causes are:

- Emission from combined heat and power plants and heat-only-boilers
- Emission from household stoves and refuse burning
- Vehicle exhaust
- Dust from dry land and waste dumping site
- Forest and/or grass fire

The Air Quality Agency of the Capital City examined that air pollutants from ger stoves and heat-only-boilers (HOB) in the ger areas could be the most serious as shown figure below:

The UBMP, therefore, points out a strategy: “Take urgent countermeasures against air pollution in ger areas” towards an “environment-friendly city.”

Ger area development and improvement shall be prioritized in urban development planning.

(2) Integration of Air Pollution Management with Urban Development

Air pollution management can be defined as:

- It has been acknowledged that more than half of the world’s population live in cities. Cities have many benefits for their populations including jobs, a wide social environment, cultural activities, and so forth. Although, cities have many environmental problems.
- Severe air pollution threatens human health and the gains of economic growth in large cities.
- Therefore, Urban Air Pollution Management shall contribute to various pollution sources, impacts, approaches, etc. in accordance with the feature of cities.

In order to contribute to air pollution management, it is necessary to understand the following characteristics of an urban area:

**Characteristics of Urban Area**

**Rapid Population Growth**
- Accumulated population density
- Diverse lifestyle, income level, and increase of vulnerable people

**Rapid Industrialization**
- Increase in energy and resource consumption
- Increase in traffic volume
- Increase in pollutants

**Artificial Structure**
- Increase in high-rise buildings
- Pavement of surface ground and loss of greenery
- Change in natural feature

An “urban dome” is created by urban activities.

Climate features in urban areas are quite different from those outside the urban area. Buildings and other structures in the urban area could affect wind...
or air condition as well as block wind flow and accumulate air pollution.

\[ \text{Pollution in street canyon} \quad \text{Down wash and down draft} \quad \text{Shut by buildings} \]

Figure 7.3.6 Examples of air stagnation by urban structures

Urban planning, design of structures shall be considered to change of urban climate.

(3) Scheme for Effective implementation of urban Development

For a smooth implementation and/or acceleration of urban development, a Joint Crediting Mechanism (JCM) could be introduced.

JCM scheme contributes to the ultimate objective of the UNFCCC that complements the CDM. It encourages project proponents to facilitate dissemination of leading low carbon technologies, products, etc., as well as implementation of mitigation actions and contribution to sustainable development.

As of 2015, the following types of projects have been studied:

- Wind power generation
- Energy efficient housing complex in ger area
- Transmission/Distribution system improvement
- Upgrading/Installation of centralized control system of HOBs
- Solar power generation
- Improvement of combined heat and power plant by thermal insulation

In addition to properly linking urban planning to air pollution management, the co-benefit approach is also highlighted.

Co-benefit approach means basic concept to tackle multiple purpose solutions and to raise a wide variety of benefits. In environmental management, programs and projects are often interrelated, so they can be multiple-purpose solutions. For instance, the following projects are expected to have multiple benefits aside from air pollution management.

### Table 7.3.1 Multiple-purpose Solutions of Air Pollution Control

<table>
<thead>
<tr>
<th>Type of Project</th>
<th>Expected Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDF Power Generation</td>
<td>Energy improvement, Reduction of solid waste, Reduction of greenhouse gas (GHG)</td>
</tr>
<tr>
<td>Power Generation by Sewage Sludge</td>
<td>Energy improvement, Reduction of sewage sludge, Reduction of GHG</td>
</tr>
<tr>
<td>Mass Transit, Public Transportation</td>
<td>Mitigation of traffic congestion, Mitigation of air pollution, Fuel energy saving</td>
</tr>
<tr>
<td>Improved Stove, Coal Improvement</td>
<td>Reduction of coal use, Reduction of burden on income</td>
</tr>
<tr>
<td>Rehabilitation of HOB</td>
<td>Reduction of coal use, Mitigation of air pollution, Fuel energy saving, Reduction of GHG</td>
</tr>
<tr>
<td>Micro Hydropower Generation</td>
<td>Renewable energy use, Water resource management, Increase of water supply, Disaster prevention</td>
</tr>
<tr>
<td>Solar Power</td>
<td>Renewable energy use, Mitigation of air pollution, Fuel energy saving, Reduction of GHG</td>
</tr>
<tr>
<td>Biomass</td>
<td>Fuel energy saving, Reduction of GHG, Reduction of domestic waste</td>
</tr>
</tbody>
</table>

Figure 7.3.7 Concept of JCM Scheme between Japan

Mongolia is the first country to exchange signatures with the Japan Government for the JCM scheme, which was signed in January 2013.
(4) Expected Measures for Air Pollution Management

As previously explained, triangle approaches must be introduced. The table below indicates possible measurements of each approach depending on pollution sources.

<table>
<thead>
<tr>
<th>Cause</th>
<th>Physical / Engineering Approach</th>
<th>Social Approach</th>
<th>Institutional Approach</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emission from power plants, HOBs, etc.</td>
<td>• Install adequate exhaust gas treatment device                                                   • Public awareness and education                                               • (Re)Develop legal framework</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Rehabilitate aging facilities                                                                  • Promote lower emission boilers for private industry                              • Strengthen inspection / enforcement system</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Install sufficient new facilities                                                               • Raise incentive and consensus on legal compliance                                • To introduce tax exemption, subsidy, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Improve coal quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Introduce renewable energy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emission from household stoves</td>
<td>• Shift heating system from traditional household stove                                          • Public awareness and education                                                  • Control/prohibit aging stove, low-quality coal</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Introduce higher insulation for houses                                                           • Promote lower emission individual heating                                      • Prohibit in-house combustion of waste</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Introduce improved stove                                                                       • Raise incentive and consensus on legal compliance                                • Introduce tax exemption, subsidy, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vehicle exhaust</td>
<td>• Introduce low emission vehicles                                                                • Public awareness and education                                                  • Strengthen emission gas standard, and enforce car inspection</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Strengthen public transportation network                                                        • Promote lower emission vehicles                                                • Prohibit low-quality fuel and/or high-emission vehicles not Applying for regulation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Improve road condition                                                                         • Introduce “eco-driving”                                                          • Enhance public transportation, control use of private vehicle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dust from dry land and waste dumping site</td>
<td>• Plant trees/grasses at bare land                                                              • Public awareness and education                                                  • To introduce tax exemption, subsidy, etc.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Improve waste disposal site                                                                    • Promote greening in private vacant areas                                         •</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Forest and/or grass fire.</td>
<td>• Strengthen fire prevention system                                                               • Public awareness and education                                                  • Guide/Regulate on the control of spread of dust in construction site</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Measures taken in Mongolia

(1) Ger stove improvement and destructive briquette

Ger stove improvement aims for low emission of air pollutant and reduction of coal consumption. The decline in coal consumption is expected to benefit for poverty reduction. For effective installation of improved stoves, the introduction of improved fuel coal destructive briquette is also recommended.

![Figure 7.3.8 Improved Ger Stove](Image)

![Figure 7.3.9 Improved Coal](Image)

UB City in practice and through international assistance (e.g. WB, ADB) has taken actions using those approaches, however, results have been beyond satisfactory. Considered issues are:

- Proper monitoring method of air pollution is necessary to evaluate the stove efficiency.
- Change of community perception, financial assistance, guidelines, etc. are important for effective installation.
• Connection to a heating network or installation of a cluster heating system could be an alternative solution.

(2) Improvement of HOBs by JCM Scheme
High-efficiency latest model boilers were constructed at a school in Bornuur soum using JCM scheme.

International Experiences in Air Pollution Management

(1) Integrated Coal Gasification Combined Cycle (IGCC)
This technology aims for an effective coal usage for thermal power station by attaching a gas-combined cycle system.
Benefits:
• Possible to generate power with less emission of carbon dioxide by 20%
• Low-quality coal can be utilized and reduce fuel cost
• Reduce sulfur contained pollution

(2) Co-Generation System (Combined Heat and Power)
Co-generation system has multiple productions of electricity and heat, both of which are used and could be maximized for its many benefits. This system can be affordable for an individual building, industrial factory, or a town/city served by district heat/cooling.
Benefits:
• Possible energy efficiency
• Possible installation for local network

(3) Local Area Heating Supply Network by Waste Power Generation
This technology integrates two functions: heat supply and solid waste management.
Benefits:
• Develop cluster network in new town, land readjustment
• Waste reduction
• Improve living environment
(4) **Renewable Energy**

This technology is defined as one of the most environment-friendly source of energy that does not generate pollution.

Benefits:

- No air pollution as well as generation of GHG

![Figure 7.3.13 Renewable Energy](image)

(5) **Tax subsidy for installation of low emission vehicles**

This approach is to introduce citizens and private companies to and encourage use of low-emission vehicles such as CNG and hybrid as well as encourage their use.

Benefit:

- Possible low air pollutant and CO\(_2\) emission

![Figure 7.3.14 Low Emission Vehicles](image)

<table>
<thead>
<tr>
<th>Types</th>
<th>Emission Load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NO(_X) (g/yr)</td>
</tr>
<tr>
<td>CNG car</td>
<td>480</td>
</tr>
<tr>
<td>Gasoline car</td>
<td>3,200</td>
</tr>
<tr>
<td>Diesel car</td>
<td>7,300</td>
</tr>
<tr>
<td>Diesel hybrid car</td>
<td>5,900</td>
</tr>
<tr>
<td>Electric car</td>
<td>1,100</td>
</tr>
</tbody>
</table>

**Estimated yearly emission amount**

Case: Truck of 2 tons capacity drives 12,000 km per year including emission by fuel production

(6) **Modal Shift**

This could encourage modal shift to public transportation (metro, LRT, monorail, etc.) from private vehicle use. In order to accelerate modal shift, social and institutional approaches are strictly required.

Benefits:

- Possible energy conservation
- Reduction of air pollution CO\(_2\)
- Road network improvement

![Figure 7.3.15 CO\(_2\) Emission Ratio by Transport Mode](image)

(7) **Park and Ride System (Modal shift)**

This system could be more effective by encouraging modal shift to use public transportation. In addition, public awareness is necessary in order to effectively introduce the system.

Benefits:

- Encourage use of public transportation
- Mitigate traffic congestion
- Control illegal parking
- Mitigate urban air pollution
- Boost businesses/commercial areas

![Figure 7.3.16 Concept of Park and Ride](image)
7.4 Protecting Water Resources

Issues and Objectives

(1) Current Issues of Water resource Condition

Current issues related to water resources management in UB City are summarized below:

(a) Water Supply

- Central water supply network covers only XX% in UB City, while rapidly expanded ger areas are not connected.
- Current capacity of water supply is beyond demand; water pipes / facilities are old and outdated.

(b) Sewage

- Central sewage (CCWWTP) covers central city and apartment area only. Most ger areas have not been connected.
- Most houses in ger areas use improper treatment (open pit latrine, etc.)
- CCWWTP operates over its capacity, so treatment level is low. Also, pipes are already old and outdated.
- Industrial wastewater is not properly treated that leads to serious water and soil pollution.

(c) Water Resources

- Due to insufficient water treatment, Tuul River and its tributaries are already polluted.
- Land encroachment in river basin aggravates water resources.
- Insufficient protection of river and its basin increase the risk of flood disaster.

(2) Objectives

Pollution of water and soil as well as shortage of water resources are significant problems likely due to improper city development design. The cause of water and soil pollution is not only pollutants from industrial sector, but also uncontrolled expansion of ger areas. Water resources protection should also focus on proper land use design besides reduction of water pollutants.

This section specifies integrated water resource management as well as ordinary water treatment technologies.

Approaches

In order to address the aforementioned issues, the following actions are to be taken:

(1) Water Supply

- Develop new water supply sources in Gachuurt and other possible water source including groundwater
- Extend and rehabilitate water supply network
- Develop water reservoirs
- Enhance re-use water system

(2) Sewage

- Raise capacity of CCWWTP, rehabilitate sewage network (pipeline, etc.)
- Construct piped WWTP system in ger areas
- Install wastewater treatment system in the industrious zone
- Introduce advanced purification system

(3) Water Resources

- Control the expansion of the city area to prevent encroachment on water resource area (river basin, etc.)
- Establish buffer zones to protect water resource areas from urban encroachment and pollution.
- Improve structure of integrated river basin management and pollution monitoring
- Develop water reservoirs and water mirrors

(4) Concepts on Water resource management

(a) Water Pollution Control

One typical approach for water resource management is water pollution control. A major engineering approach may be an installation of sewage system (water treatment system).
Types of treatment system depends on the scale of the coverage area (number of population).

<table>
<thead>
<tr>
<th>Big Scale</th>
<th>Small Scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large-scale treatment</td>
<td>Cluster type treatment</td>
</tr>
<tr>
<td>Ex. CWWTP</td>
<td>Ex. Small-scale sewage, underground sewage tank</td>
</tr>
<tr>
<td></td>
<td>Ex. septic tank, shield type pit latrine, Ecosan</td>
</tr>
</tbody>
</table>

Figure 7.4.1  Wastewater Treatment System by Size of Service Area

**Large scale treatment: Sewage network**

Figure 7.4.2  Large Scale Treatment: Sewage Network

**Cluster type treatment system (community plant)**

Location: Malaysia
Source: Kajima.co.jp

Figure 7.4.3  Cluster Type Treatment system

**Individual toilet**

Bio toilet by using sawdust

Figure 7.4.4  Bio toilet

The current urban area shows sprawling population, economic activities even on the outskirts, and uncontrolled expansion of dwellings (ger areas). Existing and planned sewage network cannot sufficiently cover the likely demand. In fact, untreated wastewater from ger area has accelerated groundwater contamination.

A separate network design is suggested, for instance, a cluster type treatment system which covers a certain area. Small scale or individual treatment could function in an existing ger area.

(b) Area Based Management

For water resource management, the point-source pollution such as industrial or domestic wastewater could be managed through a sufficient wastewater treatment system unlike with non-point pollution like rain water or untreated water from ger area. Integration with area-based management would work better.

Integrated approaches of area-based management on the protection of water resources are:

- Zoning, land use management
- Creation of buffer zone to protect water resource
- Better controlled urbanization
- Watershed management
- Integration with riverside greening to set buffer zone
- Creation of natural purification by greening
International Experiences in Water Resource management

(1) Underground treatment tank
This technology features a packaged treatment system, which is installed underground. The scale design depends on the requirements from single households (HH) to more than thousands of HH. The advantages of installing the treatment system underground are to “save installation space,” “maintain a stable temperature to minimize operation costs for warming,” etc.

(2) Water recycling
Recycled water can be for domestic and industry use as well as for plantation and greenery in an urban area.
7.5 Greening Action and value of ecosystem approach

Issues and Objectives

The Master Plan 2030 aims to secure a green area that is 8% of the city planning area, yet the supposed green area of UB City already decreased by approximately 65% from years 2005 to 2013. The decrease was said to be due to uncontrolled city development.

Urban greenery purposes other than recreation / healing for citizens are:

- Conservation of bio-diversity
- Natural resources protection
- Absorption of air water pollutants

This part indicates the methodology on creating appropriate greening area and guides for the “value ecosystem approach,” which encourages sustainable use of ecosystem services / benefits.

Issues of green and open space in the UB City

- Green space per capita drastically decreased from 8 m² in 2005 to 3.3 m² in 2013. Total area also decreased from 595 ha to 387 ha.
- The forest bank in UB city also decreased by 70% from 2000 to 2009.
- Green spaces have been devastated by improper urban development such as utilizing the green area to car parking spaces/buildings, etc.
- The public perception in the lack of green space is one of the most significant issues in living condition.

Based on these issues that need to be addressed, this section provides approaches on greening actions and value of ecosystem.
## Approaches

### (1) General

In order to tackle the abovementioned issues, UBMP discusses greening policies:

- General plan is based on “sustainable and green development that ensure human development”

- Development priority bring “safe, healthy, and green UB city with capacity to overcome and adapt in climate change and potential future disasters”

- Goal until 2020 is $20 \, m^2$ green area per capita, which occupies 8% of urban planning area (approx. 2,300 ha).

### (2) Value of Ecosystem Service

To introduce and encourage an effective greening plan in urban development, the approach on value of eco-system service is suggestible. The basics of eco-system are explained in Figure 7.5.2.

---

**Figure 7.5.1** Green and Park Network toward 2030

**Figure 7.5.2** Concept of Ecosystem Service

The value of eco-system may be introduced by the following assessment process:

I. To justify and decide how to allocate public spending on conservation, preservation, or restoration initiatives.

II. To consider the public’s values and encourage public participation and support for environmental initiatives.

III. To compare the benefits of different projects or programs.

IV. To prioritize conservation or restoration projects.

V. To maximize the environmental benefits per dollar spent.

The value of eco-system service aims to accelerate ecosystem improvement, that is to say greening through effective use of ecosystem benefits; therefore, it is important to find and measure value of ecosystem service / goods.

Three approaches to estimate value of ecosystem services are:
1. Market Prices – Revealed Willingness to Pay
   - The values of some ecosystem goods or services can be measured using market prices.
   - Some ecosystem products are traded in markets. Thus, their value can be estimated as with any other market good.
   - Some ecosystem or environmental services like aesthetic views or many recreational experiences may not be directly bought and sold in markets. However, the prices people are willing to pay in markets for related goods can be used to estimate their values.

2. Circumstantial Evidence – Imputed Willingness to Pay
   - The value of some ecosystem services can be measured by estimating what people are willing to pay or the cost of actions they are willing to take to avoid adverse effects that would occur if these services were lost or to replace the lost services.
   - For example, wetlands often provide protection from floodwaters. The amount that people would pay to avoid flood damage in areas similar to those protected by the wetlands can be used to estimate willingness to pay for the flood protection services of the wetland.

3. Surveys – Expressed Willingness to Pay
   - Many ecosystem services are not traded in markets and closely related to any marketed goods. Thus, people cannot "reveal" their willingness to pay through market purchases or actions.
   - In these cases, surveys can be used to ask people directly what they are willing to pay for based on a hypothetical scenario. Alternatively, people can be asked to make tradeoffs among different alternatives from which their willingness to pay can be estimated.

(3) Multiple Approach (Co-benefit approach)
As explained in “(1) Air quality control, monitoring and management in urban planning,” a co-benefit multiple approach could be useful to effectively implement a green action plan in accordance to urban planning.

![Co-benefit Approach](image)

Figure 7.5.3 Co-benefit Approach

The table below shows examples of greening development ideas.

<table>
<thead>
<tr>
<th>Table 7.5.1 Greening Development</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Greening Development</strong></td>
</tr>
<tr>
<td><strong>Disaster prevention</strong></td>
</tr>
<tr>
<td>• Dyke improvement with green cover</td>
</tr>
<tr>
<td>• Buffer zone with green cover</td>
</tr>
<tr>
<td>• Tree plantation for anti-landslide</td>
</tr>
<tr>
<td>• Underground water reservoir</td>
</tr>
<tr>
<td><strong>Natural conservation</strong></td>
</tr>
<tr>
<td>• Forestation in mountain area, river side</td>
</tr>
<tr>
<td>• Designation of protected area, natural park</td>
</tr>
<tr>
<td><strong>Pollution reduction</strong></td>
</tr>
<tr>
<td>• Water resource management</td>
</tr>
<tr>
<td>• Natural purification on water pollution reduction</td>
</tr>
<tr>
<td>• Absorption of air pollution, heat control</td>
</tr>
<tr>
<td><strong>Amenity, tourism, and recreation</strong></td>
</tr>
<tr>
<td>• Natural park, game reservoir</td>
</tr>
<tr>
<td>• Community park, people’s park</td>
</tr>
</tbody>
</table>
International Experiences in Greening Action and value of ecosystem approach

(1) ADB Green Cities Initiative Implementation

The concept aims formulation of “Green Cities” towards a Sustainable Urban Future.

![Framework of Green Cities Initiative Implementation](image1)

There are five approaches:

**Low level of environmental and CC impact**
- Innovative ways for developing cities:
  - Recycling, waste management, renewable energy use

**Inclusive development and engaged residents**
- City planning that includes:
  - All residents including the poor and disadvantaged and mechanisms for people to affect the decisions

**Resilience to disasters and other shocks**
- City planning and development that:
  - Anticipates impact of natural hazards and helps keep people safe and infrastructure intact

**Cultural and historic preservation**
- City planning that recognizes and incorporates:
  - Value of a city’s cultural heritage and history

**Green space and walkability**
- City planning that creates:
  - Vehicle-free areas instead of developing cities around roads and automobile traffic

(a) Experience in Vietnam

The Vietnam experience:
- Hue – UNESCO Heritage City
- Vinh Yen – Competitive Green City

(b) Experience in Indonesia–Malaysia–Thailand-Growth Triangle (IMT-GT) Region

IMT-GT Region experience:
- Melaka Green City Action Plan
- Meda, Indonesia proposed under TA for Green Cities in Indonesia

![Figure 7.5.5 Greening Actions in Vietnam and IMT-GT Region](image2)

(c) Experience in China

The China experience:
- Nanjing Qinhuai River Environment Improvement Project
- Xinjiang Altay Urban and Environment Improvement Project

![Figure 7.5.6 Greening Action in China](image3)
7. Environment and Disaster Management

(2) Forest management for disaster prevention

![Figure 7.5.7 Erosion control Forest., Japan](image)

(3) Water recycling for greening improvement

![Figure 7.5.8 Prototype of water recycling system](image)

(4) Valuation of retained stormwater runoff due to green space in parks

Objective:
Demonstrate the water retention value of trees, grass, riparian corridors, and plants for a significant reduction of amount and cost of runoff water in the city’s sewerage and surface network.

Methodology:
1) Analysis of aerial photographs to obtain land cover data. Division of the city into park areas and non-park areas
2) Calculation of hourly annual precipitation data to estimate annual runoff based on U.S. weather data.
3) Comparison of the modeled runoff (with parks) and runoff that would occur from a city the same size and level of development (i.e., with streets, rooftops, parking lots, etc., but without any parks).
4) Calculation of the reduction in runoff due to parks.
5) Calculation of the costs to manage each gallon of stormwater using traditional methods (i.e., “hard infrastructure” such as concrete pipes and holding tanks rather than parkland).

=> From this number and the amount of water held back by the park system, assessment of the economic value to the parks’ water pollution reduction.

Box: Calculation for Philadelphia
1) 12% of the city (10,334-acre) = parkland
   => + than 7 acres for every 1,000 residents
2) Philadelphia’s parkland = 81.3% pervious
   Rest of the city = 34.9% pervious
3) Average of 43.29 inches of rain per year
   => Model developed by the Forest Service shows that Philadelphia’s parks reduced runoff in 2007 by 496 million cubic feet compared with a scenario in which the city had no parks.
   => Philadelphia stormwater management cost is 1.2 cents ($0.012) per cubic foot. Thus, the park system provided a stormwater retention value of $5,949,000 in 2007.

(a) Experience of valuation of forest conservation in USA

<table>
<thead>
<tr>
<th>Items</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Target Evaluated</td>
<td>Natural water purification</td>
</tr>
<tr>
<td>Location</td>
<td>New York, USA</td>
</tr>
<tr>
<td>Background</td>
<td>Due to water pollution by agricultural sector from upstream, New York installed a highly technical but costly water treatment system. It was planned to give money to the farmers to raise incentive to treat / reduce pollutants from their farmland.</td>
</tr>
<tr>
<td>Results</td>
<td>Payment to the farmers: 1–1.5bn USD Construction of new treatment system: 6–8bn USD Annual maintenance: 0.3–0.5bn USD Raise of water supply charge in case build new treatment: double in case no build new treatment: 9% increase</td>
</tr>
</tbody>
</table>
7. Environment and Disaster Management

7.6 Safeguard policy on environmental and social impacts

Issues and Objectives

Urban development should be planned in order to aim economic growth, improve living condition, etc., however, improper planning could have risks to degrade environment quality. In addition, owing to the recent increase of public interest in environmental issues, many conflicts have risen against urban developments on the possibility of either damage to environment or escalating negative conflict among citizens. This situation could lead to stagnation and/or interruption of project implementation.

Urban development shall be taken in consideration in avoiding or minimizing any environmental risks. Planners should ascertain that their development plan is designed properly in order to satisfy safeguard requirements.

Generally, an environmental impact assessment (EIA) is used to secure safeguards; Mongol also has this system. Therefore, the methodology of securing safeguard policy that is internationally adapted is introduced in this text.

Approaches

(1) Safeguard policy under international donors

International donors such as WB, ADB, JICA, etc. issued a safeguard policy to assure consideration on environmental and social impacts. Specifics or details on safeguard policy are as follows:

- Environmental and social “safeguard” policies are designed to avoid, mitigate, or minimize adverse environmental and social impacts of projects supported. (WB)
- Safeguard policies are generally understood to be operational policies that seek to avoid, minimize, or mitigate adverse environmental and social impacts, including protecting the rights of those likely to be affected or marginalized by the development process. (ADB)
- Environmental and social “considerations” mean considering environmental impacts on air, water, soil, ecosystem, flora, and fauna as well as social impacts including involuntary resettlement, respect for the human rights of indigenous people, and others. (JICA)

![Figure 7.6.1 Policy objectives and operational principles in Safeguard](image)
Key factors to obtain safeguards are as follows:

1) Consider harmonization of environmental and social safeguard with development

2) Safeguard from planning stage (Strategic Environmental Assessment/SEA)
   Risk avoidance from anticipated environmental and social degradation public complaint

3) Public participation and consultation
   Public hearing and stakeholder meetings
   Appropriate and accessible grievance mechanisms

4) Information disclosure
   Transparency and accountability
   Risk avoidance from public complaint

5) Monitoring and evaluation

(2) Strategic Environmental Assessment (SEA)
   SEA defines which:
   - Facilitates a systematic evaluation of the environmental impacts of a policy, plan, or program and its alternatives
   - May be applied as a best practice approach in the preparation of the environmental assessment.

SEA is introduced as a method and approach for conducting environmental assessment of program loans, sector development program loans, and sector loans. (ADB)

![Time Schedule](image)

The need for early implementation of safeguard policy are explained below:

- Consistency between other and upper level policies / strategies
- Early consensus building between stakeholders
- Overall evaluation for multiple projects
- Assessment on accumulated risk
- Risk management and avoidance
- Feedback to planning process
Four key tools for effective implementation of SEA:

- **SEA Tools** -

1) **Alternative plan:**
   Evaluation on alternative plan should focus on “natural impact/risk,” “social impact/risk,” and “economic improvement/risk.”
   Zero option (without case) shall be evaluated.

2) **Spatial Analysis**
   GIS mapping to identify environmental / social factors, economic / demographic indicator, infrastructure network, natural disaster risks, etc. Useful for site selection.

   ![Land potential map (Indonesia)](image)

3) **Public Consultation**
   Consensus building between stakeholders

4) **Matrix table for impact evaluation**
   - **Compatibility matrix:** Used to compare the way in which different policies inter-react with each other
   - **Compound Matrix:** Used principally to evaluate individual plans/programs/projects against a range of environmental criteria
   - **Scoping matrix:** Helps assess the potential risks and opportunities associated with the certain project in creating the scope of work
7.7 Disaster Management

Issues and Objectives

Disaster management to protect human life and assets of the citizens shall be an important key factor on urban development especially that earthquake and flooding are major concerns of UB city. Formulating disaster-resistant designs is ideal, however, it is also important to select a suitable location or low-risk disaster area to build structures. Furthermore, those residing in disaster-prone areas should be relocated before any disaster occurs. This section will describe disaster management approaches.

Approaches

(1) Hazard Mapping (Spatial Analysis)

In this sub-sector, methodology on spatial analysis and hazard mapping to identify high- or low-risk disaster areas are primarily introduced.

![Figure 7.7.1 Flood Prone Area in MUB](image)

(2) Necessary actions for seismic disaster prevention

1) Disaster reduction related to laws, system, and organizations
   - Involve mass media, Red Cross, academics, economics in the Disaster Prevention Standing Committee or sub-committee
   - Establish sub-committees for advice on policy-making under the committee
   - Member of council or sub-committees of not only seismologists, but also experts from geology, civil engineering, architecture, sociology, economics, etc.

2) Proposal for earthquake disaster management plan
   - Indicate target of damage reduction
   - Urge role-sharing on disaster reduction among public and private sectors and citizens and involve them as members
   - Make the plan available to public for their understanding and possible inputs
   - Setup checking procedures for monitoring progress of the plan

3) Financial actions, enactment of disaster-related laws and regulations for implementation of the plan
   - Allocate budget based on project prioritization
   - Enact disaster related laws, regulations, and standards
   - Publish the plan to citizens

4) Establish communication and reporting system during disasters
   - External evaluation on quake resistance
   - Develop educational materials such as brochures and videos about early warning systems
   - System construction proposal to install early warning system in local cities

5) Establishment of seismograph network system
   - Install devices for quick estimation of seismic scale

6) Emergency Response System
   - Promote and strengthen earthquake resistance of important facilities and bridges across main roads
   - Setup seismic storage tank for fire protection
   - Develop operating rules and specifications of important roads
   - Establish expert network
   - Develop emergency safety check system for affected buildings
   - Develop network on lifeline construction officials for emergency recovery
• Develop a disaster response manual, educate school students, etc.

7) Control of land use and development
• Promote new town development, rebuilding of aging buildings, ger area development, land readjustment, etc., and integrate to “city planning”
• Formulate disaster urban planning from viewpoint of enhancement disaster prevention in urban, and to be consistent with city master plan

8) Disaster Management City Plan
• Disaster management shall focus on mitigation and preparedness in an urban planning.

![Disaster Management Cycle](Image)

City Master Plan, Local Disaster Management Plan, and Disaster Prevention Master Plan are formulated in Japan as shown in the table below:

| Table 7.7.1 Disaster management Plan and City Master Plan in Japan |
|---|---|---|
| Local Disaster Countermeasures for disaster management to protect life of citizens, assets, etc. and emergency response. | City Planning Law, Long-term vision of city) | To envision future of a city with land use plan, public facilities, urban projects |
| Disaster Prevention Plan Administrative instruction by Director of Urban Bureau, MLIT. | | To address basic policy and concrete actions to create a disaster preventive city with urban spatial structure including fire-proof urban structure, evacuation routes and places, and improvement of congested urbanized area to enable evacuation and emergency activities in the event of disasters. |

8) Disaster Reduction Measures and Citizen’s Participation
Community-preparedness is one of the important factors in disaster management being that communities’ cooperative rescue activities have helped a lot of people in events of earthquakes and other disasters. Enhancement of community preparedness against natural disasters is, therefore, crucial.

**Box: Kobe Earthquake on Rescue Activities**
- 35,000 People rescued: 27,000 (80%) Rescued by families and neighbors, while 8,000 (20%) by the public sector—Self-defense force, police, and fire-fighters. (Survey by Ministry of Internal Affairs and Communications.)
- Another survey: 35% Self-rescued, 32% by family, 28% by friends and neighbors, and only 2% by rescue teams. (Survey by Japan Association for Fire Science and Engineering.)

A lesson from recent seismic disasters is the importance of sharing responsibilities among the public, individual, and community in disaster management activities. In disaster management, as shown in Figure 7.7.4, efforts of self-help, mutual-help, and public-help are combined to form a comprehensive disaster management capacity. As such, citizen’s participation in planning process of Disaster Prevention Plan at city level is preferable.
Community-level disaster management is important to include in urban planning such as:

- Development of public facilities based on Neighborhood Area Development Concept
- Awareness-raising of citizens about “self-help, community help, public help” city planning and disaster management

9) Infrastructure as Urban Spine for Disaster Prevention

- Roads, parks and open space are used as evacuation routes and places
- Fire-spreading prevention measures are promoted by construction of fire-proof buildings

10) Area Improvement

- Trunk road for emergency and evacuation routes
- Dike roads for ger area

11) Infrastructure Network development against disaster (approach to the UB City)

- Green network (green space and parks) as buffer zone and evacuation routes and areas
Section 7. Environment and Disaster Management

International Experiences in Disaster Management

(1) Disaster Prevention City Plan (Tokyo)

Figure 7.7.7 Disaster Management Plan, Tokyo

(2) Community Participation

Community mutual assistance

Community canal cleaning

Figure 7.7.8 Community Activities for Disaster Management

(3) Public Information, Japan

Figure 7.7.9 Hazard map in portal WEB site of MOE, Japan