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Integrated Cities and Urban Development Project (ICUD)

Comprehensive Public Transportation Master Plan for the Urban Center of Ramallah and Al-Bireh

Executive Summary

ICUD is jointly implemented by the **Ministry of Local Government (MoLG** and the **Municipal Development and Lending Fund (MDLF)**

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smart moving cities

Comprehensive Public Transportation Master Plan for the Urban Area of Ramallah and Al-Bireh

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1. Introduction

The Comprehensive Public Transportation Master Plan for the Urban Area of Ramallah-AlBireh has been produced according to the Terms of Reference for this assignment. The assignment aims to prepare a Public Transport Master Plan, formulated based on a detailed assessment of existing national and regional transport network and the results of a comprehensive analysis of existing gaps. This report represents a summary of the final 'Comprehensive Public Transportation Master Plan for the Urban Area of Ramallah-AlBireh', which covers Ramallah, AlBireh, Beitunia, and Surda Abu-Qush.

2. Current situation

The public transport service in Ramallah-AlBireh urban area is composed of buses, shared-taxis (service), and private taxis. All public transport services and vehicles are owned and operated by the private sector. The internal roads in Ramallah-AlBireh urban area are generally narrow and congested especially in the CBD area and the vicinity, with weak parking control in most streets.

Buses, carrying between 20 and 50 passengers, currently play a relatively minor role in the provision of public transport within the Ramallah-AlBireh urban area and for long distance travel. Shared-taxis are the predominant form of public transport on most routes. Local buses do not operate to schedule. In general, the drivers decide when to leave the terminal, based on their experience of demand. The frequency varies during the day, and passengers have no means of knowing when to expect a bus to arrive. Fare collection systems are basic, with a flat fare charged regardless of journey length.

Shared-taxis normally operate non-stop on a somewhat fixed route between the starting point and destination, departing from the terminal as soon as they have a full load of passengers. There are no regular stops along the route where passengers are picked up; taxis stop as required by the passengers. All taxis operate on the route specified on their licenses.

There are seven off-street public transport stations/terminals within the study area; their physical conditions vary. In addition, there are on-street stops/stations for public transport services. The majority of public transport terminals is located in the city center and its immediate vicinity; therefore, because of the limited space may have inadequate space for all operating vehicles. This will also result in severe congestion by public transport vehicles entering and leaving the terminals, congestion inside the terminal, and congestion by public transport vehicles parked in the surrounding streets restricting the movement of all traffic. Circulation inside the terminal is generally challenging as the space is limited. Shelters and passengers' facilities are modest in the majority of terminals.

Although the officially published population figures for the urban area of Ramallah-AlBireh by the Palestinian Central Bureau of Statistics is slightly more than 110,000 with an estimated annual growth of approximately 2.2%, the actual population figure is much higher due to the nature of this urban area. The current population (in year 2020), including the refugee camps, is estimated to be approximately 210,000. with an estimated growth rate of 2.5% per year. The rapid increase in population, as well as in vehicle ownership, and economic activities in the area has considerably increased vehicular trips and has started congesting the area. Traffic conditions have worsened despite the fact that the municipalities have implemented several road rehabilitation projects and traffic improvements in the last few years.

3. Goals

Main goal: A public transport system should be a system that is continuously developing in a sustainable way, and that contributes to improving livability and accessibility.

This mobility goal is intertwined with the policy goals as summarized in the Spatial Development Framework Plan, Traffic and Transportation Plan of October 2016. These are:

- Enhance overall transportation system sustainability
- Improve accessibility and coverage
- Reduce congestion
- Enhance traffic safety

Sub goals

- Lead modal shift from private car to public transport and walking/cycling
- Accessible and reliable public transport
- Affordable public transport
- Achieve socio-environmental benefits
- Achieve sustainable and integrated public transport system

Doing so public transport becomes a mode that will and can compete with the private car. Besides the better environment and accessibility, it also means a big win in the scarce urban space. The use of space per mode differs considerably. Walking is very efficient in terms of needed space while the (private) car consumes the scarce space. (Good) public transport (bus, metro) uses 6 times less space than the car. As such, Ramallah-AlBireh urban area will/can become 'Smart Moving' with a good balance between walking and cycling, the car and public transport.

4. Participation

Throughout the whole plan process of more than a year the approach has been an interactive and cooperative one. The signals from the participants were very uniform and clear: the public transport system must be changed in all its section. The participation took different forms; several meetings, workshops, and focus groups.

5. Measuring is Knowing (Fieldwork and Modeling)

Smart technologies and expertise enable the collection of valuable data, needed to take the right decisions, to formulate the right policies and to evaluate. Extensive data regarding the public transportation system and its characteristics were collected despite the general conditions in the region as a result of COVID-19 pandemic. The analysis of the current situation provided the necessary baseline against which the proposals could be measured during the analysis and transportation modeling phase. The public transportation allocation model was developed under the modeling tool TransCAD for the base case (existing conditions), and for various scenarios including today (2020), for 5 years (2025), for 10 years (2030) and for 15 years from now (2036).

With the developed TransCAD Public Transport model for Ramallah-AlBireh urban area, the main attraction and generation zones in the city can be identified. Figure 1 shows that it is essential to connect the main attraction and generations points with the high-quality public transport system. The red lines give a conceptual idea of the main corridors.

6. Scenarios (including Preferred scenario)

6.1. Main components of the public transport system

A wide range of factors influence the public transport demand; the number of users per route. The best scenario is the scenario which has a low cycle time, higher max load, low interval time, high frequency, low fleet number and high boarding numbers.

In building the scenarios, the main corridors remain the same while the main differences between scenarios are the type of vehicles, operation and supplies. Key is the three Multi-modal Hubs and within this triangle the decongestion of the area for cars by priority for public transport. Starting with a prioritized connection between for instance: North and West terminal by a hyper modern electrical bus. Next phases will be South terminal and upgrading the vehicles to BRT/Trackless Tram.

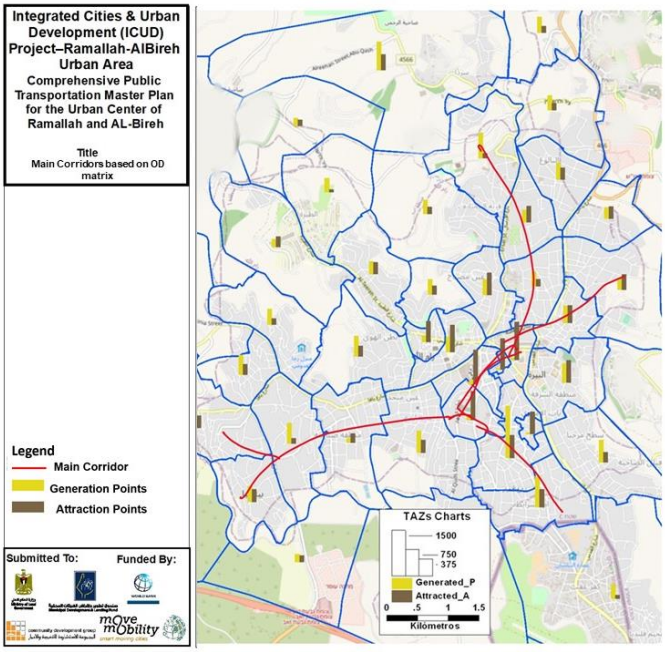

Figure 1: OD matrix

6.2. *Summary of the Scenarios*

Four different scenarios were proposed and analyzed. The scenarios are designed based on:

- The central corridors
- The terminals
- The connection between external and internal lines
- The mode, bus and/or BRT
- The total coverage of the urban area

All scenarios include central terminals at the ends of the corridors and an interchange terminal in the core of Ramallah-AlBireh urban area. The main characteristics of each scenario are:

- **Scenario 1:** Two internal public transport (bus) routes (north and west corridors) with specific operating characteristics, exclusive lanes, and the operation in the rest of the area will be the same.
- **Scenario 2:** Two internal public transport (BRT) routes (north and west corridors) with specific operating characteristics, exclusive lanes, and the operation in the rest of the area will be the same.
- **Scenario 3:** Three internal public transport (bus/BRT) routes (north, south and west corridors) with specific operating characteristics, exclusive lanes, and the operation in the rest of the area will be the same. This is further divided into two sub-scenarios; 3A using 50 and 80-passenger buses, and 3B using 160-passenger BRT on north (Etha'a Street)/west routes and 50/80-passenger buses for north (Nablus Street)/south routes.
- **Scenario 4:** Three internal public transport (BRT) routes (north, south and west corridors) with specific operating characteristics, exclusive lanes, and the operation in the rest of the area will be the same.

Table 1 summarizes the main elements of the studied scenarios. Scenarios are scored for the seven outputs of the modeling and ranked from ***** (high) to * (low), as shown in Table 2. Based on the Feasibility Analysis the investment cost per scenario has been added.

6.3. *Feasibility Analysis*

Feasibility analysis was conducted based on financial analysis, the environmental impacts, and social feasibility for the studied scenarios.

Table 1: Summary of the scenarios

	Main corridors	Stops	Vehicle Typology	Speed	Capacity	Interchange
Scenario 1	Jaffa Street - AlEtha Street	300 meters	Bus	15 km	80	City center
Scenario 2A	Jaffa Street - AlEtha Street	500 meters	BRT	18 km	160	City center
Scenario 2B	Jaffa Street - AlEtha Street	500 meters	BRT	19 km	160	North and West terminals
Scenario 3A	Jaffa Street - AlEtha Street / Al Nadha street - Al Quds street	300 meters	Bus	15 km	80 & 50	City center
Scenario 3B	Jaffa Street - AlEtha Street / Al Nadha street - Al Quds street	300-500 meters	Bus/BRT	15 km	160, 80 & 50	City center
Scenario 4	Jaffa Street - AlEtha Street / Al Quds street	500 meters	BRT	18 km	160	City center

Table 2: Overall comparison of the scenarios

	Cycle time	Max load	Length	Interval time	Frequency	Fleet numbers	Boarding	Investment costs	Final score
Scenario 1	****	****	***	***	***	*	***	*****	2
Scenario 2A	***	****	**	*	**	**	***	**	0
Scenario 2B	***	***	**	****	**	*	****	**	1
Scenario 3A	***	*****	*****	***	*****	****	*****	*****	5
Scenario 3B	***	*****	*****	*	***	*****	*****	**	4
Scenario 4	***	***	****	****	**	***	****	**	1

a. Financial Feasibility

It includes investment costs (land acquisition and construction of main terminal stations and transfer station), operating expenses (corridors rehabilitation, charging stations, stops, and vehicles), and investment returns (annual rent and onetime payment for eviction charges). The summary of expenses among scenarios is presented in Table 3.

b. Environmental Aspects

The potential environmental impacts and mitigation measures of the different potential modes and scenarios focused on:

- Land acquisition and rehabilitation
- Involuntary resettlement
- Economic activities
- Traffic
- Public facilities
- Traffic accidents
- Ecosystems
- Air pollution
- Water pollution
- Soil contamination
- Waste
- Noise and vibration

Table 3: Cost Summary (USD)

	Scenarios					
Cost Item	**1**	**2A**	**2B**	**3A**	**3B**	**4**
a. Investment						
Land Acquisition and Preparation [(1)]	18,099,000	18,099,000	18,099,000	18,099,000	18,099,000	18,099,000
Construction Cost	31,359,800	31,359,800	31,359,800	31,359,800	31,359,800	31,359,800
Total Investment	**49,458,800**	**49,458,800**	**49,458,800**	**49,458,800**	**49,458,800**	**49,458,800**
b. Operational						
Corridors Rehabilitation	1,950,000	6,500,000	10,000,000	3,600,000	8,150,000	10,000,000
Charging Stations	-	866,667	1,733,333	3,166,667	2,100,000	1,966,667
Stops	165,000	260,000	400,000	300,000	402,500	400,000
Bus/BRT Vehicles	-	19,500,000	39,000,000	38,900,000	32,300,000	43,973,750
Total Operational	**2,115,000**	**27,126,667**	**51,133,333**	**45,966,667**	**42,952,500**	**56,340,417**
c. Investment Returns						
Annual Rent	1,328,000	1,328,000	1,328,000	1,328,000	1,328,000	1,328,000
One-Time Payment	49,800,000	49,800,000	49,800,000	49,800,000	49,800,000	49,800,000

[(1)] The land for terminal TS01 is a public land owned by Al-Bireh Municipality for an estimated land value of $5,040,000. Therefore, no direct payment is required. Furthermore, the land for terminal TS02 had already been acquisitioned by Ramallah Municipality for an estimated value of $5,560,000.

It should also be noted that the annual maintenance cost for the BRT corridor is higher than the regular bus corridor. Based on several international experiences, it is estimated at $120,000 per km.

In general, the investment to implement a Bus/BRT system is far less than the Light rail (LRT) system. LRT attracts more people and has less noise and pollution than the diesel version of the buses; however, the electrical bus has the same quality in terms of noise and pollution. The investment in the trackless tram system (TTS) is the highest and the required passenger capacity is high and not available at the time being. Compromising the relatively little increase in the noise caused by Bus/BRT as compared to TTS, it has the lowest capital cost while achieving the objective of this project; the study recommended the Bus/BRT system.

c. Social Feasibility

The social feasibility focusses on identifying and analyzing the main variables that should be considered to maximize the social feasibility of this project through a process of redistribution of social costs and benefits between the different stakeholders. The need to strike the balancing scales would be extremely necessary to establish a sense of fair-treatment, considerate approach, and a sense of buy-in. Enhancing the maximum engagement of the community and the spectrum of stakeholders as early as possible in the planning phase will be a remarkably critical factor to avoid serious risks to the successful implementation, as long as boosting the community development of these urban centers constitute a central part of the whole purpose of this project.

The main strategies suggested to manage the different variables affecting the social feasibility are classified under three main levels; the hardware, the software, and the organizational level. The first is concerned with the project physical infrastructure aspect (for which no strategies are suggested), the second is concerned with the information dissemination and awareness raising as well as community engagement, while the third is concerned with the organization structure of the project including the manpower involved in its implementation.

- **Hardware Strategies**
  - No strategies suggested under this level
- **Software Strategies**

- Stakeholder Analysis and Social Dialogue Strategy
- Community Engagement Strategy
- Awareness Raising and Marketing Strategy
- Grievance System
- Secondary Gains and Incentives Strategy
- Market Economy Enhancement Strategy

- **Orgware Strategies**
  - Establishing Social Development Unit (staffing)
    - Coordinator
    - Two community workers

6.4. Preferred scenario

Based on the evaluation and comparison between scenarios, Scenario 3 is the preferred one. Scenario 3 (A and B) consists of the re-organization of the two corridors that provide access to the center of the city from the north/south west corridor and the south corridor. Key is the inclusion of terminals at the ends of the corridors which will have the function of receiving and organizing the demand of users' circulation within the city and the exits, collecting all the demand of passengers from different routes that come from both the north, the west and the south.

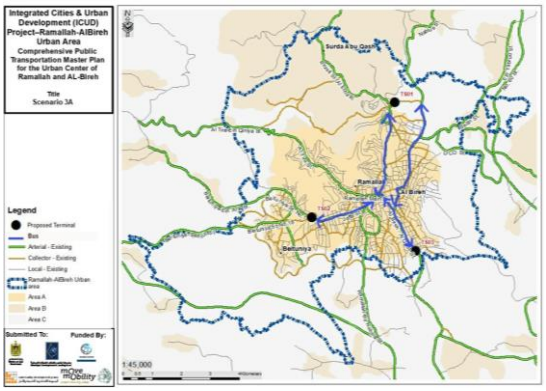

Figure 2: Scenario 3A

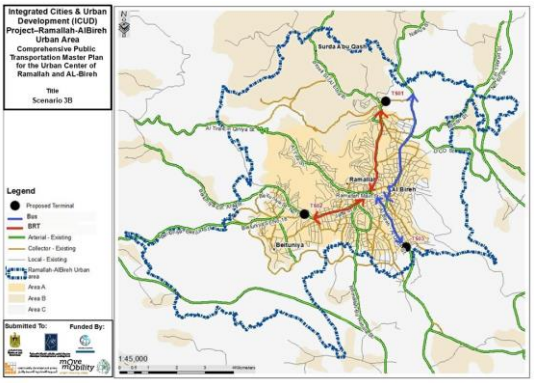

Figure 3: Scenario 3B

A step by step approach for this preferred scenario is obvious and this "phasing" has an infrastructural and a mode (vehicle) component. The BRT system requires special vehicles with a higher capacity. This mode also needs a dedicated infrastructure (lanes and stops/stations), especially designed and built for the BRT. Of course the investments and maintenance cost for the BRT system will be higher than for the bus system.

For the first 5 years, the (electric) bus system in this preferred scenario that will be adequate to handle the predicted demand of passengers. All other measures mentioned in this Public Transport Master Plan (as well as in the Traffic and Transportation Plan, 2016) will cause a shift from private cars to, by then, the competitive public transport. All measures together (public transport improvement, P+R, pedestrian facilities, strict parking regime, etc.) will result in a motivation to use public transport more and more. The demand for public transport will rise beyond the modeling output. That is the moment the upgrading of the preferred scenario from bus to BRT system has to be considered seriously. This can be achieved in approximately 7 years from now, depending on the speed with which the strategies and measures are implemented.

7. The Master Plan

A public transport system should be a system that is continuously developing in a sustainable way, and contributes to improving livability and accessibility. The structure of a solid public transport system for a city consists of:

- A backbone (for the bigger concentrated flow – longer distances)
- Coverage of the urban areas (medium long distances)
- Feeder system (short distances)

The translation of the current situation, and the outcomes of the scenarios and modelling show the following concept of the Public Transport plan:

- The backbone for the urban area are the corridors that connect the three terminals: North, South and West.
- The coverage of the different urban areas is done by the existing bus lines.
- The feeder systems operate towards the terminals and also to some stops in the bus lines (Figure 4).
- The integration between the corridor lines and other internal lines is crucial (see Figure 5). A high quality of the public space for pedestrians will be key. The internal lines would interchange with the main lines at their junction points.

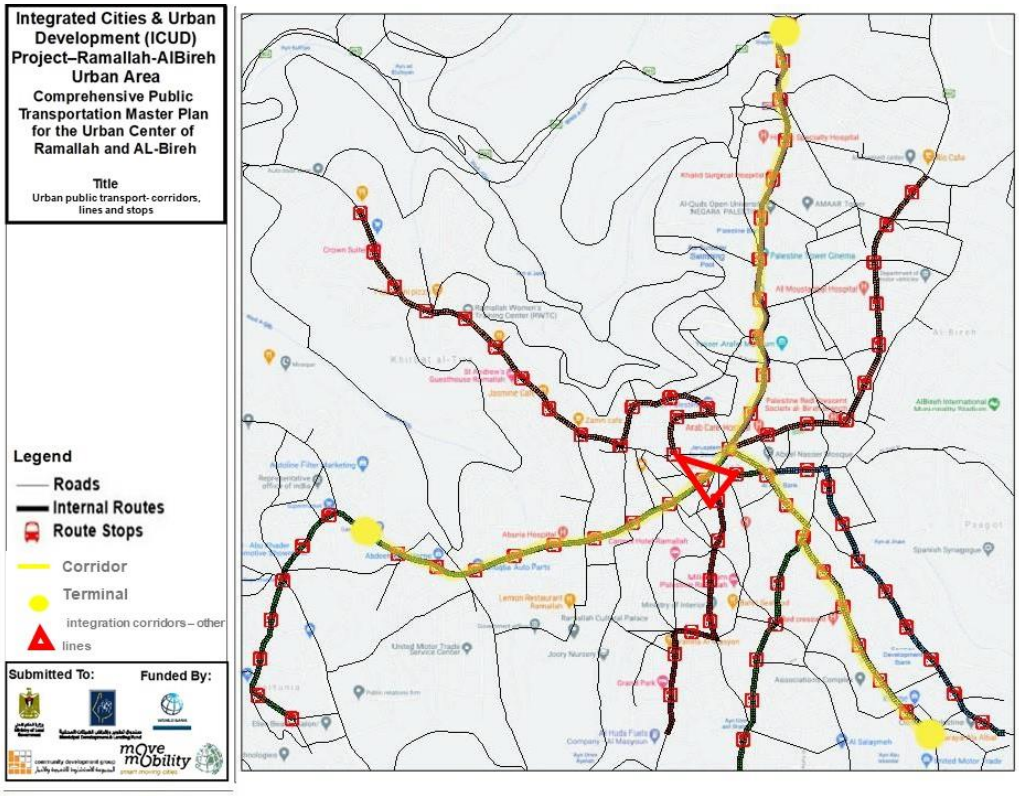

Figure 4: Urban public transport corridors, lines and stops

Planning structure

The planning structure in this study is from big to small. First the chosen scenario with lines, terminals and mode and then the topics like fares, crew and vehicle scheduling, infrastructure interventions like bus lanes and bus stops.

Transport planning has to consider all aspects that are important:

- **Orgware** - a planning system that includes all the actors involved in a project. This ensures that all visions are taken into account, resulting in strong planning strategies, laws, regulations and guidelines
- **Hardware** - planning, scenario development, designing and implementation of infrastructure and systems
- **Software** - culture, communication, information, education, health, etc.

The three Multi-modal Hubs (terminals) are a crucial part in the 'backbone' of the Public Transportation Master Plan. At these locations passengers in the public transport system can shift from internal lines to external lines and vice versa (Figure 6).

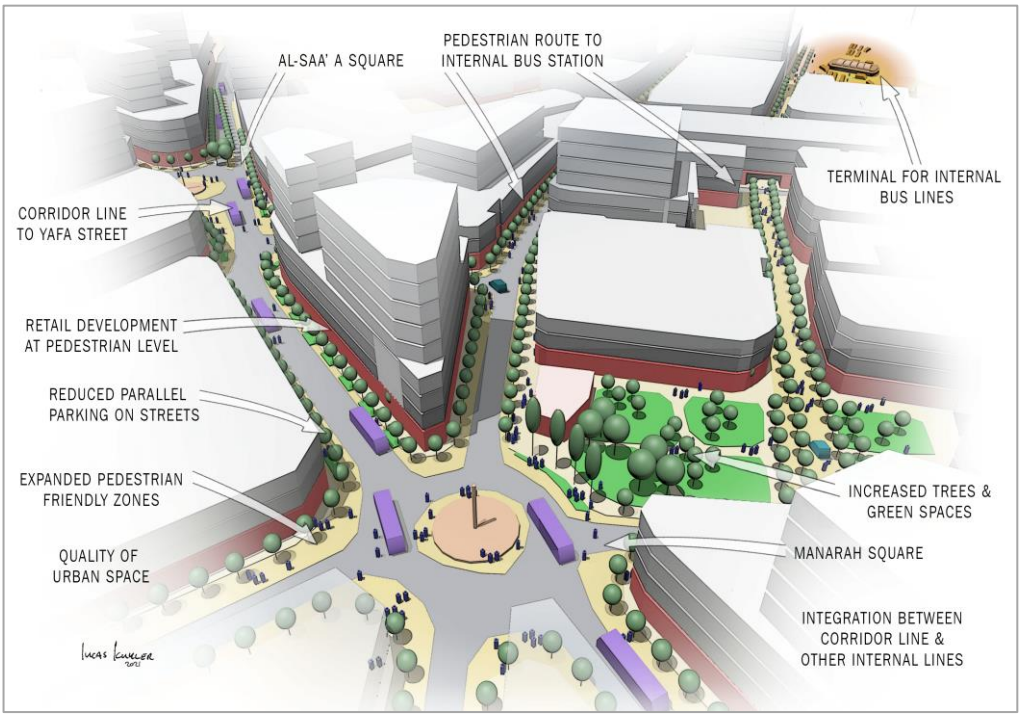

Figure 5: Integration between corridor line & other internal lines

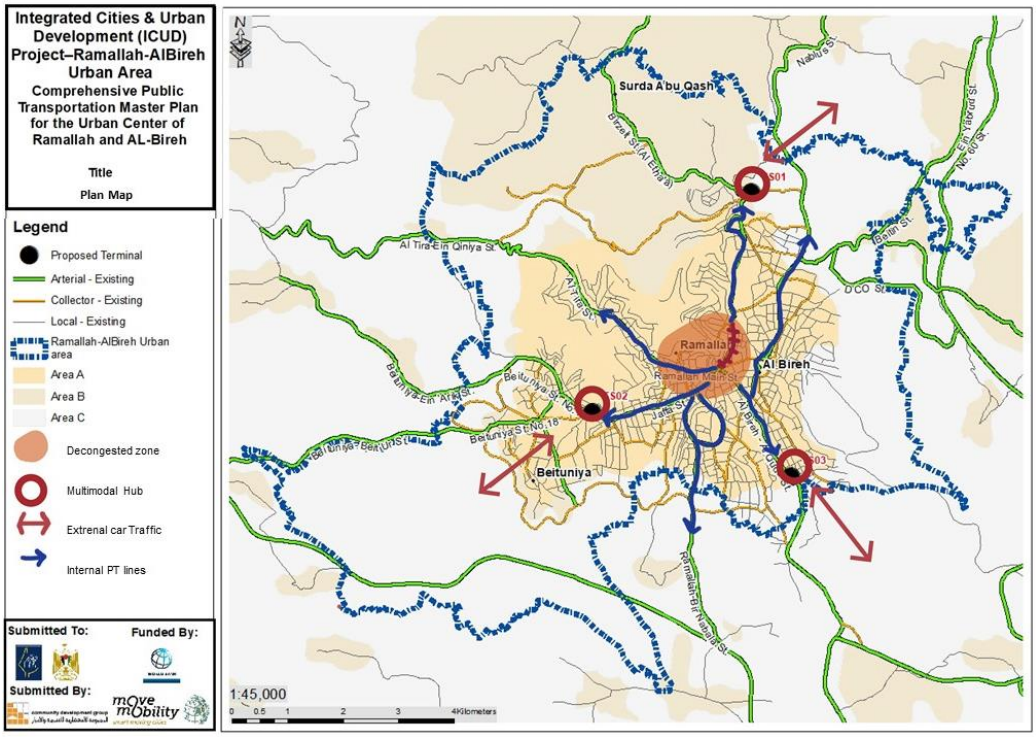

Figure 6: Plan map

8. Measures and costs

8.1. Strategies and Measures

Parking strategy

Key interventions aimed at improving the overall parking conditions in the CBD area of Ramallah-AlBireh focus on increasing off-street parking and Park+Ride facilities, with connection with the designed Multi-modal Hubs. External car traffic can park and continue the journey with public transport (Park+Ride). This is a

crucial part of the parking strategy for cars in the entire urban area. A solid parking strategy for the urban area must be designed, implemented and enforced with restriction for supply or control for demand to encourage the use of public transportation. A Parking strategy/parking management will be established in a step-by-step approach done by municipalities, police, PT body and traffic committee.

Pedestrian Strategy

Walking for people (pedestrians) is very efficient: in terms of used space, environmental impact, health and cost. During the last decade, the policy has more and more been “give the city back to the pedestrian”, especially in vulnerable areas like the inner city. Therefore, the improvement of pedestrian facilities is included as part of the roadway rehabilitation program. In this plan a no car zone is proposed in the central area. So a domain for only pedestrians and public transport.

Legislation

In general, the public transportation sector in Palestine suffers from several difficulties, including an outdated bus fleet, an inefficient service provision, which is irregular, and in some areas inaccessible. Public transportation is planned by the service providers. This means that bus companies, shared taxis and shared cabs have each set their “informal” rules for establishing routes, schedules and rules of operation. This has not sufficiently been controlled by the governmental agencies which hinders a proper public transport planning based on demand.

The legislation of the public transport includes activities such as the legal relationship between the transport operators and passengers, and between operators and public administration bodies. It is also including fiscal (customs duties for imported vehicles) and social (consumer) and environmental protection. Local government has a central role to play in the development and implementation of the plan.

Integrated urban transport committee

At a national level the success of a public transport system lies in

- Set up integrated urban transport authorities within the cities which covers all modes of transport and considering issues beyond transport such as housing and land use in order to set the institutional framework for the development the public transport plan and integrated urban transport policies.
- Develop integrated transport and land use master plans coupled with local and district development plans in order to promote long-term urban planning.
- Implement a basic package of policies to push car users away from private cars, including congestion charging, parking management, restriction/auction of license plates and promoting car-free areas in order to set a favorable environment for the development of sustainable transport.
- Set up an urban transport fund that oversees investment in sustainable transport, especially public transport and non-motorized transport to ensure the adequacy of financial resources availability.

The national government has a key role to play in catalyzing actions at the local level, like

- Design and implement fiscal measures such as fuel and vehicle taxes, and phase out environmental harmful subsidies.
- Implement regulatory measures such as vehicle efficiency standards and fuel standard.
- Promote private investment in more environmentally efficient vehicle and technologies through tax cuts/rebates and subsidies for research and development.

Establishment of Public Transport body (Joint Public Transportation Unit – JPTU)

The success of a public transport system lies in establishing a local/regional body that has the authority to make decisions, controls and manages the system. Locally, the municipalities are more aware of their needs. The JPTU will handle: Public transport service planning; Public transport infrastructure; Operational aspects of the service; Communications; and Financing. The JPTU should be supported by a technical committee headed by the Joint Cooperation Unit, JCU. The role of this committee includes performance monitoring, conducting studies, field observation, etc., and submitting guidance and recommendations for the administrative body of the JPTU.

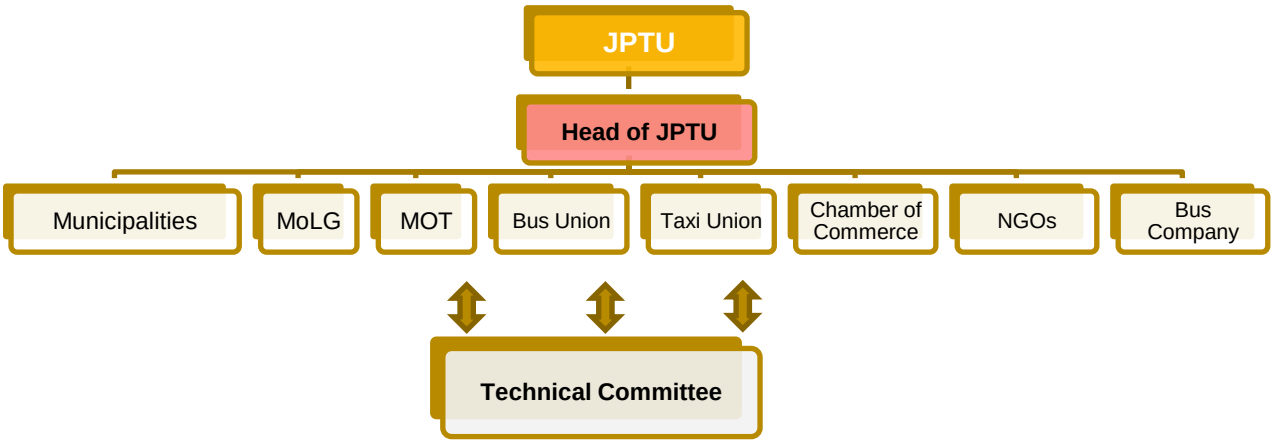

Figure 7: Public Transport body scheme

The role of taxis

The role of the taxi will change significantly. Taxi services will in the future feed more towards the public transport terminals and the central station. Taxis provide an essential means of transport for the vulnerable groups such as elderly and disabled. Furthermore, they are valuable for the economy because they create jobs and tax revenue for the local government. To improve the taxis contribution, the following measures can be taken:

- Modernize vehicle fleets to a lower level of air pollution and carbon emissions.
- Support the use of taxis in price setting and in communication in word and in image. For instance, showing the same logo on all vehicles which provide the public transport in the urban area.
- Ensure the effective regulation of services.
- Support improvements in the vehicle standards.

Technical and operational measures

- *Elements: terminals, lines, feeders and modes*

Building it up towards a solid public transport system, the first elements from the scenarios are the terminals and the connecting corridors. There is a common understanding about the North and the West terminal locations. The one in the South is the subject of a detailed survey. These terminals will function as Multi-modal Hubs; crucial are the external lines that stop here, and the internal public transport system takes over the role of moving people from and to the urban area. The connection between the terminals must be comfortable to use for public transport vehicles. This will be established in two ways:

1. The bus will get priority on the route; bus lanes, priority at junctions, etc.
2. A no-car zone in the central area (central stop).

The modelling results showed that a bus with a capacity of 50 is a good mode for the urban area in the coming period. Not only in terms of services (frequencies), but also in terms exploitation and investments in infrastructure. A BRT requires a fully dedicated elevated platform including the stations. When the use of public transport increases on the central corridors, a jump towards a BRT system can be considered.

- *Fleet*

The fleet numbers indicate the number of buses needed for the city. The operational design for the first 5 years is composed of all routes that go from the outer terminals to the center operated by buses of 80 and 50 passengers.

- *Bus stops and coverage*

The lines of the public transportation plan cover the area as good as possible, giving the geographic structure, the living areas, the working areas and the central areas. In combination with the bus stops, this will result in a coverage by public transport of the essential areas. The bus stops are located at obvious and safe places. The distances between the bus stops is approximately 300 m. In the figure below the bus stops

are projected for each line. With a radius around each stop and terminal of 350 m (the walking distance to/from public transport). This achieves a coverage of 80% of the living areas in the urban area. One of the monitoring tasks of the Public Transport body will be to keep this percentage at this level or even improve it.

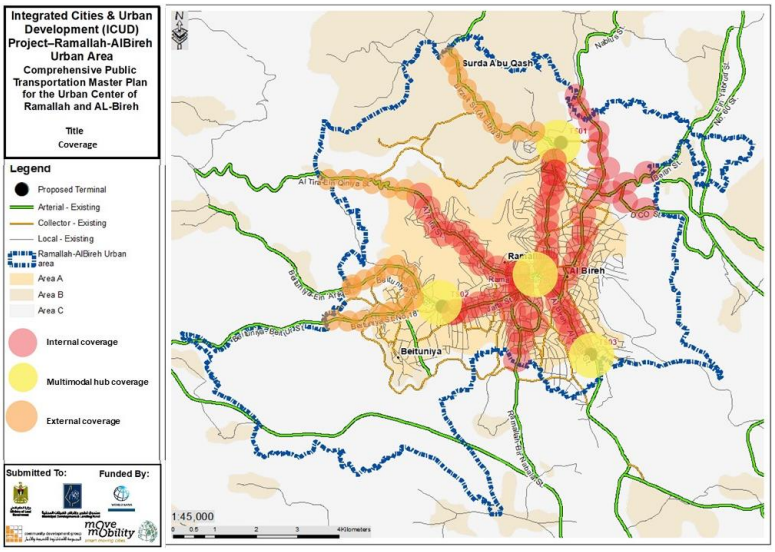

Figure 8: Coverage of public transport

» *Flow measures*

Public transport will operate based on time tables; this means that the traveler can rely on arriving and departing on time. Organizing this whole system of "operating on time" is executable especially thanks to the modern techniques. Even small delays can be recovered within the system.

The roads are shared by all kinds of modes, movements etc. A completely separated public transport system will solve the congestion issue. In urban areas with the size of Ramallah-AlBireh it is not feasible to create a (fully) separated public transport system. It can be separated on some (central) corridors. In the rest of the network "flow measures" will be a solution for the public transport to avoid the (possible) congestion. In other words, public transport (bus, minibus, vans) will get priority over cars.

Possible measures are:

- Bus lanes
- Priority at traffic lights
- A bus that halts in a bus stop along the roadway gets priority to re-enter the road.
- For the central corridor it is possible to make a total design of flow measures, one-way system (which already exists on most roads), no car zone, etc.
- The reconstruction of the central corridor will have an impact on the "freedom" for the car system. A circulation for this mode must be designed.

The physical elements for the proposed scenarios are shown in Figure 9. These measures need to be considered to implement a bus priority system:

- Design of road infrastructure including public transport
- Detailed design of the main corridors in order to implement the dedicated bus lanes and pedestrian facilities.

» *Electrification of public transport*

Electric vehicles are eco-friendly, have quiet operation, and need minimal maintenance. To introduce electrification of public transport it is advised to formalize and implement a long-term charging infrastructure plan, which is essential for a successful electrical bus system. So it is important to create a site plan to address the reality of land scarcity, analyzing and defining technical specification of charging stations,

exploring innovative charging mechanism such as smart charging and developing a plan to deal with power outages. Of course the Multi-modal Hubs will also be main charging stations.

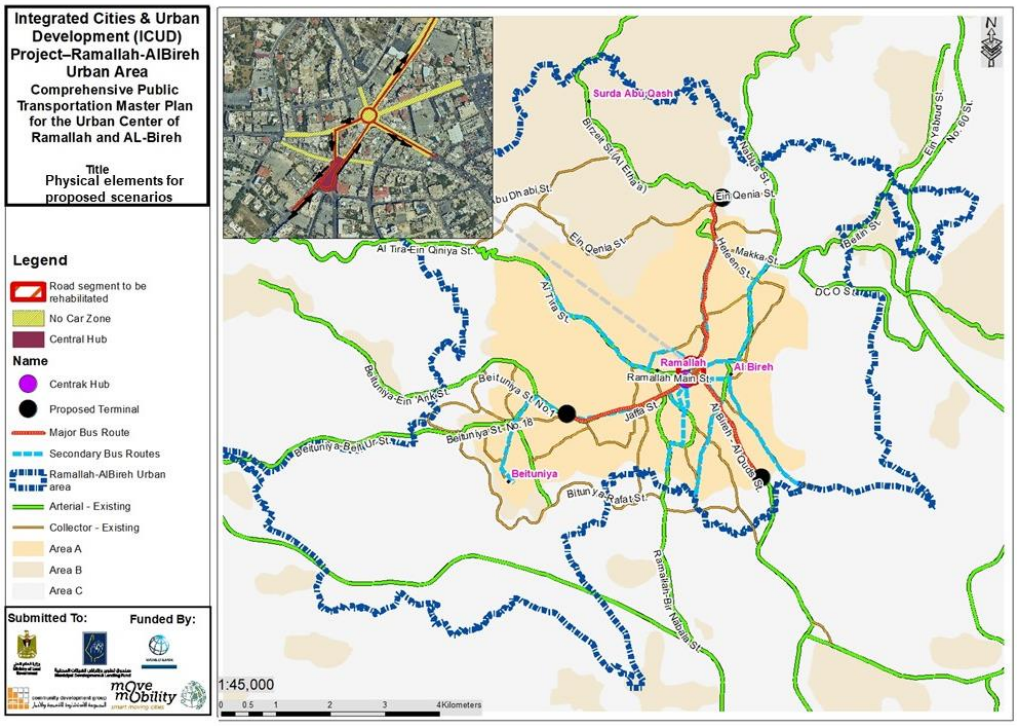

Figure 9: Physical elements for the proposed scenarios

» *Multi-modal Hub*

Worldwide we see a process of bringing more options, more quality, more convenience etc. for people that want to/have to travel for short and longer distances. This means a lot for “terminals” of the future. Nowadays these are called Multi-modal Hubs (Figure 10). Could be fully covered by the Palestinian notation “Terminal”. Therefore, P+R locations should be designed at the terminals North, West and South. It is advised to start with a reasonable number (50 places) with a flexibility in the design to extend easily.

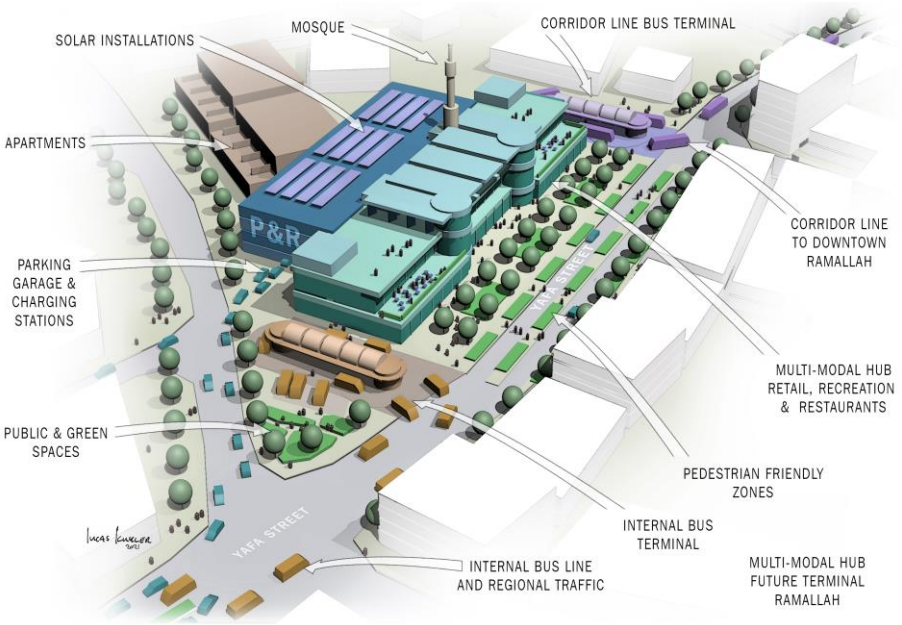

Figure 10: Multi-modal Hub (future terminal)

» *Central Station/Urban Accelerator*

Where is the heart of this city? That is a crucial topic and many (inhabitants and visitors from outside) will answer: “This is the place”. Why is this important? Well, “the place to be” is interesting for investors, shops, hotels, just walking, etc. Every city has those “urban accelerators”, with a high quality of urban space (Figure 11). This special place must have good public transport; this is provided by the North-South-West corridors. The congestion of cars and taxis will disappear thanks to the corridor measures; pedestrians and public transport will be in the majority. Public transport must have a “major stop” in this central area; this will be a kind of Central Station.

- It is a perfect location for the public transport Central Station with many people using it. It is a publicly owned land.
- The public transport stop will be properly designed with good accessibility, waiting places, information for the area and the public transport, shade, etc.
- It is a good location in the network of streets and roads to create an (almost) no-car zone, to bring some air and space in this vulnerable area
- Pedestrians/cyclists get the space they need/deserve
- Quality of urban space will flourish
- The whole surrounding area will accelerate in terms of quality, investment, livability, etc.
- It will bring people from the outside to this central location; therefore, business and commercial sector will highly benefit, and will not be negatively hurt by not allowing cars to enter the central zone.
- Special attention for later on in the detailed design is needed for the delivery of goods and people by car in this area.

Urban accelerators have a rippling effect, like a stone in the water. These places have much more meaning and can enforce developments that will determine the successes of the city. They will be recognized by everybody and they will have their own character and identity.

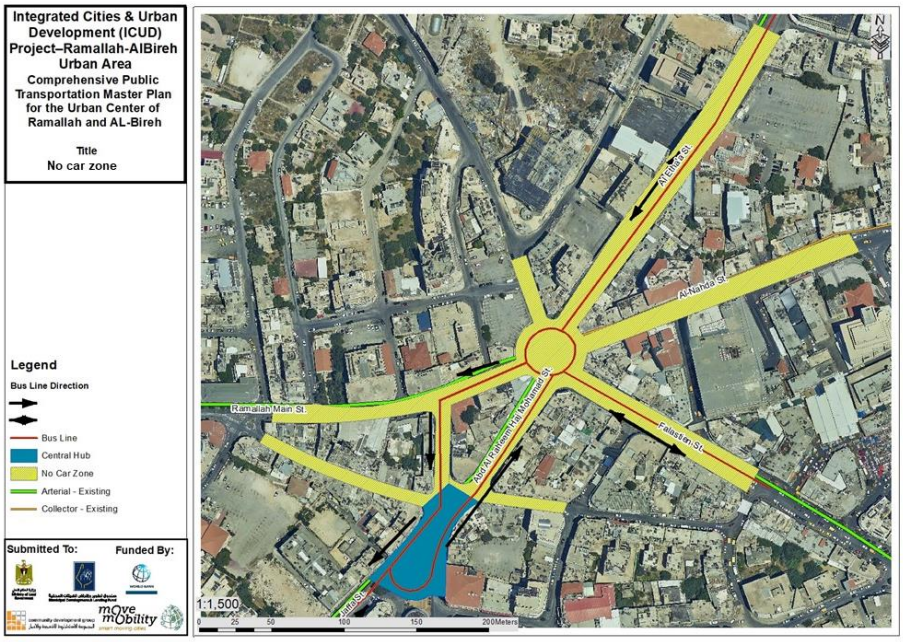

Figure 11: No-car zone and central hub

» *Information system*

One of the necessities of a public transport system is having an accurate real time information system. Not only for guiding passengers, also for safety reasons and to enable the control center to take action on time. People need accurate information to access the public transport services. Correct and reliable information need to be available during and before travelling.

Adoption of advanced information technology requires significant financial investments, which have to be assured from the beginning of the project (e.g. by the regional or municipal transport authority). To assure the economic sustainability of the measures after the implementation, a specific business plan should be designed that includes costs and revenues generated from advertising, internal cost reductions, and sales of specific customized information services, (e.g. selling this to other travel service providers). It is also recommended to ensure that the original tender includes adequate technical back-up to ensure long term operation of the system. It is reasonable to initially install such equipment at the main transfer stations and important stops. Less important stops can also be covered by mobile phone services. The public transport operator is committed to pay for the equipment at the stops and on the vehicles as well as for the hard- and software of the system. Financial support should be given also by the city council or the public transport authority.

» *Ticketing and fare collection*

In general, the total revenues earned by the public transport service should be sufficient to cover the total costs and a reasonable profit**.** Basis for collecting the total fares is a solid, reliable and attractive system. Furthermore, an attractive ticketing system will generate more use of the public transport system. The pricing should be reasonable and easy to understand. Tickets and payment facilities should be available through the city, at ticketing vending machine (bus stops, stations), on internet or via mobile phone. A well-defined ticketing system helps the city to have a huge valuable data base because the ticketing process can collect the data from the passengers which can be used in the management system of the public transport.

9. Overview measures, responsibilities, costs and timeline

In Figure 12 the timeframe of measures and strategies are described, starting with the short term measures, increasing to medium term and long term and ending with the various strategies which start in 2021 and continue until 2036.

In Table 4 timeframe and strategies, the (mainly) hardware projects are put in place in short, medium and long term. For the different measures the costs are summarized.

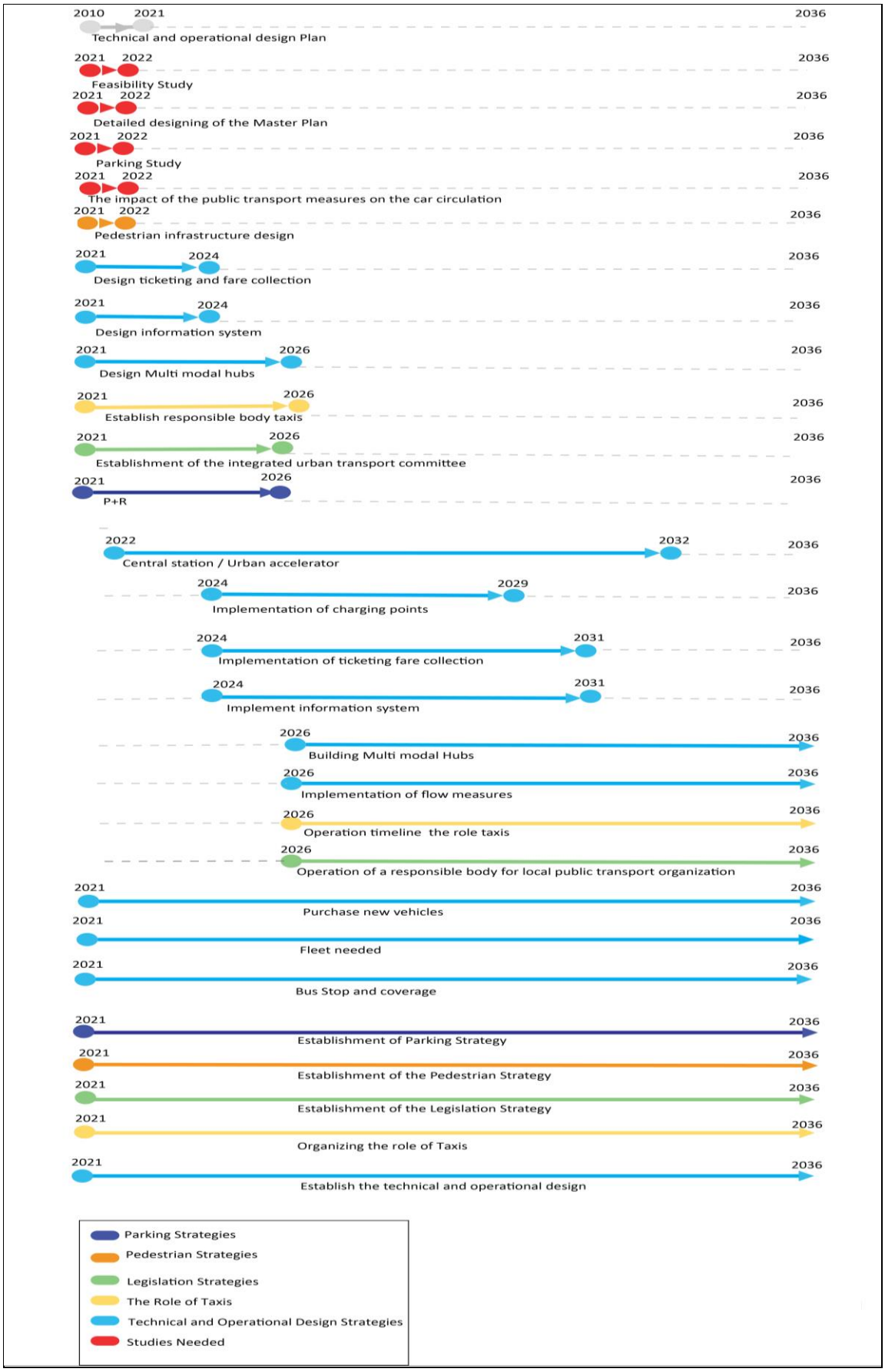

Figure 12: Timeframe of Measures and Strategies

Table 4: Timeframe and strategies								
Strategies	**Measures**	**Responsibilities**	**Estimated cost (USD)**				**Timeline**	**Aspect of the work**
			Short term 2021-2025	**Medium term 2026-2030**	**Long term 2031-2036**	**Total cost**		
Parking strategies	Establishment of the strategy	Local municipalities, police, PT regulatory body and traffic committee					15 years	Organization Software
	P+R	Local municipalities, police, PT regulatory body and traffic committee		1,200,000	1,200,000	2,400,000	5-15 years	Organization Software Hardware
Pedestrian strategies	Establishment of the strategy	Local municipalities					15 years	Organization Software
	Pedestrian infrastructure and design	Local municipalities	100,000			100,000	Design: 1 year Implementation: 4 years	Hardware
Legislation	Establishing the strategy	Municipalities and Ministry of Transport	40,000	60,000	60,000	160,000	15 years	Organization Software
	Establishment of the integrated urban transport committee	Municipalities and Ministry of Transport	10,000			10,000	5 years	Organization Software
	Establish a responsible body for local public transport organization	Ministry, Local municipalities and PT regulatory	10,000			10,000	5 years to establish 10 years operational timeline	Organization Software
The role of taxis	Establish responsible body	Local municipalities, PT regulatory body and private investor	10,000			10,000	2-5 years to establish 10 years operational timeline	Organization Software
Technical and operational design strategies	Establish the technical and operational design strategies	Local municipalities, PT regulatory body and private investor					15 years	Organization Software
	Technical and operational design	Local municipalities and Public transport body and consultant	Master plan has been finalized				2 years	Organization Software

	Terminal, lines, feeders and modes	Local municipalities and Public transport body	28,144,300	21,314,500		49,458,800	Design and land acquisition: 2-5 years Build: 3-10 years	Hardware
	Fleet needed	Public transport body and private companies	25,750,000	9,800,000	3,350,000	38,900,000	15 years	Hardware
	Bus stop and coverage	Local municipalities, private investor, PT regulatory body	150,000 (7,500 p/bus stop)	150,000		300,000	15 years	Hardware
	Flow measures	Local municipalities, PT regulatory body	1,200,000	2,400,000		3,600,000	Design: 3 years Implementation: 3-10 years	Hardware
	Central station/Urban accelerator	Local municipalities, PT regulatory body and police	187,500	187,500		375,000	10 years	Software Hardware
	Information system	Local municipalities, PT regulatory body and private investor	175,000	175,000		350,000	Design: 3 years Implementation: 5-7 years	Hardware
	Ticketing and fare collection	Ministry of Transport, Local municipalities and PT regulatory body	50,000	50,000		100,000	Design: 2-3 years Implementation: 5-7 years	Hardware
Other studies needed	Feasibility studies	Local municipalities, police, PT regulatory body and traffic committee	150,000			150,000	1-2 year	Software
	Detailed designing of the Master Plan	Local municipalities, police, PT regulatory body and traffic committee	250,000			250,000	1-2 year	Software
	Parking study	Local municipalities, police, PT regulatory body and traffic committee	150,000			150,000	1-2 year	Software
	The impact of the public transport measures on the car circulation	Local municipalities, police, PT regulatory body and traffic committee	125,000			125,000	1-2 year	Software
		Total cost (USD)	**56,501,800**	**35,337,000**	**4,610,000**	**96,448,800**		