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# **Republic of Yemen**

## **Urban Transport in Sana'a**

### **Strategy Note**

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## **CURRENCY EQUIVALENTS**

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1 USD = 205 YER  
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## **ABBREVIATIONS AND ACRONYMS**

BRT	Bus Rapid Transit
CTMS	Comprehensive Traffic Management Study for Sana'a
IAP	Immediate Actionp Plan
MOI	Ministry of Interior
MOLA	Ministry of Local Administration
MPWH	Ministry of Public Works and Highways
MOT	Ministry of Transport
ROW	Right of way
TPTED	Transport Planning and Traffic Engineering Department

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## **FOREWORD**

This report was prepared by Mr. Philippe Blanc, Professor of traffic engineering at Ecole Polytechnique Fédérale of Lausanne (EPFL) and Co-director of Transitec Consulting Engineers, and by Mr. Patrick Boillat, Project Manager at Transitec Consulting Engineers following a mission to Sana'a from October 31<sup>st</sup> to November 10<sup>th</sup>, 2008, under the guidance of Mr. Jean-Charles Crochet, Senior Transport Economist and Task Team Leader at the World Bank.

During this mission, the key stakeholders in the urban transport sector in Yemen were met. Numerous field visits and observations were also made in order to collect essential information and complete the diagnosis of the current situation. In addition, existing studies on Sana'a's urban development and transport system were used as sources of information and, in particular, the Comprehensive Traffic Management Study for Sana'a City (CTMS), a large traffic study realized by the consultant Team International on behalf of the Republic of Yemen and the Municipality of Sana'a under funding from the Arab Fund for Economic and Social Development. This study is currently used as a guide for Sana'a's urban transport policy.

## EXECUTIVE SUMMARY

### Background

During the last decades, the city of Sana'a has experienced very high population growth and rapid spatial expansion. These two phenomena have had a negative impact on urban management in general and on the efficiency of the transport system in particular, unable to cope with the growing demand for mobility. Forecasts show that the growth rate of Sana'a's population should remain very high in the future (about 4% annually), further fuelling the city's spatial expansion. Constrained by its geography, Sana'a spreads over 400 km<sup>2</sup> in a linear form (40km x 10-12 km) along the main transport arteries. As in most cities in developing countries, including in the MENA region, a majority of trips are made with public transport modes in Sana'a, essentially microbuses and taxis. The motorization rate is relatively high, however, given the level of income, and should increase significantly in the future. Walking is also an essential but neglected mode of transport. In its current form, the performance of the transport system represents a handicap in the short term and a severe threat in the long term for the city's ability to work as an engine for the entire economy of the Republic of Yemen.

### Main issues

**Institutional obstacles and strategic weaknesses:** Responsibilities for urban transport are formally split between different public institutions (namely the Municipality of Sana'a, the Ministry of Transport, and the Ministry of Interior) and there are no coordination mechanisms between them. In any case, most of the urban transport and traffic management functions are not appropriately addressed by the current institutional framework basically because there are no units in charge of urban transport planning and traffic management. The newly created Land Transport Agency of the Ministry of Transport is only beginning to address public transport issues and still has very limited means for doing so. The Municipality of Sana'a also suffers from a serious lack of human, logistical and financial resources for urban transport, and there is an alarming shortage of transport planning and traffic engineering skills in the country. Enforcement of traffic rules is poor. Furthermore, there is a major problem with planning and strategy formulation because the Comprehensive Traffic Management Study (CTMS) for Sana'a City, which has set the directions for the capital's future transport policy and traffic management, is not a comprehensive multimodal strategy, and offers only a partial answer to Sana'a's transport problems.

**Public transport:** The public transport industry in Sana'a is highly fragmented, with the predominance of individually owned buses and taxis, and it relies almost entirely on the informal sector. Public transport is mostly unregulated and lacks strategic vision. Indeed, there is a total absence of public transport service planning, with gaps in terms of network coverage, and no service obligations. The poor quality of service disproportionately affects certain categories of users, women in particular. Controls of vehicle safety and emission standards are ineffective. The fleet of buses and taxis is heterogeneous and composed mostly of low-capacity vehicles (minibuses, taxis), old and poorly maintained, representing an important source of traffic congestion and pollution, and inefficient in terms of road capacity use.

**Road network, traffic management, parking, and pedestrian routes:** Despite the high capacity of major arteries and massive investments which have mostly benefited the outer, not the central, urban area, Sana'a's street network has reached saturation especially in the centre. This is mainly due to the lack of an appropriate functional road hierarchy, poor traffic management, inadequate intersections design and operations, widespread parking violations, poor enforcement, and lack of discipline of drivers. These issues have serious consequences on traffic speed and fluidity and on local accessibility. The maintenance of streets and related infrastructure is also neglected. Road safety is poor and accidents numerous. Despite the essential role of walking for Sana'a's population, pedestrians' needs are poorly addressed. There is no continuity of pedestrian routes, insufficient sidewalks, poor lighting, and a general lack of secure street crossings. This affects in particular children, women, and persons with reduced mobility. The excessive number of microbuses and taxis clogging up the main axes, is

also a major problem.

**Financing problems:** Urban transport in Yemen in general and in Sana'a in particular suffers from a lack of financial resources, an unbalance in the distribution of funds and a chronic lack of investment in public transport and traffic management. Public funds allocated to urban transport, whether their source of financing is Yemeni or foreign, have for long been exclusively directed to roads and focused on the development of large infrastructure projects, in particular numerous grade separated intersections. On the contrary, the public transport sector has been fully deregulated and left to the informal sector, without any significant public investment in the facilities (like dedicated lanes) that would help make it more attractive and more efficient.

## Recommendations

**Institutional development:** The improvement of institutional performance in the field of urban transport should be addressed as a priority. In particular, as shown by the experience of successful countries, a department in charge of transport planning and traffic engineering should be created within the Municipality of Sana'a. This department should assume a wide set of responsibilities in transport planning and management, from policy development to traffic operations. It should also be in charge of public transport planning and route franchising, so that there is full coherence between the development of public transport and that of the other modes of transport, including especially the management of roads and traffic. Sufficient human and financial resources should be secured to allow the new department to fulfill its missions. The improvement of transport planning, public transport regulation, and traffic engineering skills is another strong priority, and significant efforts should be expanded on the development of training programs in urban transport. Finally, urban transport strategies should be developed with a consensus-building approach, involving the participation of all stakeholders, national and local authorities, and civil society.

**Strategy formulation and planning:** There is an urgent need for the development of a real multimodal urban transport strategy and master plan which would set priorities in terms of urban transport policy measures and investments for the medium to long term. This comprehensive strategy would aim at optimizing the performance of the transport system in a holistic fashion. It would include both soft and hard measures and specify the role to be played by each mode of transport, considering its respective features and the city's context and constraints. It would include a five to ten-year priority investment plan based on a realistic assessment of available resources.

**Restructuring of public transport:** A coherent package of reform measures should be implemented as soon as possible to drastically improve the quality, efficiency, and sustainability of public transport. These measures include in particular the following:

- A strategy should be formulated for reorganizing the public transport system and restructuring and expanding the public transport route network. This would include a transition from individually-owned minibuses without service obligations to route-based public transport private operators accountable for providing services according to standards required by the authority. Bigger buses should also be deployed on the main routes and complementary roles defined for the other types of vehicles (minibuses and taxis). Support should be provided to private investors to facilitate the emergence of properly sized, competent, public transport operators.
- The quality of service, comfort and safety should be raised in order to improve the attractiveness of public transport and its responsiveness to the actual needs of users; attention in these regards should be paid to all categories of users including in particular non-captive users and women.
- The current legal framework should be adjusted to make possible a system of competitively bid route-franchises by private operators including exclusive or partly-exclusive rights on defined routes and service obligations.

- The existing over-capacity in the minibus and urban taxi sectors should be reduced and the quality of the fleet improved through increased standards and controls for vehicles and drivers and progressive elimination of the oldest and most poorly maintained vehicles, possibly through an incentive scheme for the owners of these vehicles.
- Strong priority should be given to public transport in the city-centre and on radial axes leading to the city-centre, including through dedicated bus lanes, busways, and priority for public transport at intersections; the creation of a Bus Rapid Transit (BRT) network on the main arteries should be considered.
- Measures, including a social assistance program, should be implemented to ease the transition of the owners and drivers of minibuses and taxis to a more professional and organized public transport system.
- Measures specific to women and persons with reduced mobility should be taken to facilitate their use of public transport (protected bus stops, appropriate facilities at bus stations, regular bus schedules, better coherence between supply and demand, separate space if feasible in the large buses, etc).

***Improvement of the street network, traffic management, parking and pedestrian routes:*** It is possible to substantially reduce traffic congestion in Sana'a through a judicious combination of soft and hard measures. These include in particular the following:

- A proper functional road hierarchy, clearly attributing to each road or road segment a specific function and specifying technical requirements for each hierachic level as well as a traffic circulation plan integrating both private cars and truck traffic, should be designed and put in place urgently in Sana'a. Concrete actions that could be proposed in the circulation plan include the designation of one-way streets, the identification of pedestrian streets, principles for controlling the volumes of cars entering saturated parts of the city, car-restricted and traffic-calmed zones, the creation of public transport corridors with dedicated public transport lanes and priority at intersections, and the location and type of management of parking spaces.
- An intersection management and signalling strategy should also be implemented. It would define what combination of geometrical layout and operating principles (presence or absence of traffic lights, type of signal programming, priority for specific routes or means of transport, etc) are best suited for each intersection. Its implementation would require investments far higher than currently planned in Sana'a's Immediate Action Plan.
- An asset management system should be put in place to record and monitor the condition of streets and related infrastructure, and maintenance should be given priority over other expenditures.
- A parking policy should be developed, limiting in particular parking violations, reducing parking time in busy commercial streets, and establishing parking tariffs with a view to better align the private and social costs of car use. Private investment in off-street parking should be encouraged.
- Enforcement of traffic rules should be improved drastically.
- The importance of pedestrian movements should be recognized in Sana'a, including in particular through the definition of proper standards and the implementation of a pedestrian route network limiting detours and offering safe crossing possibilities for all, continuous walking infrastructure, and adequate lighting at night. The special needs of children, women, and persons with reduced mobility should be recognized and catered for.

**Increasing and re-directing funding:** As cities grow and become more complex, increasing financial resources must be devoted to their urban transport systems. The benefits generated by these resources are very large, however, in terms of productivity, quality of life, and better access for the poor to public services and economic opportunities. This applies very much to Sana'a. In this context, the following measures, in particular, are recommended.

- It will be essential to provide appropriate funding to the municipal department in charge of transport planning, public transport, and traffic engineering for its operating expenses and for the numerous studies which will be needed in the near future. Substantial funding will also be needed for training and capacity development.
- Funding for investments should be distributed in a more balanced manner between the different modes of transport. Greater priority should in particular be given to the development of public transport infrastructure as well as to traffic management, improving the operations of intersections, and maintenance of assets.
- Private investment in public transport services should be encouraged through measures making the sector more attractive, including a clear and predictable regulatory framework, the reduction of excess capacity, a transition to a system of route-franchises, and fair and consistent enforcement of regulations.
- Given that very significant investments will be needed for a long period of time with benefits accruing to the economy of the entire country, most of the funding for the development of Sana'a's urban transport system will have to come from the central government. International donors have an important role to play in supporting the central government in this.

# **Republic of Yemen**

## **Review of Urban Transport in Sana'a**

### **I. INTRODUCTION**

1. Yemen, the fastest urbanizing country in the Middle East and North Africa Region, has a very limited natural resource base and the efficiency of its cities is therefore essential for its future economic growth. However, this efficiency is increasingly handicapped by the poor performance of urban transport, especially in the capital Sana'a.

2. In this context, at the Government's request, the World Bank has prepared a review of urban transport in Sana'a, with the following objectives:

- improving the understanding of the Government and the Bank of key urban transport issues in Sana'a;
- identifying practical measures that should be implemented as a priority, possibly under World Bank financing, in order to improve the efficiency of the transport sector.

3. This report presents the main findings of this review and makes key recommendations to improve the efficiency of urban transport in Sana'a. It contains the following chapters:

- a first chapter presents the general context of the study, characterized by fast demographic and spatial growth in Sana'a, causing major difficulties in terms of urban transport management;
- a second chapter analyses and describes the main underlying issues affecting the performance and efficiency of Sana'a's transport system;
- a third chapter presents institutional, technical and financing recommendations to improve the performance of Sana'a's transport system ;
- a fourth chapter presents a tentative three-year action plan for implementation of the recommendations.

## **II. BACKGROUND AND GENERAL CONTEXT OF THE STUDY**

### ***The problem at a glance.***

4. During the last decades, the city of Sana'a has experienced very high population growth and rapid spatial expansion. These two phenomena have caused serious problems in terms of urban management in general. They have had a negative impact on urban planning and on the efficiency of the transport system unable to cope with the growing demand for mobility. Forecasts show that the growth rate of Sana'a's population should remain very high in the future (about 5% annually), further fuelling the city's spatial expansion. In its current form, the performance of the transport system represents a handicap in the short term and a severe threat in the long term for Sana'a's ability to work as an engine for the entire economy of the Republic of Yemen.

***Sana'a has experienced extremely high population growth in the last decades, and will keep growing at a sustained pace in the coming years.***

5. During the last decades, Sana'a has experienced population growth rates exceeding 10% per year at times, and about 6% on average in the recent past. The main causes of this have been the growing economic prosperity, the transformation of society, the rural to urban migration that they both generate, and the high birth rate.

6. According to the population census, Sana'a counted around 1,8 million inhabitants in 2005. However, these data are probably very approximate and, according to some experts (e.g. Stadnicki, 2008), underestimated. In fact, Sana'a probably reached a population of 2 million inhabitants a few years ago. The following table shows Sana'a's growth since 1970.

**Table 1 Evolution of the population of Sana'a – data from selected population census**

Year	Population
1970	70'000
1975	130'000
1996	1'120'000
2000	1'490'000
2004	1'750'000
2005	1'830'000

*Source : Statistical Yearbook, Ministry of Planning and International Cooperation*

7. According to population forecasts, Sana'a should keep growing at a sustained pace in the short and medium term. For instance, the Comprehensive Traffic Management Study for Sana'a City (CTMS), carried out by Team International, based its projections on an annual average growth rate of around 4% for the period 2004-2024. This would bring the population to 2.85 million inhabitants in 2014, and 3.83 million inhabitants in 2024, an increase of more than 2 million over 20 years.

***Sana'a's population growth has resulted in a fast and largely unplanned spatial expansion, deeply changing the historic urban form of the city.***

8. From an old compact urban core, the old town of Sana'a, the city has expanded rapidly since the 1960's, first following a radio-concentric pattern (1970-1985), then radially along a system of long avenues (1985-today). This spatial growth of the city has been constrained by important topographic obstacles West and East of Sana'a, inducing a longitudinal development along a North-South axis of 40km (for a width of around 10-12km). This urban expansion has been largely unplanned and uncontrolled by public authorities, and has mainly been directed by the strategies of private actors, resulting in the development of numerous spontaneous, or informal, settlements.

***The spatial structure and organisation of Sana'a has significantly changed with its urban growth, and there are signs of transformation towards a multipolar organisation with the emergence of a network of new secondary centres.***

9. Sana'a's current urban structure can be described with the following main elements<sup>1</sup> :

- the city-centre, composed of the old town (only around 5% of the total built surface) and of the adjoining old Ottoman and Jewish areas of Bîr al-Azab and al-Qâ : according to R. Stadnicki, the old town is progressively losing some of its service functions (administration, education, ...) and upper class residents, attracted by new residential neighbourhoods, but its tourist function is being reinforced. The district of Bîr al-Azab concentrates both residential and administrative functions (embassies, national and municipal administrations) ;
- around the city-centre, a very dynamic and large urban belt with high building and population densities: this multifunctional zone concentrates many retail and commercial activities, placed along major arterials and forming a set of linear shopping corridors (notably al-Zubayri and al-Mughni street). It corresponds approximately to the urban area located between the city-centre and the Sitteen Road, the current outer ring road of Sana'a. According to R. Stadnicki, this sector is composed of three major neighbourhoods, Hasaba (North), Shumayla (South) and Hayîl (West), characterized by intense commercial activities organized around dynamic markets;
- beyond Sitteen Road, an area of recent urban extensions, organised around several new and emerging centralities (e.g. Asir, Dar Salm, Madhbah, Hadda) : most of the time developed around markets (regrouping in some cases 400 to 500 merchants) and transport nodes, these new centers concentrate economic activities and services. For R. Stadnicki, this network of secondary centers is a sign of the mutation of Sana'a towards a multipolar organisation.

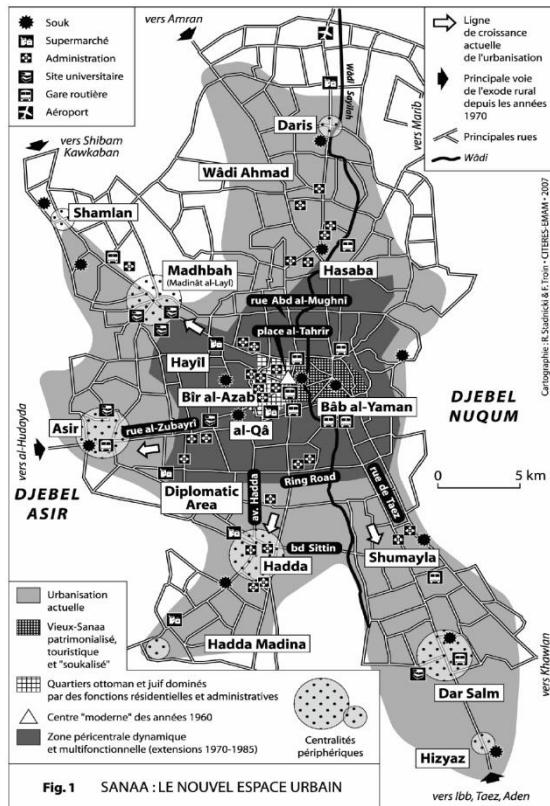
***There is a lack of information about the location of jobs, economic activities and services in Sana'a.***

10. Unfortunately, no statistical data are available about the spatial distribution of economic activities and jobs in Sana'a. Moreover, there is no comprehensive inventory of the location of services. According to R. Stadnicki, all the main centres are equipped with markets, health services, schools and universities. Public universities are located in Hayîl and Madbah, and private universities are located in Madbah and Dar Salm.

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<sup>1</sup> Stadnicki R., "The Greater Sana'a : multipolarity and new forms of urbanity in the capital of Yemen", *Annales de Géographie*, vol.1, n° 659, p. 32-53, 2008. Roman Stadnicki is a PhD student in Geography at the University of Tours, currently writing his thesis about Sana'a's urban development. He has published many scientific articles about the city's spatial dynamics and was attached to the CEFAS, the French Center in Sanaa for Archaeology and Social Sciences, in 2006.

**Figure 1 The new urban structure of Sana'a**



Source : Stadnicki R., 2008, *The Greater Sana'a: Multipolarity and New Forms of Urbanity In the Capital of Yemen*, Annales de Géographie, 659, pp. 32-53.

***With continued spatial expansion and demographic growth, the distribution of population will change significantly in the short and medium term.***

11. According to CTMS, the spatial distribution of Sana'a's population should change much in the future, with stronger expansion in the areas located beyond the current outer ring (Sitteen road) than in the areas located inside this ring.

12. In 2004, the distribution of the population was the following:

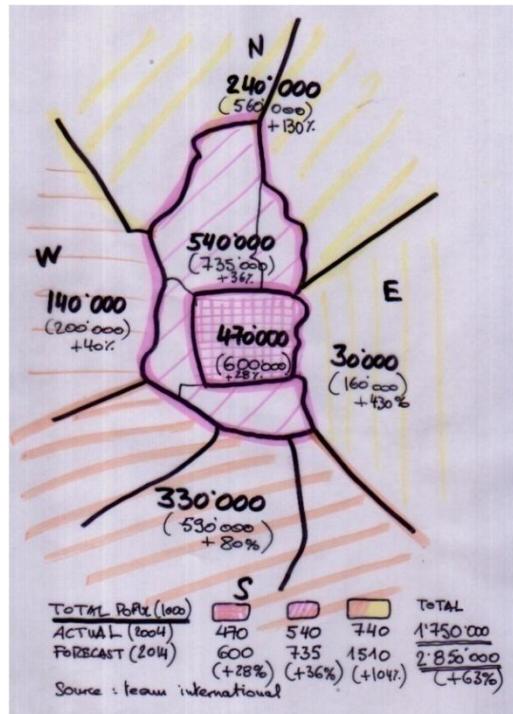
- 470'000 residents in a very dense city centre (more than 300 residents per ha), inside the inner ring road (corresponding to 27% of the total population);
- 540'000 residents in the immediate periphery of the city centre, between the inner and the outer ring road (31% of the population);
- 740'000 residents beyond Sana'a's current outer ring (42% of the population).

13. These numbers show that in 2004, more than 1 million residents, corresponding to more than 50% of the population, lived inside Sitteen road. However, population forecasts for 2014 and 2024 indicate that the distribution will shift as follows:

- 600'000 residents in the city centre (+28%), bringing its weight down to 21% of the total population ;

- 735'000 residents between the inner and the outer ring road (+36%), bringing its weight down to 26% of the population ;
- 1'510'000 residents beyond Sana'a's outer ring (+104%), bringing its weight up to 53% of the population.

**Figure 2 Current and future (2014) distribution of Sana'a's population**



Source : CTMS, March 2007, Final Report.

14. Concerning population forecasts for 2024, they show the following results:

- 650'000 residents in the city centre, bringing its weight down to only 17% of the total population ;
- 810'000 residents between the inner and the outer ring road, bringing its weight down to 21% of the population ;
- 2'370'000 residents beyond Sana'a's outer ring, bringing its weight up to 62% of the population.

15. These numbers show that the areas of Sana'a located inside the limits of Sitteen road will still grow significantly in the coming years (+40% to +50% forecasted in the 2004-2024 period). However, much of the growth will take place beyond the outer ring road, with a population that could more than triple between 2004 and 2024. Even if these numbers are approximate, they highlight a serious challenge for the mobility of tomorrow.

***As in many cities in developing countries including the MENA region, a majority of trips are made with public transport modes in Sana'a. However, the motorization rate is relatively high given the level of income, and should increase significantly in the future.***

16. Data about motorization or mobility behaviour in Sana'a are extremely poor, and statistics about the transport system suffer from an absence of historic data. Although CTMS has provided some data, they are still approximate, and should be only used as a rough guide.

17. For instance, the number of private automobiles in Sana'a is not reported. As a consequence, the motorization rate of the population can only be estimated from survey samples (2339 households surveyed by CTMS), considering the average number of cars per household (0.59) and the households average size (5.14 persons). This gives an approximate motorization rate of 115 cars per 1000 inhabitants, which is unexpectedly high compared to other developing cities like Cairo (68 cars per 1000 inhabitants) and Algiers (83 in 2004), but is close to cities like Tunis (100 in 2002), Casablanca (110 in 2004) or Istanbul (134 in 2006)<sup>2</sup>. Considering Sana'a's current population of 2 million inhabitants, it can be estimated that the number of private cars in the capital of Yemen is over 200'000. This figure should grow significantly in the future, following the general trend of rapid growth of motorization rates in developing cities, and considering demographic forecasts for Sana'a. If the sole demographic factor is taken into account, Sana'a should count around 450'000 cars in 2024, for a forecasted population of 3.83 million residents. As a result, the pressure on the road network will be intensified in the coming years.

18. Information about the respective share of the different modes of transport in urban trips in Sana'a is also approximate. However, the CTMS studies showed a high share of collective transport modes in traffic. On average, they represent 40% of vehicles, including microbuses (6%), minibuses (12%), standard and tourist buses (2%) and taxis (19%). Private cars represent 33% of vehicles in traffic, and trucks 25%. World Bank consultants have used CTMS traffic counts by type of vehicles to estimate the modal split in terms of persons, considering the average occupation rate of vehicles. This analysis has confirmed the weight of collective modes, with an approximate share of 60% of persons transported crossing the external cordon of the city (marked by Sana'a's outer ring road). Private cars represent about a quarter of persons transported, and trucks 15%.

19. The dominant weight of collective modes in motorized trips is characteristic of many developing cities and of many cities of the Middle East and North Africa region (MENA), as can be seen on the following figure. Very high shares of trips by collective modes are indeed recorded in Algiers (70%), Cairo (74%), Casablanca (61%), Istanbul (64%), Tunis (50%) or Teheran (59%).

20. Unfortunately, no data are available about the share of trips made by walking in Sana'a. However, trips by foot probably play a very important role in the transport system, as, and probably more than, in many developing cities. In Casablanca, for example, walking represents 54% of urban trips<sup>3</sup>. In Dakar (Senegal), walking represents 73% of trips, and in Conakry (Guinea) 65%<sup>4</sup>. Considering these elements, it is realistic to estimate that walking represents 50% to 75% of trips.

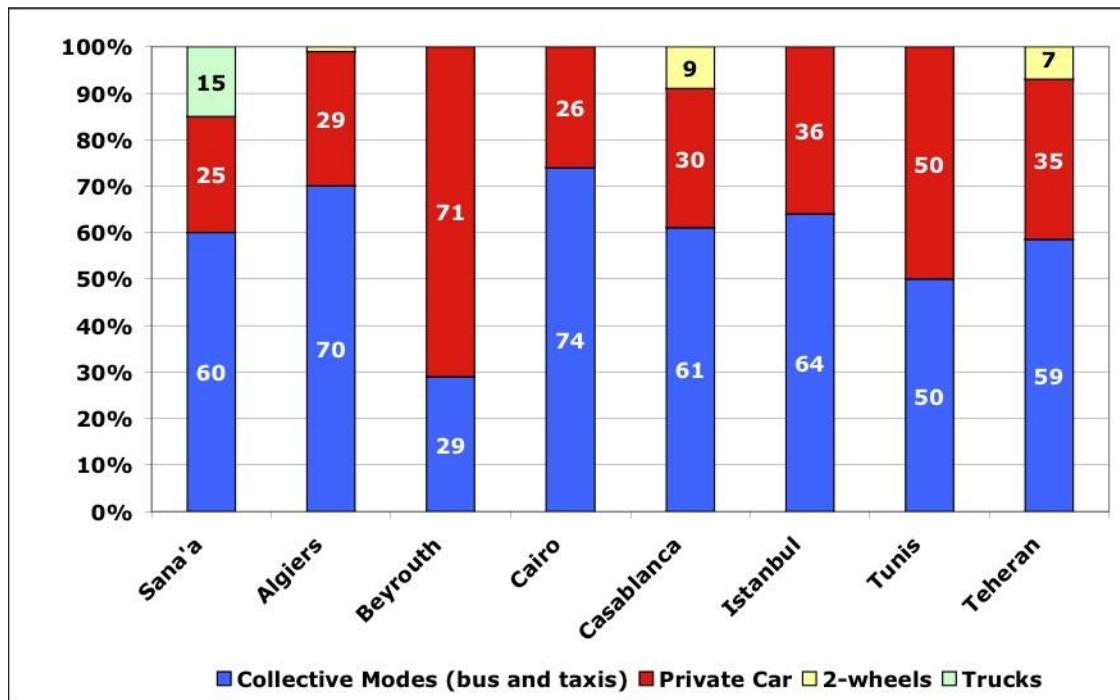
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<sup>2</sup> Source : CODATU, 2008, Urban Transport in the Mediterranean Region : Guidance and Recommendations.

<sup>3</sup> Source : World Bank, 2008, Royaume du Maroc, Secteur des Déplacements Urbains : Note de Stratégie Sectorielle.

<sup>4</sup> Source : CERTU, 2008, Stratégie de mobilité durable dans les villes des pays en développement : Guide pédagogique.

**Figure 3 Comparison of modal split in different MENA cities (walking trips not considered)**



Source : CODATU, 2008, *Urban Transport in the Mediterranean Region : Guidance and Recommendations*, data based on household surveys and traffic counts.

***There is a gender dimension to urban transport in Sana'a, which has not yet been taken into account***

21. Roads and public transport play a central role in urban life, and even more so in large cities such as Sana'a. In order to understand the impact of transport on urban women, a study was conducted in the spring of 2009 by the Yemen Center for Social Studies and Labor Research under World Bank financing. 540 individuals were interviewed in nine neighborhoods of Sana'a, and some thirty focus group discussions were conducted. The study found that women rely mainly on walking and public transport for city trips. Indeed, women's use of private means of transport (including especially cars) is limited for social and economic reasons. Data collected showed that the proportion of working women among interviewees is directly related to the provision of better urban infrastructure such as sidewalks, bus terminals, and street lighting. The highest rate of working women (15%) was observed for the old Sana'a neighborhoods, where streets are paved, sidewalks exist, street lighting is reliable, public transport terminals are close by and there are even pedestrian crossing facilities on one of the major axes. The rate is at its lowest for the peripheral neighborhoods (8%), where road infrastructure is of bad quality, public transport is hardly accessible, and lighting does not exist. Female interviewees highlighted the importance of road infrastructure and especially street lighting for making trips possible as and when needed.

### **III. MAIN ISSUES**

22. Sana'a's urban transport system suffers from considerable problems affecting its performance and efficiency. These problems include the weak institutional and strategic framework (urban transport planning and management), the poor organisation and management of public transport, the lack of traffic management and parking policies, and finally the insufficient and unbalanced financing of urban transport. These problems are described below.

#### **A. Institutional obstacles and strategic weaknesses**

*Responsibilities for urban transport are split between different public institutions and there are no coordination mechanisms*

23. Since 2000, with the adoption of Law No. 4/2000, Yemen has initiated a decentralization process and established the structure of local administration in the country. In the case of Sana'a, local government responsibilities are carried out by the Capital Secretariat (Municipality of Sana'a), which, in particular, is in charge of transport projects and urban planning through its Department of Technical Affairs. The Capital Secretariat became responsible for roads within Sana'a in 2003, taking over from the Ministry of Public Works and Highways. However, responsibility for public transport has remained with the central government and is split between the Ministry of Transport (general policy, regulation, vehicle standards) and the Ministry of Interior (vehicle registration and route licensing). There is no official coordination mechanism between these entities.

*There are major institutional gaps particularly in transport planning, public transport regulation, and traffic management*

24. There is no organisation in charge of developing a comprehensive urban transport strategy for Sana'a and monitoring its implementation. As a result, the planning and management of the transport system largely consists of a project based approach, lacking a comprehensive vision as well as clear objectives, and favouring short-term local remedies allowing temporary improvements or limiting damage, but without considering their long-term consequences and their impacts on the whole transport system. In the absence of a planning function for urban transport, there cannot be any coordination between urban development and urban transport despite its importance.

25. The fully liberalized public transport system operates in an institutional vacuum, without any appropriate service planning, without service requirements for the operators, and without effective control of vehicle safety and emission standards. There is a strong informal institutional and regulatory structure but it poorly takes account of the needs of the public.

26. There is no unit with the capacity to organize and manage traffic and formulate appropriate parking policies for Sana'a. This deficiency is well illustrated by the outdated and unsuitable traffic control devices whose programming has not been retimed since they were installed, and by the chaotic parking situation on the main arteries.

27. The capacity for enforcement of traffic regulations is not sufficient. The traffic police, from the Capital Secretariat Traffic Department, is currently used to supervise and control operations at intersections, whether they are controlled by traffic lights or not. But it is clearly overwhelmed by the scale of traffic problems and it also cannot deal with parking issues.

28. Public awareness of the impact of general behaviour on traffic congestion, road safety or the environment is low. There is also no understanding that better policies and management would lead to major improvements in the performance of the system.

***Underlying these problems is a major shortage of transport planning and traffic engineering skills in Yemen***

29. Urban transport has never been seen as a separate academic and professional discipline in the past. Given the institutional gaps, there has also never been any incentive for the discipline to emerge as an important field of activity. As a result, there are very few professionals with expertise in urban transport in Yemen. There are also no professional networks and no means to acquire or update knowledge and information. The teaching of urban transport at the University is very limited.

***The Comprehensive Traffic Management Study (CTMS) for Sana'a City, setting the guidelines of the capital's future transport policy and traffic management, is not a comprehensive multimodal strategy, and offers only a partial answer to Sana'a's transport problems.***

30. The CTMS has set directions the city's future urban transport policy and traffic management, and some of its recommendations are already being implemented, notably the development of grade separated intersections. Considering the pre-existing lack of data in Sana'a, and the acuteness of the capital's urban transport problems, it is an important contribution towards a more effective urban transport system. for the following reasons:

- the data collected since 2004 are reliable and give a good, although not comprehensive, basis for the studies that will be needed for future transport strategies, policies and measures ;
- the analysis conducted for each means of transport are good. With the relevant analysis of the existing institutional problems, they give a sound diagnosis of the current situation and issues.

31. However, the CTMS study suffers from having followed what can be called a "classic" urban transport planning process:

- if the analyses for each means of transport are good, there is a lack of transversal, multimodal analysis. The diagnosis that has been made is too "mono-modal", and does not consider the various means of transport simultaneously nor takes into account their respective roles and the way they complement each other ;
- interesting short term, medium term and long term actions are proposed by the CTMS for each mode of transport (private cars, public transport, pedestrians). Nevertheless, there is no real multimodal urban transport concept as a basis for the identification and selection of actions;
- the interactions between proposals are not clear. Priorities should be reviewed and settled, according to the role that each mode of transport has to play in the transport system as a whole, and there should be a consensus on these priorities among all concerned stakeholders;
- in the absence of a concept, choices and proposals focus mainly on the improvement of the road network. However, there is a risk that this excessive focus on roads and cars, while bringing temporary positive effects, will have serious negative impacts in the future, such as urban sprawl, low density of development, and car dependence;
- the CTMS study might suffer from an over-reliance on traffic modelling. All the propositions made by the study result from a substantial traffic modelling effort, but a critical discussion of the proposals, notably from a strategic or sustainability point of view, is missing;
- proposals concerning public transport seem to be limited and directed by the fear of disturbing

traffic, and their relevance is hardly demonstrated. The choice of the Saylah right of way for the implementation of a Bus Rapid Transit (BRT) and the proposed marking of exclusive bus lanes on Sitteen road, two roads where the integration of public transport does not present strong difficulties, illustrates this tendency.

## B. Public transport issues

32. In a fast growing city like Sana'a, with a high number of captive non-motorized residents, public transport plays an essential role. In the future, considering the expected development of the capital, and despite a likely important increase of the motorization rate, public transport should play an even more strategic role and be a key element of the city's transport management policy.

33. However, public transport in Sana'a suffers from a range of weaknesses affecting its efficiency and its attractiveness. It also has negative impacts on traffic and the environment. This chapter describes the main underlying issues<sup>5</sup>.

### ***The public transport industry structure is highly fragmented and lacks regulation.***

34. The urban public transport industry in Sana'a is highly fragmented, with the predominance of individually owned small size buses, and the absence of any operator possessing a substantial fleet of vehicles. In fact, the whole public transport system relies mostly on the informal sector, including for the planning and delivery of the service, and there is only minimum regulation and no strategic vision. This organisation, as ingenious as it is, has negative impacts on the efficiency and quality of public transport, and on its ability to fulfil present and future mobility needs, as can be illustrated by the analysis of the two following dimensions :

- *Traffic operations:* public transport vehicles receive a route licence allowing them to operate on a single fixed route. However, the licence does not impose any service obligations. As a consequence, there are high variations (from day to day or depending on time) regarding the number of vehicles operating on each route, the frequency and the capacity of service;
- *Service Planning:* there is a total absence of a proper public transport service planning in Sana'a. There is no process to monitor demand or supply nor to change the network or services in response to changes in demand.

### ***The public transport network is ill-adapted to customers' needs and characterized by significant gaps in terms of territorial coverage.***

35. Sana'a's public transport network's structure is unpractical for passengers making long trips. It is indeed composed of 43 to 61 routes, depending on sources of information, radiating from seven main terminals, and with many routes sharing the same street. Most of these routes are short, and cross-city routes are rare, making the system unfriendly for passengers making long trips, who, as a result, need to transfer from one line to another line. Moreover, there are significant gaps in terms of network coverage, for example in the north-west zone of the city, where extensive areas of the suburbs lack adequate service coverage.

36. As shown by the study mentioned in Section II above, in suburban neighborhoods, men and women have to walk long distances without lighting to reach a major artery where public transport is

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<sup>5</sup> It is based on the report prepared by Mr. Richard Meakin for the World Bank in July 2008 and on elements gathered during Transitec's field visit in Sana'a in November 2008.

available. Waiting time is not predictable and sometimes substantial, and because transport means are scarce, costs are high. Unreliability of public transport and its cost makes it difficult for women to seek a paid job, although their household may need it.

***The public transport fleet is composed of an abundance of old low-capacity vehicles accounting for a large share of traffic, which is an inefficient way to use limited road space.***

37. Public transport services in Sana'a are provided by a large fleet of micro- and minibuses of three different sizes :

- 7-seater microbuses, or Dabab, with 4'000 to 7'000 vehicles, depending on sources;
- 12-seater minibuses, or nuss-bus, with 5'500 to 7'300 vehicles;
- 24-seater bus, or coaster, with around 700 vehicles.

38. This heterogeneous fleet of vehicles is unsuitable for the needs of a city of the size and with the growth rates of Sana'a, and is an important source of traffic congestion and pollution. In addition, most of the buses are very old, in poor condition, polluting, unsafe and uncomfortable. As a consequence, they have a very negative impact on the environment and they are unattractive to non-captive users.

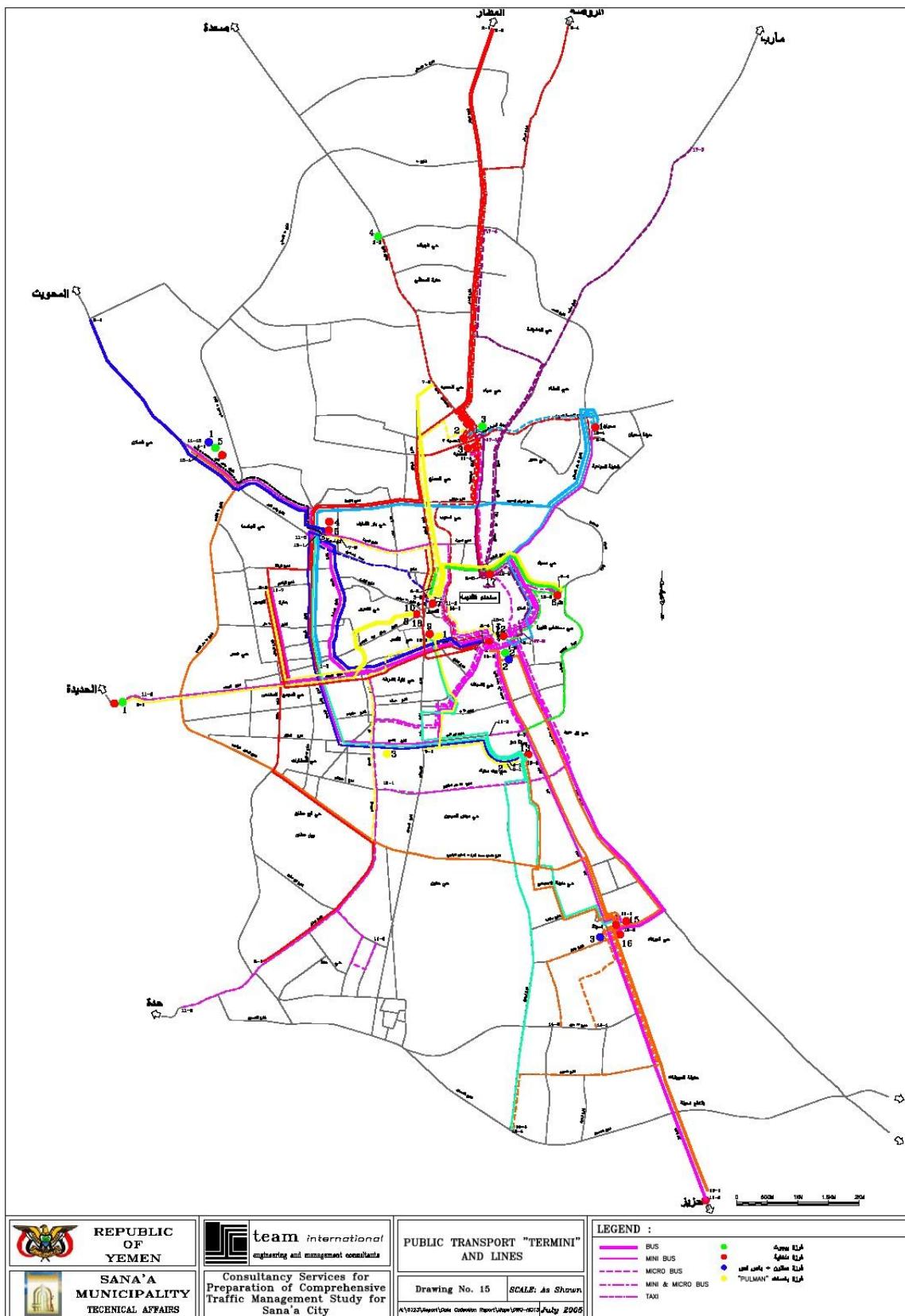
**Table 2 Fleet of buses in Sana'a, by type of bus and according to different sources**

Type of bus	2005 Annual Report of Traffic Department	CTMS Public Transport Survey
Microbus (Dabab)	7'000	4'000
Minibus (Nuss-bus)	7'300	5'500
Bus (Coaster)	700	700
Total	15'000	10'200

39. In addition to the bus network on fixed routes, thousands of taxis are available in Sana'a. According to the data of the Traffic Department, there is an estimated number of 33'000 taxis in the metropolitan area of Sana'a. This shows an excessive supply. Indeed, it has been observed that many taxis operate empty, contributing significantly to traffic congestion and air pollution. Despite the introduction of a fleet of new cars with a radio-dispatched and metered taxis service, with the launching of the Raha Taxi Company in 2006, most of the vehicles remain extremely old and often in poor technical condition, making them unfit for service.

40. The abundance of low-capacity vehicles is inefficient in terms of street capacity consumption, and precious road space could be saved with higher capacity vehicles. As shown later (paragraph 49), in Sana'a central area, within the inner ring road, between 40% and 60% of the traffic is usually comprised of taxis and buses. This is an exceptional situation even by comparison to most least developed countries.

Figure 4 Sana'a's public transport "termini" and lines



## **C. Problems concerning the road network, traffic management, parking, and pedestrians**

41. Sana'a suffers from severe malfunctions in terms of road network, traffic management and parking policy. This chapter describes these various problems, after a short presentation of the road network structure and of present traffic demand and structure.

***Sana'a's road network is quite well developed and structured around a system of radials and ring roads supplying high traffic capacity (4-8 lanes). Numerous and costly grade separated intersections have been (or are being) built at key intersections.***

42. Sana'a's road network is characterized by the following main elements:

- a historic external radial network which structured urban development: most of these radials present high capacity, being 4-lanes roads and even often 6-lanes roads. However, these streets suffer from a non uniform width and from several bottlenecks along their alignment;
- an inner ring road, or Daiiri, surrounding the city centre: this ring road is characterized as well by a non-homogenous width and by a number of lanes varying between 4 and 6;
- an outer ring road (Sitteen Road) currently under improvement: this ring road offers very high capacity with a number of lanes varying between 6 and 8. However, it is not a complete ring road, since topographic reasons have prevented its development on the East of Sana'a;
- a substantial, and maybe too important, network inside the inner and the outer ring roads, attracting traffic to the city centre because of the high capacity of some roads and the presence of numerous grade separated intersections easing fluidity of traffic, in particular at intersections between the Sitteen road and major radials.

43. Finally, the authorities of Sana'a have planned important developments of the ring roads system, mainly with the construction of a third ring road, partially underway.

***Despite its high capacity, the road network inside the inner ring road is largely saturated by traffic, mainly because of poor traffic management and drivers' lack of discipline.***

44. Traffic volumes are generally important on Sana'a's major roads. However, they differ depending on the type of roads and their location :

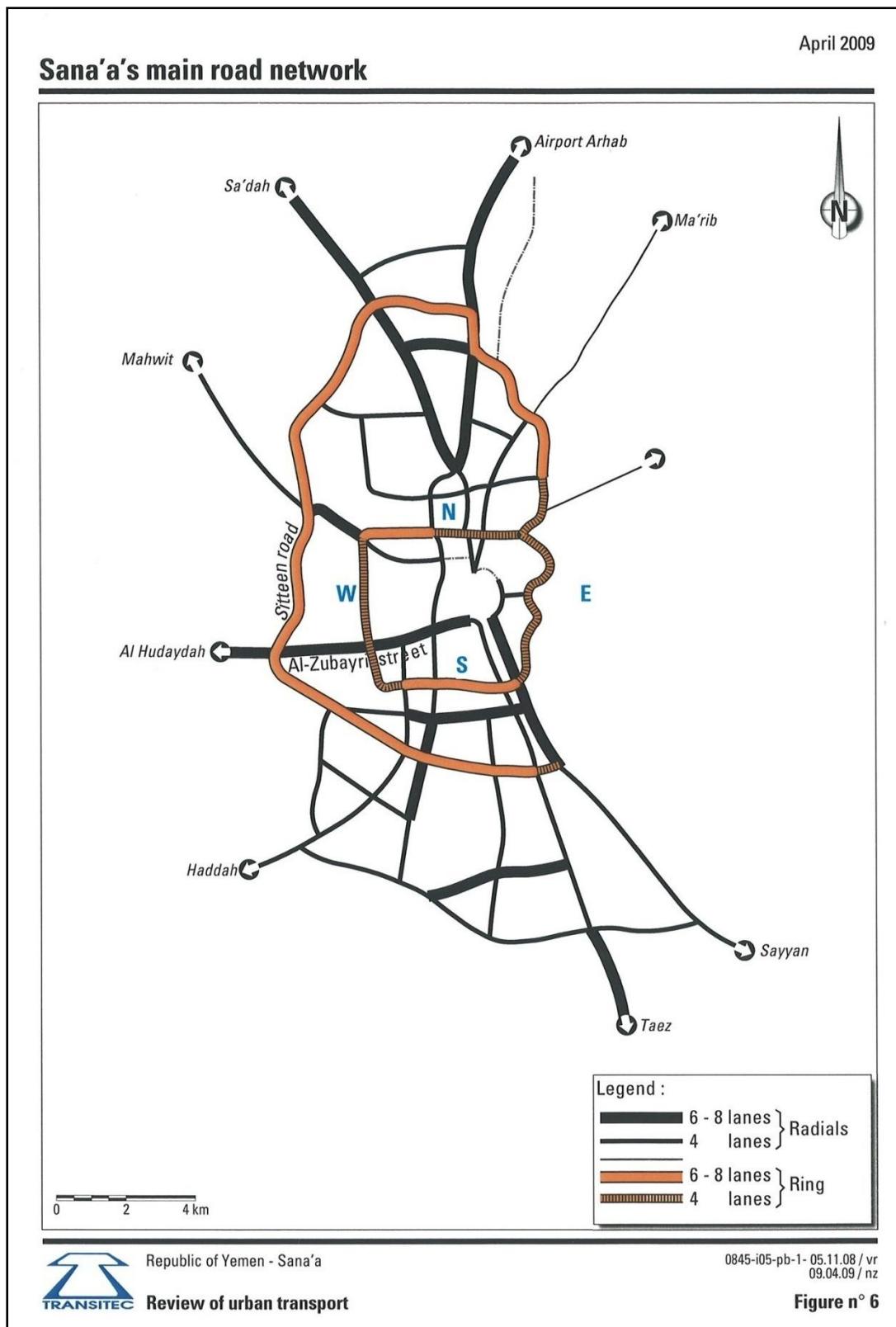
- exterior radials carry high amounts of traffic volumes: this is particularly the case of Taez Road, with 40'000 vehicles per day, of Demascus Street, connecting the city centre and Haddah, with 45'000 vehicles per day, or of the road to Mahwyt, connecting the city centre with the important area of Madhbah ;
- radials carry sometimes even higher amounts of traffic volumes inside of the outer ring road (Sitteen Road): this is for instance the case of Yakreb Street, with 52'000 vehicles per day ;
- the outer and the inner ring roads present comparable traffic volumes in absolute terms (between 27'000 and 38'000 vehicles per day on Sitteen Road, between 16'000 and 40'000 vehicles per day on the Daiiri) ;

- finally, very high traffic volumes are recorded inside the inner ring road: this is especially the case of al-Zubayri Street, crossing the city-centre from West to East, with 43'000 vehicles per day, and of Qiyada Street, crossing the city-centre from North to South, with 30'000 vehicles per day.

45. Analysis of traffic volumes per traffic lane highlights traffic flows relative to capacity of roads. It gives a much more contrasting image and shows profound differences in capacity use. Indeed, it appears that the inner ring road and some major radials are comparatively and relatively far more loaded than the outer ring road :

- the inner ring road and some major radials (Taez Road, Demascus Street, Yakreb Street or the road to Mahwyt) present traffic volumes per lane exceeding 8'000 vehicles per day: considering the lack of discipline of drivers (notably double parking practices) in Sana'a and the inappropriate traffic management in the city (inadequate management of intersections, lack of road hierarchy), the daily capacity of a lane doesn't exceed 8-10'000 vehicles per day. In other words, these roads are close to their limit of capacity ;
- to the contrary, the outer ring road (Sitteen road) is far from its limit of capacity, with maximum volumes of 4-6'000 vehicles per day, and even less than 4'000 vehicles per day on some sections.

Figure 5 – Sana'a's main road network



***Despite its important remaining capacity, the outer ring road (Sitteen road) is not sufficiently used as a bypass for trips with an origin and a destination in the city-centre. This bypass function could be optimized in order to reduce traffic flows in the city-centre.***

46. In order to understand the functions played by the outer ring road, a comparison was made between traffic flows reaching the outer ring from outside (crossing a cordon placed outside the outer ring), and traffic flows reaching the outer ring from inside (crossing a cordon placed inside the outer ring).

47. Results show that between 330'000 and 360'000 vehicles cross the outside cordon everyday, with 300'000 to 320'000 vehicles crossing the inside cordon. This difference between traffic crossing the outside and the inside cordons (around 30'000 vehicles per day) shows that, without considering traffic using the outer ring for trips between its internal and its external side, more traffic uses Sitteen road for external trips (origin and destination located outside the outer ring) than for internal trips (origin and destination located inside the outer ring). This reveals a non-optimal use of Sitteen road as a bypass for internal trips. More precisely, the following observations can be made:

- the ring receives 15'000 more movements (30'000 vehicles divided by two) with an origin and a destination located on its external side, than movements with an origin and a destination on its internal side ;
- the outer ring is not very used for internal trips by drivers, who tend to prefer direct cross-city movements using the road network inside the outer ring. Therefore, there is a large potential to optimize the function of Sitteen road as a bypass for internal trips, in order to reduce traffic volumes on the road network in the city-centre.

▪ Figure 6 - Daily traffic volumes on Sana'a's main road network

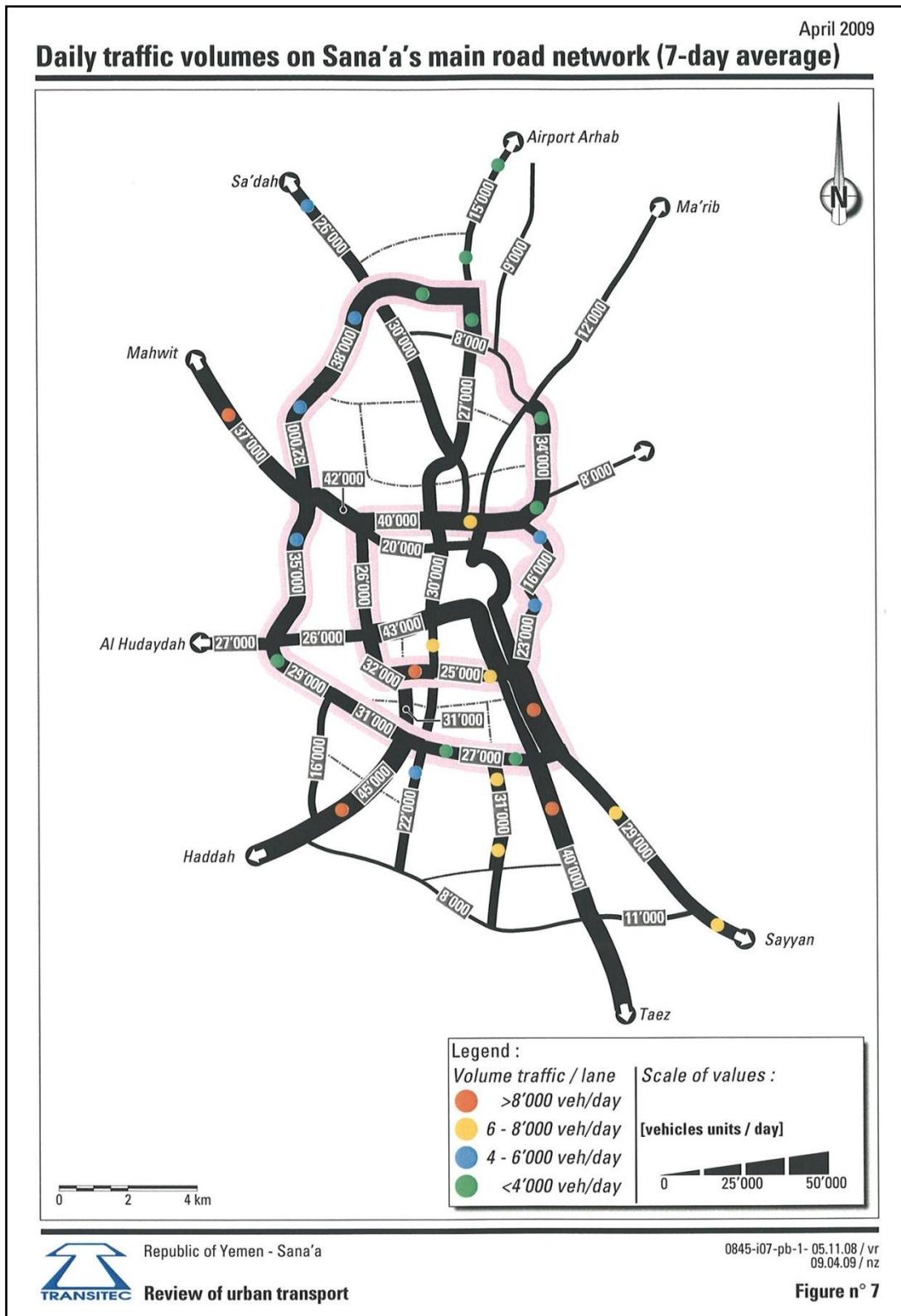
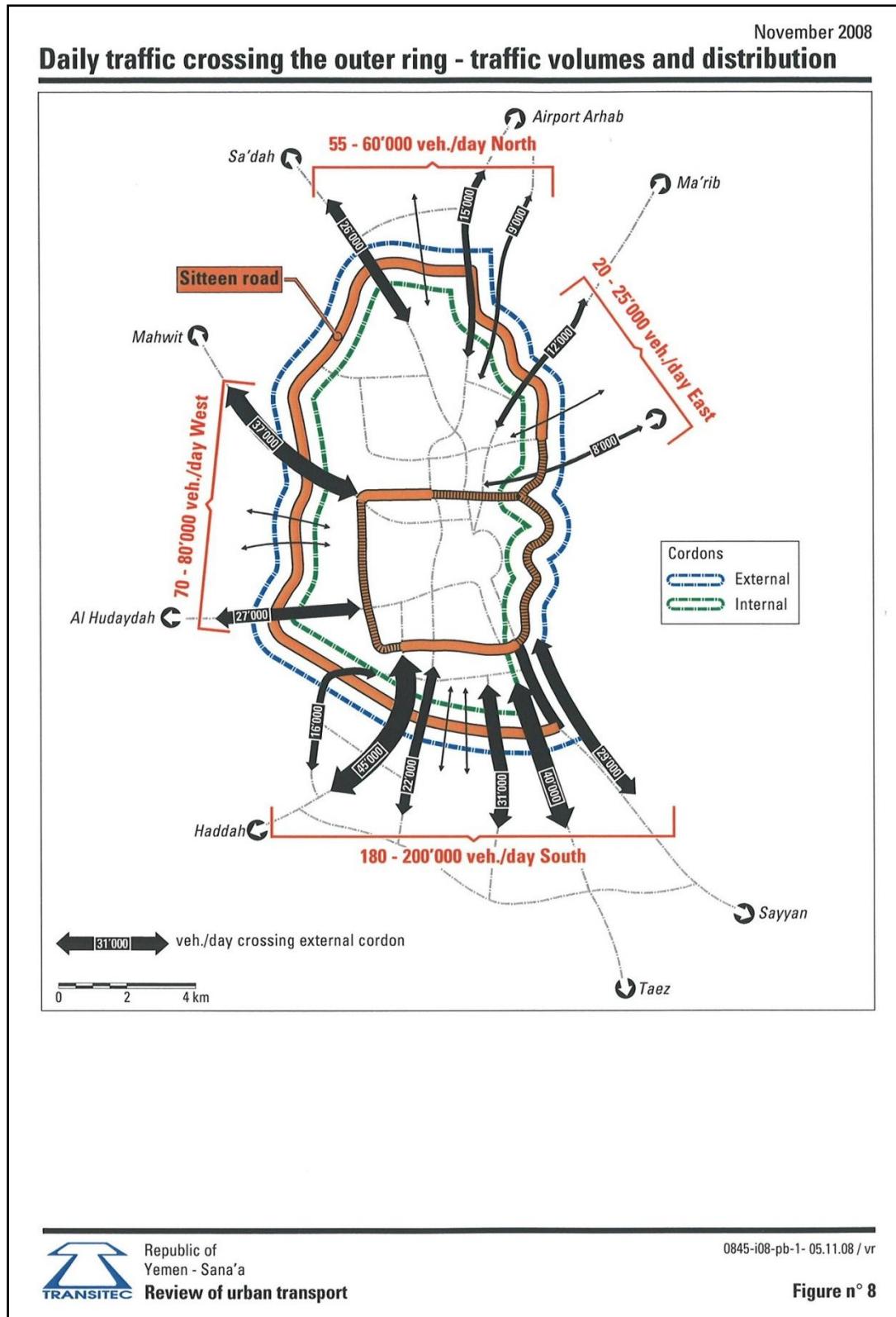


Figure 7 – Daily traffic crossing the outer ring – traffic volumes and distribution

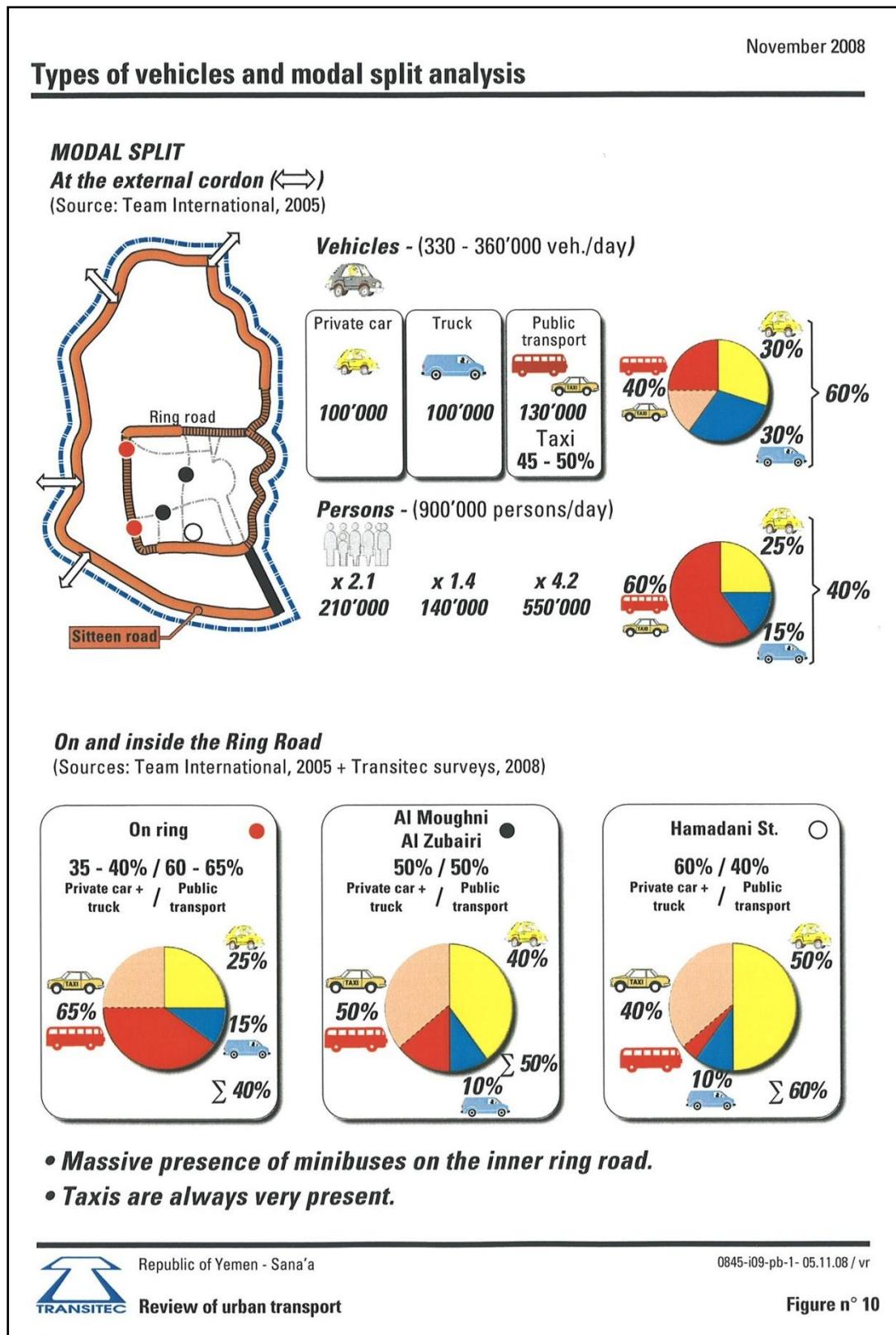


***Public transport modes (microbuses and taxis) represent a very large share of traffic flows and have a major impact in terms of congestion.***

48. An analysis of the modal split was carried out at different locations in Sana'a. The following observations can be drawn from this analysis:

- public transport is responsible for a large share of traffic volumes in Sana'a: for instance, among the 330'000 to 360'000 vehicles crossing the external cordon every day, around 40% are minibuses (7-, 12- or 24-seater) and taxis;
- if the number of persons travelling is considered, the share of public transport is even more impressive: indeed, at the external cordon, approximately 60% of persons travel with public transport or taxis. This result shows the essential role played by public transport in Sana'a, and the high demand for public transport trips from a largely non-motorized captive population;
- the analysis of the modal split on and inside the inner ring road shows both similarities and contrasting situations :
  - on the inner ring road, around 65% of traffic is composed of minibuses and taxis, with a massive presence of minibuses (around 35% of traffic), and only 25% of private cars ;
  - on al-Moughni street and al-Zubairi street, two important radials crossing the city centre, public transport still represents around 50% of traffic volumes. However, most of public transport vehicles on these roads are in fact taxis ;
  - on Hamadani street, public transport represents around 40% of traffic volumes, mostly taxis, and private cars are 50% of the traffic.
- all these numbers highlight the very large share of taxis in traffic flows and their major impact on traffic conditions, wherever it is in the city :
  - 60'000 taxis cross the external cordon of Sitteen road everyday ;
  - taxis always represent between 25 and 40% of traffic ;
  - taxis transport on average 1.5 to 2 passengers ;
  - however, a large share of taxis operate empty and cruise in search of passengers: 30% at peak hours, nearly 50% at off-peak hours!

Figure 8 - Types of vehicles and modal split analysis



***Sana'a's road system does not have an appropriate functional road hierarchy, with serious consequences on traffic fluidity and local accessibility.***

49. The design of a road hierarchy, classifying roads according to their specific functions in order to organize traffic at city-level, is an essential tool for traffic management. In Sana'a, an appropriate functional road hierarchy is needed to bring order to an anarchic road system, to optimize traffic management, to reduce congestion and to ease local accessibility.

50. A road network simultaneously serves several functions. In a simplistic view, it has to accommodate through traffic, as well as provide access to districts, streets and properties. A hierarchic road network tends attributes to each road or road segment a specific function and to adapt its layout and exploitation accordingly, with the intention of:

- designing an efficient road system limiting conflicts between through traffic and neighbouring land uses;
- allowing an appropriate level of interaction between the roadway and neighbouring land uses;
- reducing the number of stops and maximizing traffic flows on the main arteries.

51. In Sana'a, many examples can be found of a road system that does not fulfil these two conditions :

- at intersections with grade separations, there is an excessive hierarchy: indeed, local accessibility is poor, because of a physical impossibility to turn left created by the presence of median strips with kerbs (see photo showing the example of the intersection of al-Zubairi street and Sitteen road) ;
- at ground level intersections, functions of the different roads (arterial, collector, local) are not specified nor marked. This is particularly the case inside the inner ring road. As a consequence, in the absence of traffic lights or policemen controlling traffic, there usually are numerous cases of anarchic situations resulting from conflicts between traffic coming from different roads, with serious impacts on fluidity and road capacity.

**Photo 1 Intersection of al-Zubairi street and Sitteen road: example of an excessive functional hierarchy**



***The management of intersections is highly inadequate in Sana'a, provoking delays, security problems and limiting road capacity.***

52. Based on the study team's field observations, it can be estimated that an improved management of intersections could lead to capacity gains of 20% to 30%, depending on the intersection. The following issues concerning the management of intersections in Sana'a can be highlighted :

- there is no traffic control strategy setting priorities and objectives resulting from a general urban transport policy ;
- there is a shortage of signalized intersections and a lot of intersections are not working. Only 27 intersections are equipped with operating traffic signals, equivalent to only around 20% of the intersections surveyed on 6 major corridors, with another 11 intersections equipped with traffic signals that were not working. For comparison, in Johannesburg, a city with a population size close to Sana'a (2.5 million inhabitants), the local authorities are managing and maintaining 1'900 traffic signal controlled intersections, including pedestrian crossings;
- traffic signals in Sana'a run independently as isolated intersections;
- traffic lights in Sana'a are old (10-15 years), and their programming has rarely been re-timed, notably because of the absence of a proper engineering function within the municipality. As a consequence, timing of traffic lights lack flexibility, with fixed timing and no adaptation to daily variations of traffic demand;
- timing of phases and sequencing of the different traffic movements are inappropriate and inefficient. Typically, all movements coming from the same origin are mixed in the same green phase. In particular, there is no specific left-turn phasing. This situation generates significant losses of capacity;
- cycle lengths are extremely long, provoking delays: drivers should wait one minute on average, and often even two minutes, for the next green phase ;
- finally, there is a general absence of lane assignments to the different movements at intersections, with nearly no specific lanes for left-turn or right-turn movements, and too few lane markings.

**Photo 2 A 3-phases intersection on al-Zubairi street (cycle length: 2'10")**



**Photo 3 A 4-phases intersection west of the inner ring road (cycle length: 2'50")**



***Road condition monitoring and road maintenance are neglected***

53. In large cities in middle income countries, the department in charge of the road network often disposes of a data base for recording the characteristics and condition of the streets and key related infrastructure (flyovers, underpasses, lighting systems, drainage, etc). This is not the case in Sana'a. As a result, it is not possible to monitor and study the condition of these important assets and define appropriate strategies for their maintenance. It is also not possible to optimize design of new infrastructure facilities based on the performance of existing ones. Because of this, and also funding limitations, street and infrastructure maintenance is currently neglected. There are visible signs on many older parts of this network that they are in a serious state of deterioration. This neglect will have a heavy cost in the future as streets and infrastructure are bound to need early reconstruction, vehicle operating costs will be unnecessarily high, and traffic may be hampered.

***Road safety is very poor and accidents numerous.***

54. Road safety is a major concern in Sana'a. For instance, it is believed that 40% of all traffic accidents in Yemen occur in the Sana'a region (CTMS survey, 2007, Final report, vol. 1). The main causes of accidents are the following :

- a general lack of proper road safety devices (signing, marking, traffic islands, delineators, etc.) ;
- a lack of consistency in the design and construction of transportation facilities, confusing drivers and increasing the probability of accidents ;
- inadequate road planning: speedways built without integration of the surrounding areas, lack of protection of traffic joining the main road, presence of numerous very dangerous U-turns ;
- a prevailing aggressive behaviour of drivers, combined with a poor respect of driving rules and regulations, due to weak awareness and enforcement.

55. U-turns on major radials and on the outer ring road represent a particularly serious safety problem. Indeed, since it is physically impossible to make left-turns at intersections with grade separations, drivers are obliged to make U-turns 200 to 500 meters away from the intersection, both highly dangerous and negative in terms of traffic fluidity. Lacking adequate protection and organization, these movements against the main traffic flows increase the risks of severe crashes. The

problem is made even worse by drivers encouraged to speeding by generous 4-, 6- and 8-lanes roads, with lanes generally too wide.

56. An identical type of problem exists when parallel service roads are found along expressways, namely on the western section of Sitteen road, between Asir and Madhbah. Here again, the insertion of traffic from the service road to the expressway is brutal and highly dangerous, lacking protection, proper signing and marking. It has negative impacts on traffic fluidity on the expressway as well.

**Photos 4 and 5 Sitteen road: highly dangerous U-turns and dangerous integration of traffic from the service road to the expressway**



*There is generally more on-street parking supply than demand in Sana'a, except from a few busy commercial streets, but parking violations are widespread, in particular double-parking, with severe negative impacts on road capacity. Parking is also not used in order to manage traffic demand.*

57. Parking is an important source of traffic congestion in Sana'a. In the absence of a comprehensive parking policy for residents, workers, customers or visitors, and with parking mostly unregulated and almost no enforcement of parking restrictions, on-street parking is often chaotic, particularly inside the inner ring road, provoking serious negative side effects.

58. In depth parking surveys conducted in the CTMS study on major commercial arterials of the city-centre have shown that there is no acute shortage of on-street parking spaces in Sana'a, since curb occupancy rates are generally low and parking durations are short (92% of all curb sides studied with an average parking duration of less than two hours, with an average parking duration of 1.3 hours). This contrasts for example with the case of Casablanca, where on-street parking spaces of the city-centre are saturated, with average daytime occupation rates reaching 95%<sup>6</sup>. In Sana'a, parking space deficiency is limited to few busy commercial streets<sup>7</sup>, where parking demand is high, and where long term parking monopolizes space, at the expense of short-term parking of visitors and customers.

59. Despite the general availability of on-street parking spaces, parking violations are widespread, in particular double-parking, angle parking at intersections, and parking on sidewalks. Indeed, a lot of

<sup>6</sup> Source : World Bank, April 2008, *Royaume du Maroc, Secteur des Déplacements Urbains : Note de Stratégie Sectorielle*, Rapport No. 40199-MOR.

<sup>7</sup> CTMS, September 2005, Interim Report, Chapter 4, p.4.

double-parking can be observed on the streets of Sana'a, and even sometimes triple-parking.<sup>8</sup>. As a consequence, full capacity of 4-lane streets is rarely available. This is a particularly acute problem on the inner ring road, where parking interferes with the essential traffic function of this road. "Pick-up" parking of micro- and minibuses, stopping on demand along their route or standing at informal terminals, as can be seen on Wahda street near Sana'a's University, also contributes to this problem.

60. Alternatives to on-street parking are extremely rare in Sana'a. There are only 9 parking lots, representing around 600 spaces, in the city centre. The use of these parking lots is very similar to curb-side parking in terms of occupancy rates or average parking duration. Unlike on-street parking, which remains free in Sana'a, fees are collected in at least some off-street parking lots, but they "are still low and are not segmented by location and duration (...)"<sup>9</sup>. Private parking facilities are scarce and rarely offer enough capacity. Only new large commercial centres have underground parking, and most of them provide much less space than required for their tenants and visitors. Moreover, "building laws do not provide for adequate parking spaces for various floor uses"<sup>10</sup> and "parking requirements for new developments and buildings are not respected when issuing building permits, especially for office buildings and commercial centres"<sup>11</sup>.

61. In a city like Sana'a, with increasing congestion in the city center, it is essential to manage traffic demand and, in particular, to increase the cost of car use so that this cost can be better aligned with the negative externalities generated. A sound parking policy, including metering, is an important instrument for traffic demand management. As shown above, it is not yet used in Sana'a.

**Photo 6 Example of double-parking obstructing traffic**



<sup>8</sup> CTMS observes that "double parking is actually being practiced along some curb sides even if curb parking space was indeed available only few spaces away from the location of the double parking occurrence" CTMS, September 2005, Interim Report, Chapter 4, p.2.

<sup>9</sup> CTMS, December 2005, Immediate Action Plan, p. 28.

<sup>10</sup> CTMS, December 2005, Immediate Action Plan, p. 28.

<sup>11</sup> CTMS, September 2005, Interim Report, Chapter 8, p.1.

**Photo 7 Minibuses obstructing traffic on Wahda street, near the University**



*Although walking is essential as a mode of transport for Sana'a's population, pedestrians' needs are poorly addressed.*

62. Despite being the most used mode of transport in Sana'a (representing probably more than 50% of all trips), walking is also the most neglected. A telling indicator of this is the almost total absence of crossing facilities for pedestrians.

63. Because of the lack of road functional hierarchy, there are no appropriate standards for pedestrians, which causes many conflicting situations between traffic and pedestrians:

- Many instances can be observed, notably at signalized intersections, of pedestrians and vehicles sharing the same road space at the same time, and severely interfering with each other, especially with left-turn and right-turn traffic movements. Traffic control phases clearly neglect pedestrian needs.
- Crossing streets is a real challenge for pedestrians in Sana'a. Some major roads have been built without appropriate integration of adjacent land uses and with split neighbourhoods, generating high pedestrian volumes and a high demand to cross on each side of the road. Adequate infrastructure dedicated to pedestrians is severely lacking. This is for example the case on the western section of Sitteen road, where pedestrian crossings, overpasses or underpasses are desperately needed.
- Pedestrians are extremely vulnerable when involved in an accident, and some categories of pedestrians are particularly fragile, like children or old people. The inappropriate treatment of pedestrian needs is the source of many accidents and a serious public health concern. There is a high rate of vehicle-pedestrian accidents in the case of multilane expressways like Sitteen road.

64. Various other elements show that there is no proper pedestrian network in Sana'a, like the lack of continuity of pedestrian routes, the important detours involved in order to cross the streets in a safe manner, the lack of sidewalks, or the improper existing sidewalks.

**Photo 8 Pedestrians conflicting with traffic at a signalized intersection**



**Photo 9 Absence of proper pedestrian facilities and lack of continuity of the network force pedestrians to take serious risks when crossing roads**



65. Finally, neither pedestrian nor pedestrian-friendly streets or precincts can be found in the city-centre, with the exception of the old town of Sana'a.

**Photo 10 A car, a taxi and a motorbike on a busy shopping street of the old town of Sana'a**



***There is not yet any coordination between urban development and urban transport, and no attempt at using traffic demand management tools.***

66. It does not appear that any significant measures have been taken in the past to locate public services, commercial areas or any other important traffic generators so as to limit traffic demand. The city does not yet have an up-to-date urban development Master Plan, and its growth has been largely unplanned, with the proliferation of informal settlements. As observed by R. Stadnicki, it takes time for public authorities to equip these new developments with appropriate services<sup>12</sup>. By contrast, private actors have recognized the potential of these new neighbourhoods, and provide them with a range of services (private universities, hospitals, ...), but without coordination at the city-level.

67. CTMS has rightly highlighted the importance of providing appropriate services at different scales in order to reduce reliance on the car and public transport. In particular, CTMS has suggested the division of the city in three hierarchical levels, districts, communities and neighbourhoods, and the development of service centres for each level, providing essential services such as schools, health facilities, etc. This would indeed contribute to reducing transport needs and traffic demand.

68. No information was found on measures to stagger office hours or the schedule of schools and universities in order to spread transport demand over time. However, traffic counts have shown that hourly variations of traffic were small, without significant peak hours. Therefore, this type of traffic demand management measures may not be a priority in Sana'a for the time being.

## **D. Financing issues**

***Urban transport in Yemen in general and in Sana'a in particular suffers from a lack of financial resources, an unbalance in the distribution of funds and a chronic lack of investment in public transport and traffic management.***

69. Despite the administrative and financial devolution process that has occurred in Yemen, local authorities are still weak and lack resources to fulfil their responsibilities. It is observed that their local revenue base is limited and that there are still important needs for improved municipal revenue generation and budgeting process<sup>13</sup>.

70. Public funds allocated to urban transport, whether their source of financing is Yemeni or foreign, have for long been exclusively directed to roads and focused on the development of large infrastructure projects, in particular numerous grade separated intersections. For instance, the Republic of Yemen Public Investment Program 2007-2010, revised in November 2007, foresaw expenditures of nearly USD2.1 billion for the development of the road network at the national level. One of the objectives of this funding was to reduce “the traffic jams inside cities through completing the circular/ring roads and distributing traffic on the wide roads to accommodate the urban expansion” (Republic of Yemen Public Investment Program 2007-2010, Attachment I, Sector strategies).

71. On the contrary, public transport sector has been fully deregulated and left to the informal sector, without any significant public investment in the facilities (like dedicated lanes) that would help make it more attractive and more efficient.

72. Therefore, for many years investment has been exclusively focused on the improvement of the urban road network, neglecting the strategic importance of public transport in the urban transport

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<sup>12</sup> Stadnicki R., “The Greater Sana'a : multipolarity and new forms of urbanity in the capital of Yemen”, *Annales de Géographie*, vol.1, n° 659, p. 32-53, 2008.

<sup>13</sup> Source : Sana'a City : Medium to Long-Term City Development Strategy for Sustainable Development, Proposal submitted to the Cities Alliance, 2005, p.5.

system. The medium and long term proposals of the CTMS study may begin to correct this situation, notably with the proposal to develop a Bus Rapid Transit (BRT) in the medium term (2014). However, a severe unbalance in the distribution of funds will persist between public transport and road infrastructure. Indeed, cost estimates of the proposed improvements of public transport infrastructure amount to a total of USD101 million.. On the other hand, investment in road infrastructure of the capital will amount to a total of USD344 million, with an impressive USD315 million for the development of numerous grade separated intersections, either tunnels or bridges<sup>14</sup>.

73. Current plan also include a set of short term investments in the frame of an Immediate Action Plan (IAS) designed to meet urgent urban transport needs. These investments consist mainly of geometric changes and improvements of signal operations at intersections. The total budget for implementation of the IAP amounts approximately to USD8.5 million<sup>15</sup>. This is far below the needs for addressing Sana'a's serious and fast growing congestion and urban transport inefficiencies.

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<sup>14</sup> Investments in transport infrastructure proposed by CTMS include medium term (2014) and long term (2024) investments. Investments in road infrastructure include traffic management equipment (17 million \$ to be invested by 2014), the building of new road links (3 million \$ invested by 2014 and 9 million \$ by 2024) and new grade separations (145 million \$ invested by 2014 and 170 million \$ by 2024). Investments in public transport infrastructure include the development of a BRT by 2014 (93 million \$, with half of the investment in stations, bus spots and terminals postponed beyond 2014), and the development of bus exclusive lanes on Sitteen road and Khamseen (8 million \$ invested by 2014) (Source: CTMS, March 2007, Final Report: Development of Medium and Long Term Plans, p. 174).

<sup>15</sup> Source : CTMS, December 2005, Immediate Action Plan, p. 44).

## **IV. RECOMMENDATIONS FOR IMPROVING THE PERFORMANCE AND EFFICIENCY OF URBAN TRANSPORT IN SANA'A**

74. There is a need for a comprehensive set of measures, mutually reinforcing, to address the major issues noted in the previous chapter. Recommendations for such measures are presented below. They cover the institutional, planning, public transport, traffic management, and financial aspects.

### **A. Institutional recommendations**

*A national strategy for urban transport should be developed in Yemen.*

75. Although the case of Sana'a is special since it is by far the largest and most economically important city in Yemen, it would be better if the improvement of its urban transport systems took place in the context of a national strategy for urban transport. Such a strategy including principles, guidelines, and monitoring tools, remains to be developed in Yemen. The principles should focus on sustainability and efficiency, the development of alternative means of transport to the automobile, notably public transport, the optimum use of the public (street) space from a collective point of view, and the need for coordinated approaches between urban transport planning and urban development planning.

*A department in charge of transport planning and traffic engineering should be created in the Capital Secretariat.*

76. Severe functional gaps in transport planning and traffic management have been identified in Sana'a. In particular, there is a lack of strategic guidance, limited responsibilities are split between several institutions lacking coordination between them, and most of urban transport and traffic management functions and responsibilities are not appropriately addressed. Moreover, the Municipality of Sana'a (Capital Secretariat), which has been made responsible for transport and urban planning at the local level by the decentralization process, suffers from a severe lack of human and financial means. For all these reasons, a department concentrating responsibilities in urban transport planning and traffic organization and management, non-existent today, is absolutely necessary, and should be created as a matter of priority within the Capital Secretariat.

77. The creation of such a department would be consistent with the decentralization and devolution objectives of the Government of the Republic of Yemen. It would also be efficient in terms of urban transport management, since municipal authorities have the best knowledge of local needs and constraints.

78. The new municipal department should have comprehensive responsibilities in transport planning and management, ranging from strategy development to traffic operations. As noted in the following chart, the new department should belong to the Technical Affairs of Sana'a's Municipality and should be composed of three sections, each one of them including two divisions: a Planning and Public Transport Section, a Traffic Operations & Maintenance Section, and a Public Information & Training Section.

79. The Planning Section should represent the strategic level of the urban transport policy, and should be in charge of planning urban mobility, covering all means of transport, developing urban transport strategies, and organizing and regulating public transport. This section would include two main divisions: a Policy Guidance and Planning Division, and a Studies and Data Collection Division. The Policy Guidance and Planning Division would be in charge of strategic urban transport planning, public transport planning and regulation, pedestrian network planning, parking policies, and investment plans. The Studies and Data Collection Division would be in charge of collecting information necessary for transport planning, policy development and policy evaluation.

80. The Traffic Operations & Maintenance Section would represent the operational level of the urban transport strategy, and would be in charge of everything linked with traffic management. This section would include two main divisions: an Operations Division, and a Maintenance Division. The Operations Division would be in charge of the development of traffic management strategies, circulation plans, and intersection management strategies, the management of traffic signal operations, traffic signs, road markings and schemes to improve street layout. The Maintenance Division would be in charge of maintenance of traffic signals, road signs, road marking and other devices for traffic management.

81. The Public Information & Training Section would include two main divisions: a Public Information and Awareness Division, and a Training Division. The Public Information and Awareness Division would be in charge of developing communication, educational and awareness campaigns targeting the different road users (drivers, public transport users, pedestrians, children), in order to change behaviours and promote and explain the city's policy. The Training Division would be in charge of developing training of the Department staff, traffic engineers and technicians. It would also be supporting the training of the Traffic Police, in coordination with Traffic Police services.

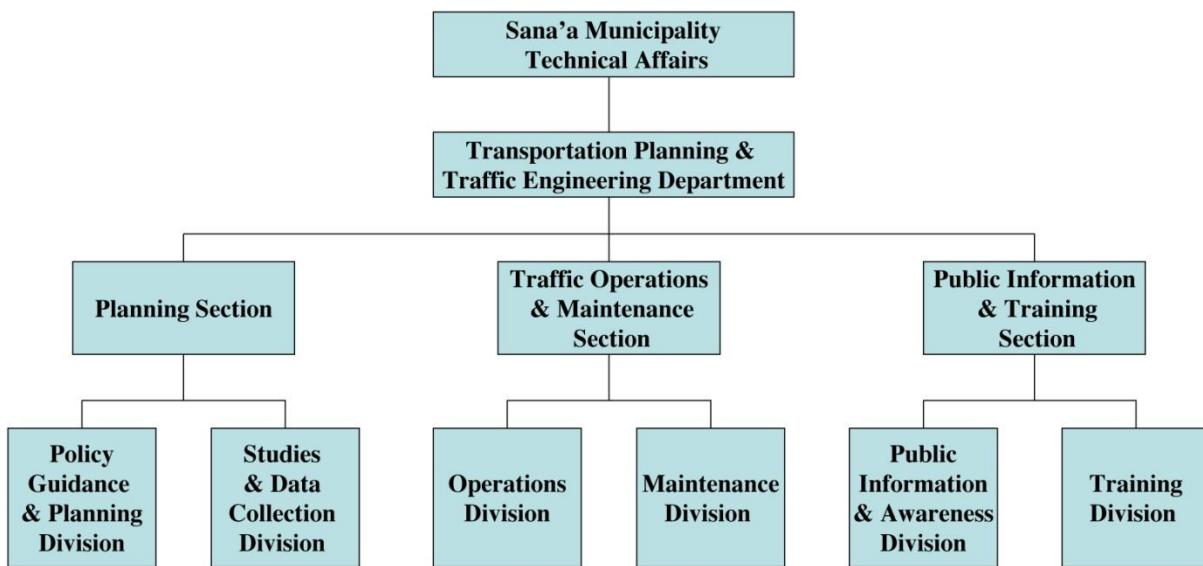
82. Each section of the new transport planning and traffic engineering department should receive staff and resources as needed to fulfil its missions. Significant budget will be needed for staff, equipment of the different units of the department, and for studies that will be necessary for the development of the urban transport policy. The City of Johannesburg in South Africa, with a population size comparable to Sana'a (2.5 million inhabitants) and currently developing a very ambitious urban and transport policy, can be used as an example of staffing needs. In Johannesburg, the Transportation Department is responsible for putting in place transport policy and public transport, planning and installing transport infrastructure, and taking care of road and transport safety. According to the Integrated Transport Plan 2003-2008, this department consisted of 22 staff in 2004, but it had been originally anticipated that it would employ some 70 staff members<sup>16</sup>. In addition to this number, there is a separate Johannesburg Roads Agency (JRA), responsible for building and maintaining roads, bridges and stormwater systems and taking care of traffic management; it employed several hundreds employees<sup>17</sup>. More generally, it is common in a city the size of Sana'a that at least a dozen staff be in charge of only the formulation and monitoring of urban transport and traffic strategies and key actions.

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<sup>16</sup> City of Johannesburg, Integrated Transport Plan 2003-2008 (Updated 2004).

<sup>17</sup> Johannesburg Roads Agency, Annual Report 2006-2007.

**Figure 9 – Proposed organizational chart of a Transportation Planning & Traffic Engineering Department for the city of Sana'a<sup>18</sup>**



***A High Level Advisory Committee should be created to provide guidance to the municipal department in charge of transport planning and traffic engineering.***

83. A High Level Advisory Committee should be created for providing guidance to the municipal department in charge of transport planning and traffic engineering, and for ensuring coordination between all stakeholders. This committee would be chaired by the Mayor of Sana'a and should include at least representatives of the Ministries of Planning, Finance, Transport (MOT), Local Administration (MOLA) and Public Works and Highways (MPWH), and representatives of the Traffic Police. The Committee should meet regularly to address key urban transport policy issues.

***Transport planning and traffic engineering skills should be improved.***

84. One of the main obstacles to the development of an effective and sustainable urban transport policy for Sana'a is the shortage of transport planning and traffic engineering skills in Yemen. Raising qualification standards and improving training and skills in the field of transport management should indeed be considered as a priority, in order to develop the capabilities of current staff as well as decision makers, fill all the necessary positions in the proposed municipal department in charge of transport planning and traffic engineering, and develop the next generation of urban transport planners and traffic engineers.

85. The CTMS study recognizes the essential training needs in transport management and devotes a significant part of the Immediate Action Plan to this issue. In particular, the role that could be played by the University of Sana'a, which did not have a graduate program in the fields of transportation planning and traffic engineering at the time of writing the plan, is highlighted. The University of Sana'a should notably be encouraged to provide a Master's Degree program in transportation planning and traffic engineering. The University should also be asked to design and administer an emergency intensive training program fitting the needs of the Municipality staff (and possibly the staff of other large cities in Yemen) in terms of continuous education.

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<sup>18</sup> This is adapted from CTMS, December 2005, Immediate Action Plan, Volume 1 : report, p.32

86. Several other options for provision of training services are available, notably the development of the use of internet resources for training of the Municipality staff (e-learning), the organization of overseas study tours, and the involvement in training programs abroad.

87. Furthermore, the Municipality of Sana'a should develop its international cooperation and join professional networks to exchange information and experience on urban mobility management and transport policies in developing cities. For example, the City of Sana'a could join the associations IMPACTS (Information Policies Assessment for City Transport Systems) or CODATU (Cooperation for urban mobility in the developing world).

***Enforcement of traffic regulations and training of Traffic Police should be improved.***

88. In order to improve the performance of Sana'a's transport system, a strong focus should also be placed on traffic enforcement. Indeed, traffic enforcement is the essential on-field complement to traffic schemes and transport policies designed by technicians. Therefore, it is necessary to make sure that the technicians in charge of urban transport policies and the Traffic Police share the same objectives and the same language, and that the Traffic Police has the ability to enforce traffic regulations. This requires notably the following measures :

- The Traffic Police should be consulted when transport policies and traffic management measures are designed;
- Traffic Police training should be improved, with the objective of developing the understanding of transport policies and traffic management by police officers, as well as in order to increase their awareness of traffic problems and their knowledge of traffic regulations;
- The Traffic Police should be properly equipped for an efficient enforcement. This may include parking control equipment (tow trucks, wheel locks, ...), communications equipment, patrol vehicles (patrol cars, motorcycles, ...), office equipment (personal computers) and field equipment (hand held data recorders, GPS, ...)<sup>19</sup>.

***Urban transport policies and traffic management strategies should be developed with a consensus-building approach, involving the participation of the different stakeholders concerned.***

89. It is absolutely essential that all the stakeholders concerned by transport and urban planning work in close coordination, in order to develop and implement coherent policies and measures, allowing the setting up of an effective and sustainable urban transport system. Objectives in terms of urban transport and traffic management strategies should be developed with a consensus-building approach, involving the participation of the different stakeholders concerned, national and local public authorities, police, transport service providers and citizens, and leading to a common and shared perspective. Consensus-building approaches are key conditions for the success of urban transport strategies, useful in particular to avoid contradictions between policies and actions of the various stakeholders, and to maximise the acceptability of the policies implemented. In particular, consensus will have to be developed between:

- institutions at the national level and institutions at the local level: an appropriate coordination will be necessary between national public authorities, in particular the Ministry of Transport, and the Municipality of Sana'a;

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<sup>19</sup> The total investment estimated by CTMS for Traffic Police training and enforcement equipment amounts to US\$200'000, which is probably a bare minimum for a first step.

- the transport planning/traffic engineering institutions and the urban planning institutions: in particular, coordination will be needed to design a multimodal urban transport concept in coordination with the land use plans. The example of Greater Amman Municipality (GAM) could be a reference for Sana'a. The GAM launched about 2 years ago an integrated land use and transport planning approach. Two main documents were produced. The first one, more general, sets the main socio-economic goals the GAM wants to reach on the longer run; this policy and planning document includes a comprehensive section on land-use planning and development within the city's boundaries. The second document is a GAM transport master plan. On the one hand, the policies set in the strategic planning document fuel the transport masterplan. On the other hand, the masterplan is based on a general modeling of the city's transport demand.
- the transport planning/traffic engineering institutions and the Traffic Police: the Traffic Police should be consulted in the development of transport policies and traffic management measures. Enforcement by the Traffic Police should be serving the objectives in terms of urban transport and traffic management;
- public authorities and citizens: transport systems should correspond to citizen needs and urban and transport policies should be accepted by local populations. As a consequence, it is essential to develop citizen participation in decision-making processes. Specific forms of citizen participation will have to be developed in Sana'a, considering the local and social context of the capital.

## **B. Recommendations to develop a multimodal strategy for Sana'a's urban transport system**

### *A multimodal concept and strategy is severely needed in Sana'a.*

90. The CTMS study has proposed a range of actions concerning the different means of transport, namely the private car, public transport and pedestrians. However, the CTMS approach has been very conventional, considering each means of transport separately, with a mono-modal perspective. A true multimodal concept and strategy is clearly needed in Sana'a.

91. The function of a multimodal concept is to specify the role of each mode of transport within the city, and how they all complement each other. Aiming to the long term, the multimodal concept intends to best match the specific characteristics and qualities of the different modes of transport with the various needs (economic, social, environmental, etc.) that should be satisfied and the various constraints to be considered while integrating all modes of transport so that each one represents an added value to the overall system. This is clearly more efficient than the current approach that merely consists of superposing (but not integrating) solutions designed in a mono-modal perspective.

### *Additional key studies are still needed and many strategic decisions will have to be taken.*

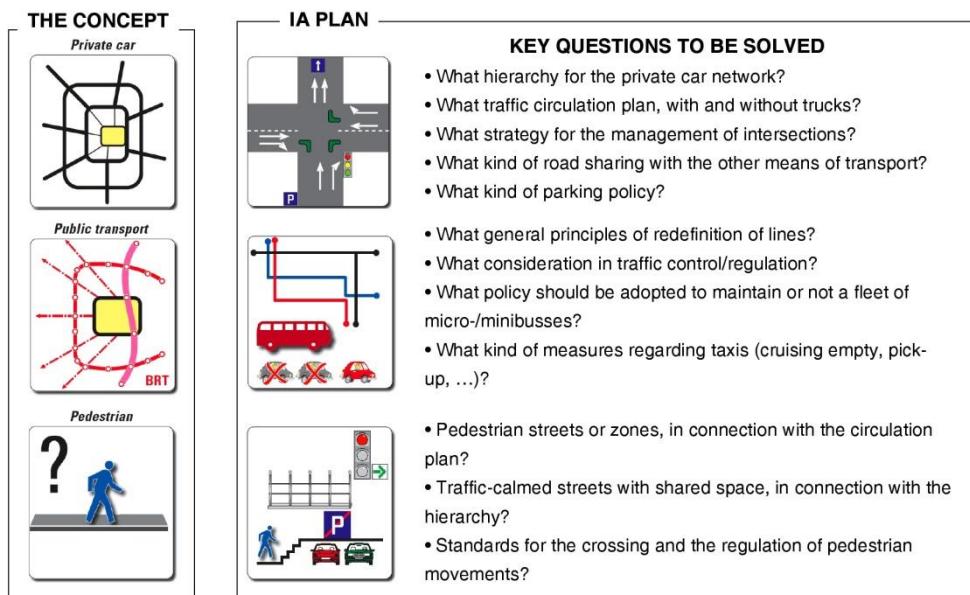
92. Many additional studies will be needed in order to complete the development of Sana'a's urban transport strategy and planning. Indeed, the proposed Immediate Action Plan (IAP) and the Medium and Long Term Plans, while proposing general principles and actions, do not deal with many essential elements of an efficient urban transport planning, since it was not the purpose of the CTMS study. Strategic decisions are still to be taken, requiring choices that will prove sometimes difficult and

the identification of clear priorities in terms of transport policies and actions. These decisions will concern in particular :

- a functional road hierarchy: this is severely lacking in Sana'a. The definition of a proper hierarchy, assigning a specific function to each road link (e.g. local accessibility, main collector, regional or national link road, etc.) along with corresponding technical specifications, will have to be adopted;
- a traffic circulation plan, integrating both private cars and truck traffic: once the functional road hierarchy has been adopted, a traffic circulation plan will have to be designed. It will specify the general principles directing the functioning of the road network and the accessibility principles to Sana'a's urban system (for example, protection of the city-centre with measures deterring through-traffic and encouraging use of the ring roads, identification of one-way-streets, etc.);
- a city-wide strategy for the management of intersections: in Sana'a, the management of intersections will be a very important tool to improve traffic fluidity, road capacity and safety. However, it should also be used as a strategic urban transport tool, in order to filter and control some traffic movements, and in order to give priority to some users and to some movements, in coordination with a general urban transport strategy. Typically, the strategy for the management of intersections should be used to filter access to the city-centre of private cars, in order to avoid its congestion, to ease exit from the city-centre of private cars and to encourage the use of the ring roads by private traffic. It should also be used to give priority to public transport at intersections;
- a parking policy for the city-centre: a parking policy, setting clear objectives and actions, aimed at different target groups (residents, visitors, customers, workers), and designed in coherence with the general urban transport policy and multimodal accessibility concept, will have to be developed and implemented;
- the identification of the general principles that should guide the redefinition of public transport routes and should frame the designing of a modern public transport network for Sana'a;
- the treatment that should be given to public transport in traffic control and regulation, specifying whether, how, and where public transport should benefit from a preferential treatment and priorities in traffic (reserved lanes, busways, priority at intersections);
- the policy that should be adopted towards the fleet of micro- and minibuses and the place that they should be given in the future, considering their poor cost-efficiency and attractiveness, their negative impact on traffic and on the environment, but also taking into account the social importance and the economic weight of this informal industry, providing revenues to thousands of residents of Sana'a;
- the policy that should be adopted and the measures that should be applied towards taxis considering their negative impact on traffic and on the environment (high number of taxis cruising empty), but also taking into account that this activity, like microbus services, is socially and economically very important;
- the development of pedestrian streets or zones, protected from car and motorcycle traffic, in connection with the circulation plan;

- the development of “traffic-calmed” streets with shared space and reduced car traffic, in connection with the functional road hierarchy;
- the standards that will need to be established and implemented for the development of a decent pedestrian network, for the organisation of pedestrian movements and for pedestrian crossings;
- through all the above, the efficient reallocation of road space between the different means of transport: private cars, public transport, pedestrians, etc;
- the coordination with land use plans and urban development activities.

**Figure 10 - Key questions to be solved to complete the development of Sana'a's transport strategy and planning**



*Sana'a's urban transport problems will not be solved with car-centered policies focused on the development of road infrastructure, but with a multimodal strategy promoting alternative modes of transport and complementary roles for the different modes.*

93. The proposals of the CTMS study are focused on cars and on the improvement of the road network. The improvement of the road infrastructure is already underway, with many new grade separations built or about to be built, and the development of a third ring around Sana'a. Nevertheless, the stakeholders and those in charge of Sana'a's transport policy should be aware of the limitations and counterproductive dimensions of the car-focused policy currently applied.

94. The classic way of dealing with a growing transport demand is to develop the road infrastructure (the supply). This has been for long and this is still the approach followed in Sana'a. This is also the strategy followed in many developing cities. However, this strategy comes at a high cost, since it includes many seriously negative side effects, notably on the quality and attractiveness of public transport, on the environment and public health, on pedestrians, or on the quality of life of residents living next to the main roads.

95. Developing cities and Sana'a in particular are characterized by a high share of the population which is not motorized and depend largely of public transport. Car-focused policies tend to weaken the quality of public transport services.

96. Traffic also has very serious consequences on air quality and public health. According to a report published in 2002 by the Committee of Tourism and Environment in the Yemeni Parliament, the air in Sana'a is heavily polluted by pollutants, dust and smog, and these are mainly attributed to the transportation and energy sectors. Another report published in 2004 by the Yemeni Environment Protection Authority (EPA) concluded that the annual cost of diseases caused by the poor air quality in Sana'a was about US\$ 100 million<sup>20</sup>.

97. The city of Bogota (Colombia) provides a very relevant example of the positive effects of such a strategy. With 6.5 million inhabitants, Bogota is, like Sana'a, a high altitude city (Bogota: 2600 metres; Sana'a: 2300 metres). In the 1990's, Bogota was characterized by severe traffic congestion, long travel times and very important pollution problems aggravated by altitude. But instead of developing the road infrastructure, the city dropped plans to build a major elevated motorway and built a highly effective Bus Rapid Transit (BRT) system, the Transmilenio. The city also reorganised the public transport network with a system of feeder buses connected to the BRT, and put significant efforts into the development of bicycle infrastructure (300 km of bikeways, bicycle parking facilities at BRT stations). The results of this policy have been impressive. Pollution has been reduced (-40%), thanks to the reduction of congestion and car traffic. Average travel times by public transport have been divided by two on the main routes. And the BRT system is responsible for over one million trips per day. In a city where 70 to 80% of the population have no alternative to public transport, the new system plays a key social function<sup>21</sup>.

98. The necessity of a multimodal strategy promoting alternative means of transport is even more obvious considering the respective space used by the different means of transport and the scarcity of road space in dense cities like Sana'a. Indeed, cars need a lot more road space per passenger than alternative means of transport. For example, in one hour, a space with a width of 3.5 metre can be crossed by only about 2,000 persons by car, but 4,500 passengers of a standard bus service and more than 15,000 passengers of a higher capacity public transport system<sup>22</sup>.

99. As a consequence, important lessons for Sana'a's urban transport strategy and policy should be drawn from these observations :

- exclusive focus on car traffic is not possible anymore, and other means of transport should be given priority, especially in the city-centre and on radials leading to the city-centre ;
- road space should be shared between the different means of transport and users, approaching the city centre and in the city centre ;
- a more important role than suggested by the CTMS study should be assigned to public transport and walking, which should be clearly identified as key functional elements in Sana'a's future transport system ;
- a mass transit system, possibly a BRT network with several lines, complemented by feeder services is needed in Sana'a to meet the important mobility needs of the population and to anticipate the future growth of the city;
- the proposals of the CTMS study focus largely on the development of new infrastructure outside the most dense part of Sana'a, where problems are less acute. A stronger focus should

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<sup>20</sup> CTMS, March 2007, Final Report, volume 2, Environmental and Social Assessment.

<sup>21</sup> Source : Institut Veolia Environnement.

<sup>22</sup> CERTU, 2008, Stratégie de mobilité durable dans les villes des pays en développement : guide pédagogique, p. 34.

be given to the dense core of Sana'a, where problems are much more serious and difficult to deal with. This will require a clearer strategy than the one proposed by CTMS, and clearer choices on issues that seem to have been sidestepped for now.

- considering the challenge posed by Sana'a's explosive development, a new knowledge-intensive approach is required, based on comprehensive transport system management and using modern management techniques. Instead, until now, the management of the urban transport system is largely based on a capital-intensive approach, solving problems with a physical expansion of the road network.

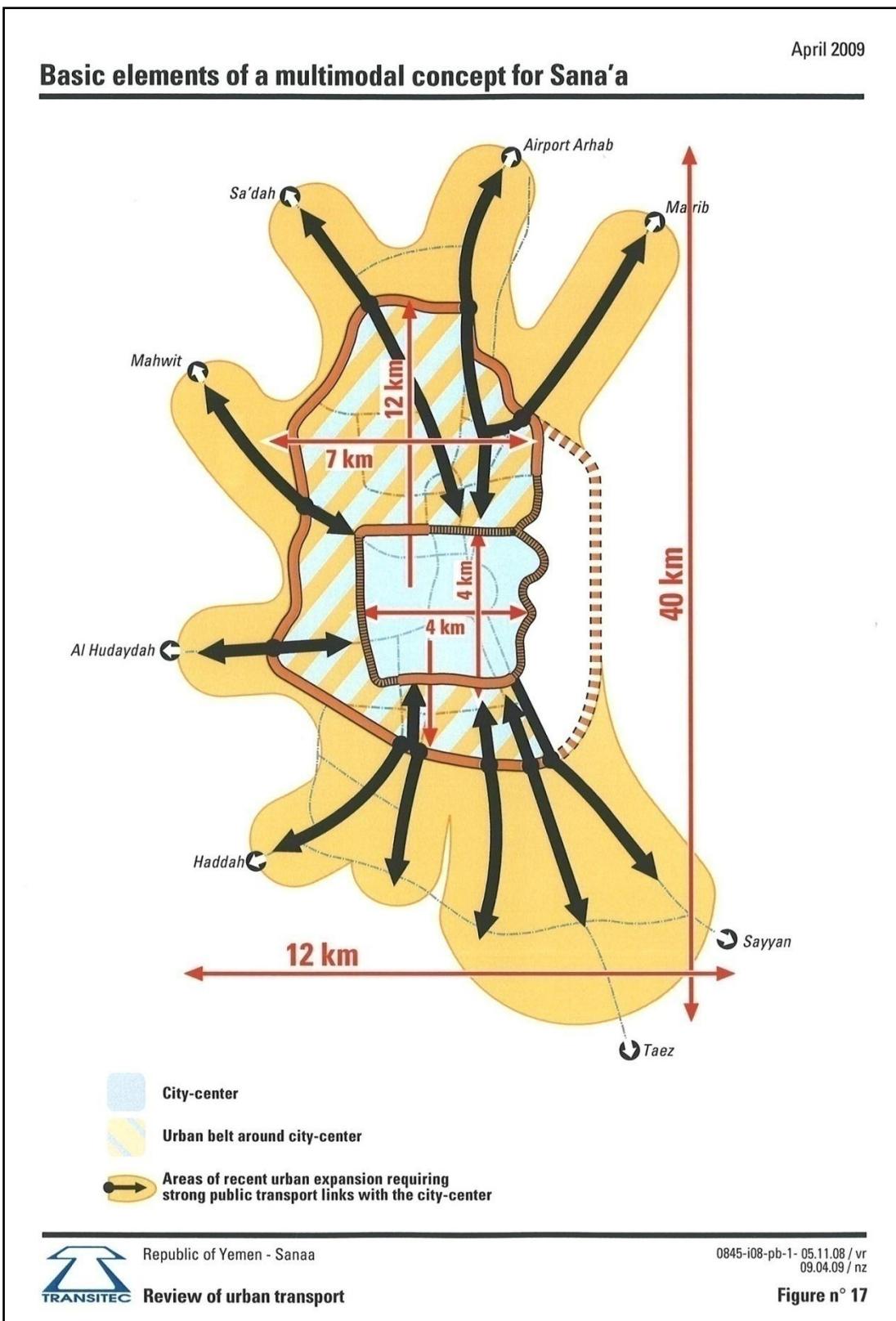
100. The multimodal concept will have to reflect the objectives in terms of urban transport and to take into account Sana'a's urban development characteristics. Thus, it should be developed in coordination with urban planners. Basically, three main types of areas, requiring three different types of transport strategies can be identified in Sana'a :

- the city-centre, inside the inner ring road: with a population of around 500'000 residents, it is characterized by high densities (around 15 km<sup>2</sup> and 300 residents/ha) and represents the economic core of Sana'a. It also contains Sana'a's old town, classified as World Heritage by UNESCO. This whole area should be protected from a car-centred policy. Car access should be limited so as to be consistent with street capacity. Priority should be given to public transport and pedestrian routes.
- the urban belt around the city-centre: this area, placed between the inner ring road and Sitteen road, has a population of about 600'000 residents and relatively large dimensions (7km x 12 km). Its transport and accessibility functions should be fulfilled by public transport as well as private cars;
- the areas of recent urban expansion: with a population of around 1 million residents today, and soon 2 million according to demographic forecasts, the urban expansion of this area will need to be placed under control by urban planning. In terms of transport, the different new secondary centres of this area will need strong public transport links to be secured with the city-centre. Trips within the secondary centre will require careful planning as well, in order to promote the multipolar development of Sana'a.

The basic elements of this multimodal concept are outlined in Figure 11 below.

101. Sana'a's future spatial development should be structured by major public transport infrastructure. Densification should be concentrated around major public transport stations, and the main urban services should also be easily accessible by public transport. For example, this kind of approach has been successfully implemented in the Brazilian city of Curitiba, where the BRT system has been implemented successfully thanks to an urban planning policy encouraging densification around high-capacity public transport lines.

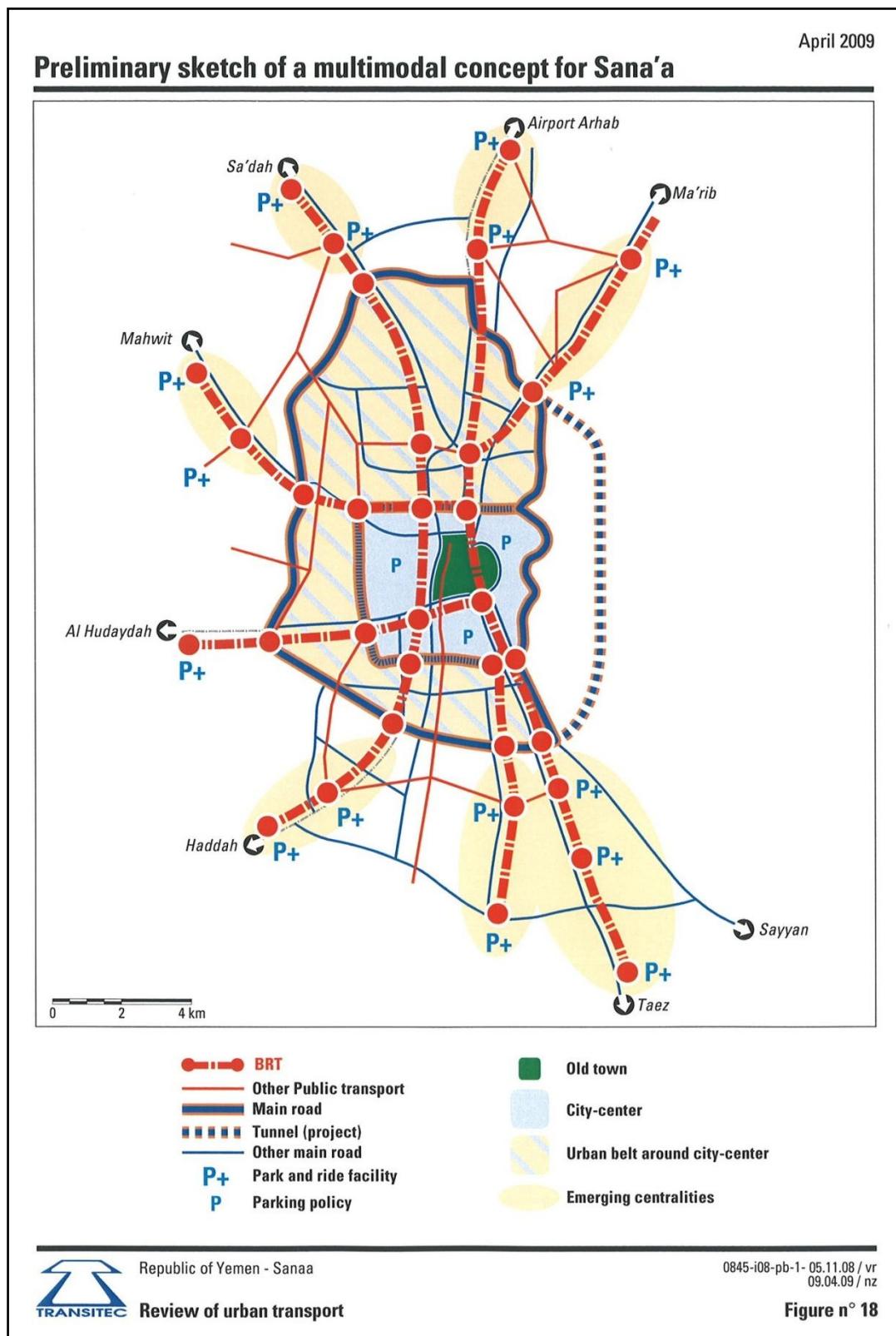
Figure 11 - Basic elements of a multimodal concept for Sana'a



102. These three types of areas having been identified, a preliminary sketch of a multimodal transport concept for Sana'a can be proposed in Figure 12 below. It is of course only a first attempt at designing a multimodal concept, and it will need further developments, but it can be used as a first guideline. The main elements of this multimodal concept are as follows:

- in the city-centre, the mix of private cars, public transport and pedestrians requires, for the short and medium term, a traffic circulation plan, an intersections management strategy, and a parking policy. Considering the high transport demand, the lack of space and the high densities of this area, priority should be given to public transport and pedestrians, and motorized private mobility should be placed under control. In particular, through-traffic should be deterred and encouraged to use Sana'a's ring roads. Finally, the circulation plan should include a network of BRT (Bus Rapid Transit) lines.
- the urban belt is surrounded by the current outer ring (Sitteen road), which disposes of high capacities. In the short/medium term, this area will need a study of the road hierarchy and of the public transport supply at the local and neighbourhood scale, in connexion with a network of radial BRT lines crossing the area. Park and ride facilities should be placed close to Sitteen road, on radials converging to the city-centre, and connected to public transport stations (BRT stations), in order to allow quick relations with the city centre and to encourage private car drivers to leave their cars at the boundaries of the dense core of the city. Traffic safety levels on Sitteen road should be significantly improved, so that it can properly fulfil its essential expressway and ring functions.
- with the emergence of new centres, Sana'a's is becoming a multipolar city. These emerging new centres should be attached to the city centre with strong and reliable links, by high capacity public transport (e.g. BRT lines) and by radial roads converging to the city centre. On these radial roads, a high level of priority should be given to public transport, at intersections but also through reserved lanes. A local public transport supply should be connected to the BRT stations, according to a hub-and-spoke network structure. Finally, a local circulation plan should make sure a right level of accessibility to the neighbourhoods is provided and should ease the access to park and ride facilities located close to the BRT stations.

Figure 12 - Preliminary sketch of a multimodal concept for Sana'a



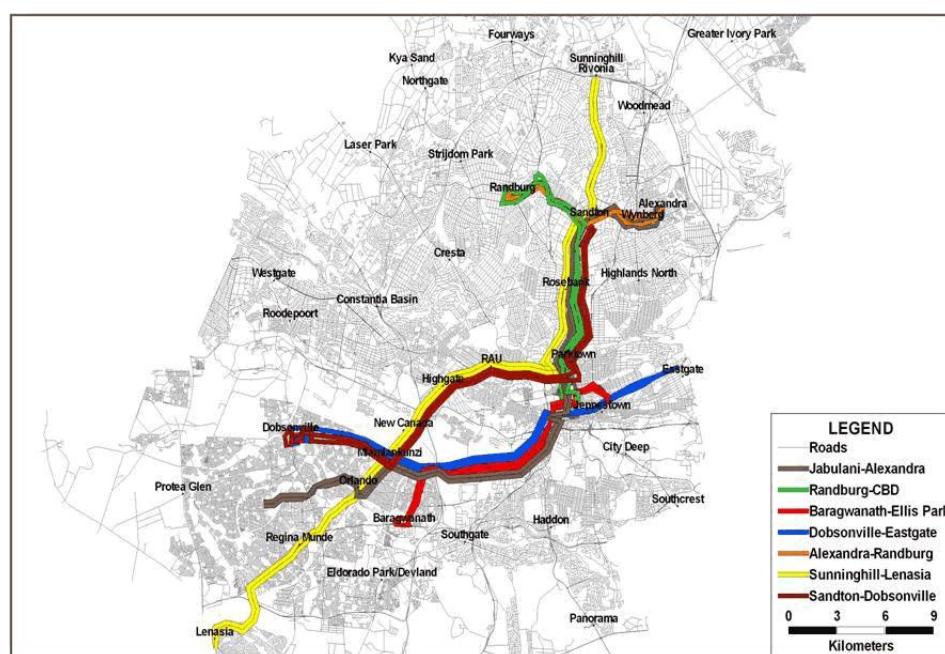
## C. Recommendations for the improvement of public transport

***Strong priority should be given to the development of efficient public transport services.***

103. At the strategic level, the essential role of public transport should be given better recognition and public transport should receive more priority in urban transport policies or in traffic management than today or than in the CTMS study. According to the above proposed multimodal concept, priority should be given to public transport in the city-centre and on radial roads leading to the city-centre, notably thanks to reserved bus lanes and priority for public transport at intersections. Several mass transit lines (e.g. BRT) should connect the new emerging centres with the city-centre, and not just only one BRT line as proposed by the CTMS study.

104. Many developing cities are currently studying or implementing mass transit systems and are giving priority to public transport in their urban transport policies. Bogota represents probably the most remarkable example, with a BRT system that is both very efficient and affordable for customers. The city of Johannesburg is currently building a BRT network that will include seven routes converging to the city centre by 2013, as can be seen on the following figure. The network will be complemented by feeder bus services connected to these routes.

**Figure 13 – The future BRT network of Johannesburg<sup>23</sup>**



105. In the medium term, an integrated fare system should be developed in Sana'a. Such a system allows passengers to use several public transport services or operators with a single ticket. For example, a customer can use a feeder bus for the first part of his trip and then a BRT for the final part of his trip with the same ticket. This is an essential element to improve the attractiveness of public transport services.

106. As observed earlier, CTMS proposals concerning public transport seem to be limited and directed by the fear of disturbing traffic, and the relevance of these proposals is hardly demonstrated. In particular, the choice of the Saylah ROW for the implementation of a BRT seems inappropriate, since it does not fit the location of main transport demand. Indeed, the line would be quite distant from

<sup>23</sup> Source : City of Johannesburg, Rea Vaya, Joburg's new public transport system, <http://www.reavaya.org.za/>

the main commercial and service areas of Sana'a's city centre, and would require longer walks. The proposed BRT axis would not serve any new secondary centres, like Dar Salm, Haddah, Madbah, Asir or Shumaila. In addition, the proposed marking of exclusive bus lanes on Sitteen road seems odd. Indeed, this artery does not attract significant public transport trips today and exclusive bus lanes seem hardly justified since traffic is fluid thanks to its large capacities.

107. At the operational level, it is essential to improve public transport supply in terms of attractiveness, cost-efficiency, performance, safety and environmental impact<sup>24</sup>:

- quality of service, comfort and safety should be raised in order to improve the attractiveness of public transport and its responsiveness to the actual needs of users; attention in these regards should be paid to all categories of users including in particular non-captive users and women;
- Public transport in Sana'a should be better monitored and basic rules should be enforced: public transport providers should not be allowed to transport more than the authorized number of riders, ride with open doors, drive dangerously, or change their route randomly. Bus stops should be integrated in the routes' design ;
- the existing over-capacity in the minibus sector should be reduced and the quality of the fleet improved through progressive elimination of the oldest, smallest and most poorly maintained vehicles; at the same time, financial incentives should be provided to bus owners to modernize the vehicle fleet;
- a transition from individually-owned minibuses without service obligations to route-based public transport organizations accountable for providing services according to standards required by the authority should be progressively implemented: a new policy offering franchises to operators, including exclusive or partly-exclusive rights on defined routes as well as various service obligations should be followed;
- bigger buses should be deployed on the main routes: the size of buses deployed on a route should reflect the hierarchic position of the route in the bus network;
- the bus network should be adjusted to meet demand: thus, a public transport study is very much needed to re-design the bus network according to the projected demand, and to offer better coverage of Sana'a by public transport.

108. Concerning the urban taxi sector, it is recommended to reduce excess capacity, in order to limit the impact of taxis on traffic and their environmental impact. Therefore, standards of taxi vehicles and services should be improved progressively:

- by imposing age ceilings on taxis, improving vehicle quality standards and enforcing new regulations;
- by making requirements for a taxi driver's licence more stringent and giving incentives to operators to improve service infrastructure.

109. Finally, a strategy should be developed in order to ease the transition from a fully informal public transport sector to a more professional and organized public transport system with route-based

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<sup>24</sup> Further details on the restructuring of public transport services in Sana'a are provided in the City and Intercity Land Transport Strategy Note prepared by the World Bank.

organizations. Since the public transport and urban taxis sectors bring revenues to a large number of residents of Sana'a, it is recommended to design a social assistance program to facilitate the transition of owners/drivers of old minibuses or taxis to their new roles in the public transport system or to different jobs. Current taxi and bus drivers could also receive positions as bus operators or be involved in the maintenance of new buses. This strategy has been followed in implementing the BRT of Bogota and will be followed in Johannesburg.

110. The current legal framework should be changed in order to allow a transition to a system of route franchises and in order to provide the authority with legal powers to award franchises by competitive tender, and to impose and enforce the franchise conditions. Typically, franchise-holders (usually a company or cooperative) will be awarded the right to operate a route for a limited period (perhaps 3-5 years for minibuses), but will also be required to provide the service to the standard required by the authority.

111. An adequate institutional structure should be in charge of public transport regulation and planning. Responsibility for public transport route franchising and service planning should be given to the new municipal Transportation Planning and Traffic Engineering Department as already proposed above. The core functions to be fulfilled would be the following ones :

- monitoring demand and supply, planning system development;
- setting standards of frequency, service quality, and safety;
- awarding and regulating franchise contracts (obligations, incentives, sanctions);
- formulating fares policy and fare-setting, as necessary.

## **D. Recommendations concerning the road network, traffic management, parking, and pedestrians**

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### *A city-wide functional road hierarchy and a circulation plan should be implemented.*

112. A proper functional road hierarchy, clearly attributing to each road or road segment a specific function and specifying technical requirements for each hierachic level should be designed in Sana'a.

113. A traffic circulation plan integrating both private cars and truck traffic should be implemented in coordination with the functional road hierarchy. Its purpose is to specify the general principles directing the functioning of the road network and the accessibility principles to Sana'a's urban system, as well as to identify concrete actions necessary in order to implement these accessibility principles. The circulation plan should be a tool to promote the objectives of the multimodal concept. In particular, it should be used to limit through traffic in the city-centre and in neighbourhoods and to optimize the ring function of Sitteen road. It should be used also to give priority to public transport in the city-centre and on Sana'a's major radials, and to provide comfort and security to pedestrians and inhabitants. Concrete actions that could be proposed in the circulation plan include the designation of one-way streets, the identification of pedestrian streets, car-free and traffic-calmed zones, the creation of public transport corridors with dedicated public transport lanes and priority at intersections, and the location and type of management of parking spaces.

### *An intersection management and signalling strategy should be implemented.*

114. An intersection management and signalling strategy should be implemented for Sana'a. It would define what combination of geometrical layout and operating principles (presence or

absence of traffic lights, type of signal programming, priority for specific routes or means of transport, ...) are best suited for each intersection, in order to implement locally the circulation plan. The intersection management and signalling strategy would define for each intersection :

- the functions of the different branches of the intersection (express ring road, radial access road to the city centre);
- the type of intersection that is most appropriate (roundabout, signalized intersection, grade separation, etc.);
- whether or not the intersection should be with traffic lights;
- whether or not priority should be given to some traffic movements and users, and some other movements and users should be controlled;
- the appropriateness of keeping the intersection isolated or to coordinate it with other intersections;
- the place that should be given to public transport and pedestrians;
- the way road space should be allocated locally and the way lanes should be designed in order to optimize traffic fluidity.

115. In Sana'a, the intersection management and signalling strategy should be a key instrument to improve road safety and traffic fluidity. It should also be used as a traffic control tool, in order to manage traffic according to the broad objectives of the multimodal concept. In particular :

- it should be used to control traffic entering the city-centre and to protect the city-centre from through-traffic. It should deter drivers crossing the city centre and encourage them to use the ring roads instead, thanks to an appropriate phasing of lights;
- it should be used to give priority to public transport;
- it should secure the continuity of the inner ring road, by controlling movements crossing the ring from outside the city-centre and giving priority to movements joining the ring from outside and inside the city-centre.

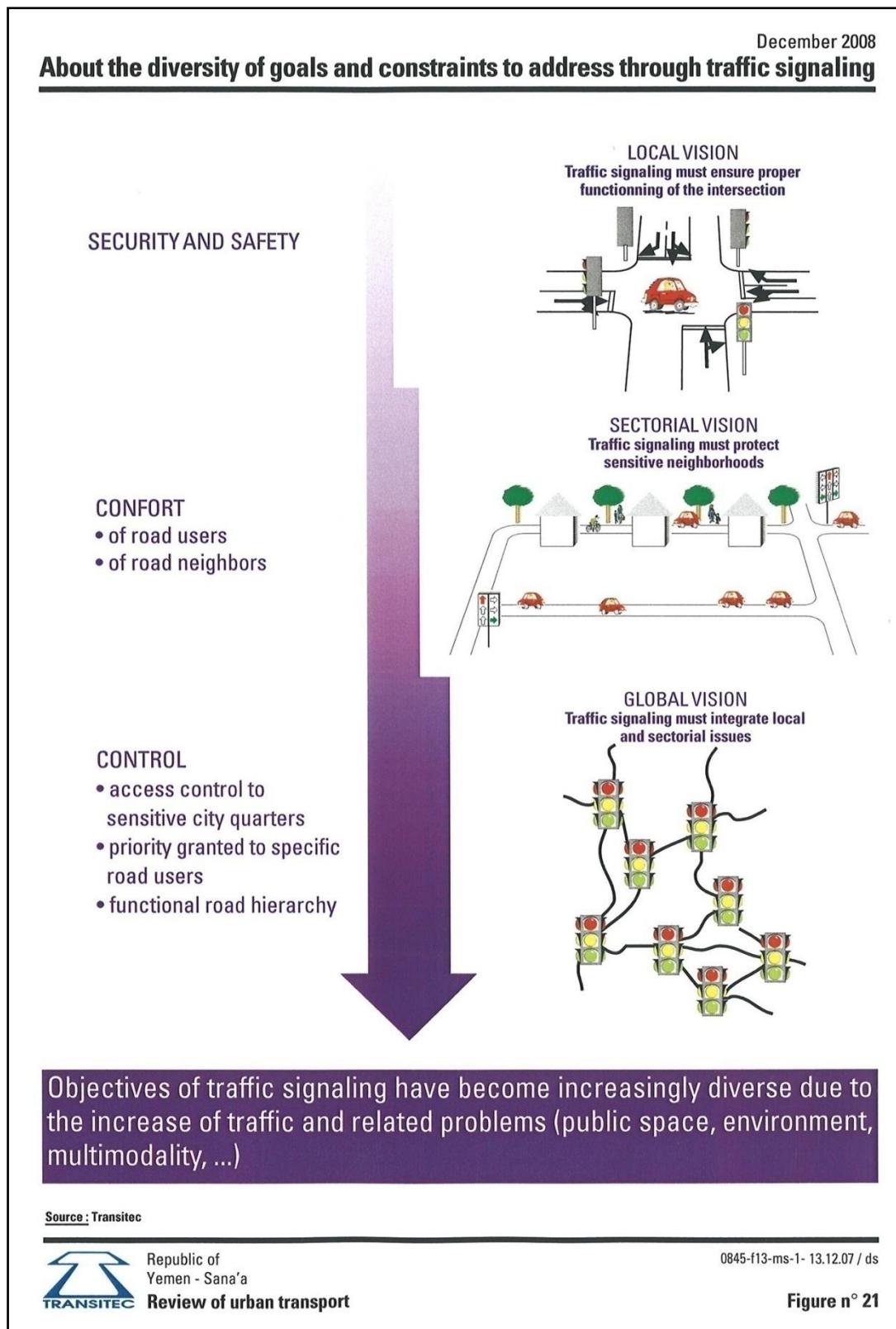
116. The core of the Immediate Action Plan developed in the context of the CTMS consists of improvement of signal operations. The Immediate Action Plan identifies 134 intersections that should be signalized with traffic lights. It is difficult to compare the needs of signalized intersections of different cities, since many factors have to be taken into account to decide if an intersection should be signalized or not and because of the various urban contexts (road network, densities, etc.). However, a comparison with the number of signalized intersections in the city of Johannesburg in South Africa (2.5 million inhabitants and around 1900 traffic signal controlled intersections<sup>25</sup>) tends to show that the number of signalized intersections proposed by the IAP is far too modest.

117. Traffic signalling is one of the most powerful tools to control flows by combining a local vision (e.g. security, comfort, priority) and a global vision (e.g. control, hierarchy, strategic issues), as depicted on figure 14 below.

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<sup>25</sup> Johannesburg Roads Agency, Annual Report 2006-2007.

Figure 14 - About the diversity of goals and constraints to address through traffic signaling



### ***Maintenance of streets and related infrastructure should be scaled up***

118. To ensure an appropriate level of maintenance, the following is required:

- An asset management system should be established including a data base to record assets and monitor their condition, and a maintenance policy with clearly defined intervention levels.
- Priority should be given to maintenance over new construction in budget allocation.

### ***Urgent actions are necessary to improve road safety.***

119. Urgent actions for the improvement of traffic fluidity and safety are recommended, among which the following:

- if they are still allowed in the future, U-turns on major radials and on the outer ring (Sitteen road) should be protected from the main traffic. Narrowing the main way and implementing painted marking or traffic islands would help to reach that goal;
- car movements from parallel service roads to the Sitteen road expressway should receive better protection, too, with proper marking and signing, and in narrowing the expressway.

### ***A parking management policy should be designed.***

120. A parking management policy, designed in coherence with the urban transport policy and the multimodal accessibility concept, should be developed and implemented in Sana'a, notably with the following objectives :

- control chaotic on-street parking and improve traffic fluidity ;
- control traffic, especially in the city-centre ;
- promote the use of public transport ;
- improve parking possibilities for short-term parking of visitors and consumers, and deter long term parking in commercial and business districts.

121. A parking management strategy can be a powerful urban transport and traffic control instrument. This is particularly the case for the city-centre of Sana'a, where the parking policy should be an instrument to control traffic entering the city-centre and promote the use of public transport, thanks to appropriate parking supply strategies (time limits, parking tariffs, number of car parks, enforcement, Park and Ride facilities).

122. A key point will be to improve enforcement against parking violations, in particular double-parking, angle parking at intersections, and parking on sidewalks. Illegal parking behaviours are a significant cause of traffic congestion and have a severe impact on road capacity in Sana'a.

123. At the same time, parking charges should be levied in all areas of high parking demand including in most of the city centre. A public private partnership approach could be considered where parking collection would be outsourced to private operators. Private investors could also be encouraged to build parking lots throughout the city and charge market rates. In addition, parking time should be limited in busy commercial streets where a high parking demand has been observed, in order to improve parking turnover.

124. Parking requirements should be set when issuing permits for new developments and buildings, especially for office buildings and commercial centres in order to limit on-street parking. In order to control car traffic in the city centre, consideration should be given to parking requirements that set a maximum (not a minimum) number of parking spaces for each type of activity based on the local context and the availability of alternative means of transport.

### ***The conditions for pedestrian traffic should be greatly improved***

125. The importance of pedestrian movements should be recognized in Sana'a and measures taken to improve the attractiveness, the comfort and the safety of walking, in particular as recommended below:

- standards, minimum requirements and specific guidelines for the layout of pedestrian facilities should be defined and implemented: for instance, pedestrian crossings should be available at regular intervals on each main artery and they should be systematically marked, sidewalks should be built or improved where needed, traffic lights phases should integrate the needs of pedestrians, and streets should be adequately lit at night;
- a vision for a pedestrian network should be formulated, identifying main pedestrian routes and linking all major equipments and urban areas;
- based on the vision, a continuous, attractive and safe pedestrian network should be implemented, limiting detours, offering proper crossing and walking infrastructure (pedestrian crossings, overpasses, underpasses, sidewalks), and identifying possible pedestrian-only or pedestrian-friendly streets.
- In formulating standards and guidelines for pedestrian facilities, the needs of children, women, and persons with reduced mobility should be well taken into account. For example, participants in the focus group discussions organized as part of the study mentioned in Section II above, emphasized the importance of street lighting for their safety, and thus their ability to move in the city. Other pedestrian facilities such as sidewalks and safe crossings were also mentioned as important to facilitate women's movements.

## **F. Financing recommendations**

### ***Sufficient means should be provided to the municipal Transport Planning and Traffic Engineering Department (TPTED)***

126. Considering the strategic role that will be played by the TPTED and its major potential impact on Sana'a's urban transport system and, indirectly, on Sana'a's economy, it is essential that the TPTED receives an appropriate budget, secured on a long term basis, for its operating expenses and for the numerous studies that need to be done in the near future (public transport network restructuring, public transport infrastructure development, functional road hierarchy, traffic circulation plan, parking policy, etc.).

127. Investment is also necessary in education programs to improve transport planning and traffic engineering skills in Sana'a and Yemen in general. Training of Traffic Police should be considered as a priority, too.

### ***Funds should be distributed in a more balanced manner between the different modes of transport.***

128. Investment has been for many years exclusively focused on the improvement of road infrastructure, and public transport infrastructure and services have been neglected. While development of road infrastructure will continue to be necessary given Sana'a very rapid population growth and increasing motorization, a far greater share of public expenditure should be allocated to public transport infrastructure as well as to the facilities for pedestrians. It would be well justified in particular to allocate significant funding to provide high-performance bus-based mass transit links between all the major emerging centres on the periphery of Sana'a and the city-centre.

***Private investment in public transport services should be encouraged.***

129. Public transport services are fully liberalized in Yemen, and supplied by the private sector. However, urban bus operations are not regarded as an attractive area for investment under current conditions of over-supply. As the international experience shows, the measures recommended in Section C above should go a long way towards promoting private investment. They need to be implemented in a fair and predictable way so that efficient operators are rewarded over the medium to long term.

***Appropriate funding should be invested in traffic management.***

49. Traffic management has also been neglected although it is essential for the improvement of traffic conditions in Sana'a (speed, fluidity, safety) and should be given first priority. The number of intersections that need to be signalized should be carefully assessed, since it seems that the proposals of the Immediate Action Plan (IAS) are very low (as noted above).

***Role of the Central Government***

130. In most countries of the world, the central government plays a key role in the funding of urban transport infrastructure. Indeed, this infrastructure is usually costly and beyond the means of the local governments, and, particularly when the capital city is concerned, it has economic and social benefits for the entire country. This applies to Yemen and Sana'a, and, therefore, continued financing involvement by the central government would be well justified. Urban transport infrastructure should also attract the interest of international donors

## V. ACTION PLAN

Main objectives and strategic measures	Description of the measures (1 to 3 years)
<b>A. General strategy</b>	
Development of a national strategy for urban transport.	<ul style="list-style-type: none"> <li>▪ Definition of strategic principles and directives setting guidelines for urban transport policies;</li> <li>▪ Technical directives for sustainable urban transport policies;</li> <li>▪ Organisational recommendations and assistance for the establishment of sound institutions at the local level;</li> <li>▪ Directives, programs and financing for the improvement of training in the field of urban transport policies;</li> <li>▪ Definition of responsibilities of the different institutional levels and organization of the coordination.</li> </ul>
<b>B. Institutional development</b>	
Establishment of a department responsible for transport planning, public transport regulation, and traffic organization and management within the Municipality of Sana'a (Transport Planning and Traffic Engineering Department - TPTED).	<ul style="list-style-type: none"> <li>▪ Identification of the functions and responsibilities of the new department;</li> <li>▪ Development of the organizational structure of the new department and description of the functions and tasks of the different units;</li> <li>▪ Recruitment of staff;</li> <li>▪ Development of staff training and skills;</li> <li>▪ Appropriate budget for operating expenses and studies needed by the department;</li> <li>▪ Development of a plan setting actions that should be addressed in priority by the new department.</li> <li>▪ Ensuring consistency with the roles played by other key Government agencies such as the Land Transport Agency of the MOT and the Traffic Department of MOI.</li> </ul>
Creation of a High Level Advisory Committee	<ul style="list-style-type: none"> <li>▪ Creation of a High Level Advisory Committee providing guidance to the TPTED.</li> </ul>

Improvement of transport planning and traffic engineering skills.	<ul style="list-style-type: none"> <li>▪ Development of a graduate program in the fields of transportation planning and traffic engineering at the University of Sana'a;</li> <li>▪ Organization of an emergency intensive training program for employees of the Municipality, possibly with the University of Sana'a;</li> <li>▪ Development of the use of internet resources for training of the Municipality staff (e-learning);</li> <li>▪ Development of a program at national level to foster exchange between national experts and to improve access to information;</li> <li>▪ Organization of overseas visit-study tours and involvement in training programs abroad;</li> <li>▪ Development of international cooperation and incorporation into networks to exchange information and experience on urban mobility and transport policies (e.g. associations IMPACTS or CODATU).</li> </ul>
Improvement of enforcement and training of Traffic Police.	<ul style="list-style-type: none"> <li>▪ Development of a training program for Traffic Police;</li> <li>▪ Distribution of improved equipment to Traffic Police.</li> </ul>

### C. Formulation of strategies and the urban transport master plan

Development of a medium to long term (5 to 10-year) multimodal concept and strategy for Sana'a.	<ul style="list-style-type: none"> <li>▪ Identification of coherent objectives in terms of urban development and urban transport performance;</li> <li>▪ Setting of strategic priorities in terms of urban transport and traffic management;</li> <li>▪ Specification of the strategic role and level of priority of the different means of transport, adapted to the needs and constraints of the various urban contexts.</li> <li>▪ Preparation of a realistic investment plan consistent with available financing</li> </ul>
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<p>Improvement of coordination between stakeholders and development of a consensus-building approach in the formulation of urban transport strategies.</p>	<ul style="list-style-type: none"> <li>▪ Setting of objectives in terms of urban transport policies, public transport, and traffic management strategies with the participation of the different stakeholders concerned, including especially the LTA, the Traffic Police, and the operators;</li> <li>▪ Organization of coordination between institutions at the local and national levels;</li> <li>▪ Organization of coordination between transport planning/public transport/traffic engineering institutions and urban planning institutions;</li> <li>▪ Involvement of Traffic Police in the design of transport policies and traffic management measures and development of accountability mechanisms to ensure proper enforcement;</li> <li>▪ Development of citizen participation.</li> </ul>
<p><b>D. Improvement and development of public transport</b></p>	
<p>Reorganization of the public transport network.</p>	<ul style="list-style-type: none"> <li>▪ Strategic study on the future of public transport in Sana'a in general, and on the place and functions of the different types of vehicles providing public transport services (microbuses, minibuses, buses, taxis); ensure consistency between the various existing regulations.</li> <li>▪ Operational study to re-design the public transport network and supply and development of a new service plan;</li> <li>▪ Development of measures giving priority to public transport in the city-centre and on major radial axes converging to the city-centre (e.g. reserved bus lanes, busways, priority at intersections).</li> </ul>
<p>Reduction of capacity and improvement of the quality of public transport services.</p>	<ul style="list-style-type: none"> <li>▪ Progressive elimination of the oldest, and most poorly maintained vehicles;</li> <li>▪ Improvement of performance, quality, and safety standards.</li> </ul>

Reorganization of public transport supply	<ul style="list-style-type: none"> <li>▪ Adaptation of a legal framework to permit a transition to a system of competitively bid route franchises;</li> <li>▪ Progressive implementation of the system of route franchises, including obligations, incentives and sanctions;</li> <li>▪ Organization of a systematic planning process for public transport supply, based on studies monitoring demand and supply.</li> <li>▪ Deployment of bigger buses on the main routes.</li> </ul>
Introduction of mass transit systems on main arteries.	<ul style="list-style-type: none"> <li>▪ Preliminary study for the implementation of a BRT network in the city centre and on the main links to the suburban secondary centres.</li> </ul>
Reduction of excess capacity in the urban taxi sector.	<ul style="list-style-type: none"> <li>▪ Progressive increase in standards for taxi vehicles and services;</li> <li>▪ Improvement of control of the respect of standards.</li> </ul>
Development of a strategy preparing a transition to a more professional and organized public transport system	<ul style="list-style-type: none"> <li>▪ Preparation of a social assistance program for the owners/drivers of old minibuses and taxis;</li> <li>▪ Whenever possible, ensure that current minibus and taxi drivers will be recruited by the new franchised bus operators;</li> <li>▪ Specify the role of informal public transport services in the reformed public transport network;</li> <li>▪ Ensure that there is adequate consultations and that the reform is well understood by all stakeholders including especially the existing informal operators.</li> </ul>
<b>E. Improvement of the street network, traffic management, parking, and pedestrian routes</b>	
Design of a functional road hierarchy and a circulation plan for the city-centre.	<ul style="list-style-type: none"> <li>▪ Study of a functional road hierarchy and a circulation plan for the city-centre of Sana'a, including cars, trucks, public transport and pedestrians;</li> <li>▪ Urgent implementation of the road hierarchy and circulation plan in the city-centre.</li> </ul>

Development of a traffic management strategy.	<ul style="list-style-type: none"> <li>▪ Study of a traffic management strategy, notably for the management of intersections, and in coherence with the multimodal urban transport concept and the objectives of the urban transport strategy;</li> <li>▪ Implementation of the traffic management strategy;</li> <li>▪ Improvement of traffic signalling devices and intersections.</li> </ul>
Improvement of road safety with urgent actions.	<ul style="list-style-type: none"> <li>▪ Inventory of dangerous locations requiring urgent improvements;</li> <li>▪ Implementation of urgent measures to improve safety (e.g. U-turns, parallel service roads).</li> </ul>
Development and implementation of a parking management policy.	<ul style="list-style-type: none"> <li>▪ Based on the data collected by CTMS, study and design of a parking management policy for the city-centre of Sana'a;</li> <li>▪ Implementation of the parking management policy for the city-centre of Sana'a;</li> <li>▪ Enforcement of parking rules, including strict control of parking violations, in particular double-parking.</li> </ul>
Improvement of the attractiveness and safety of walking.	<ul style="list-style-type: none"> <li>▪ Definition and implementation of standards, minimum requirements and guidelines for the layout of pedestrian facilities;</li> <li>▪ Design and progressive implementation of a continuous, attractive and safe pedestrian network;</li> <li>▪ Urgent development of safe pedestrian crossings.</li> </ul>
<b>F. Improvement of the financing mechanisms in the field of transport</b>	
Allocation of appropriate financial means to the city of Sana'a.	<ul style="list-style-type: none"> <li>▪ Continued support from the national budget for economically justified projects shown as priority in the urban transport master plan.</li> </ul>
Increase public investment in public transport infrastructure.	<ul style="list-style-type: none"> <li>▪ Setting up a policy for a more balanced distribution of funds between road infrastructure and public transport infrastructure;</li> <li>▪ Allocation of substantial additional means to the development of public transport infrastructures.</li> </ul>

Encouragement of private investment in public transport services.	<ul style="list-style-type: none"> <li>▪ Reduction of excess capacity in the informal public transport sector;</li> <li>▪ Setting up of a clear and predictable regulatory framework for public transport operations;</li> <li>▪ Organization of a gradual transition to a system of route-franchises;</li> <li>▪ Ensuring fair and consistent enforcement of regulations.</li> </ul>
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## **ANNEX 1 – List of key references used for this review of urban transport**

- All documents of the Comprehensive Traffic Management Study for Sana'a City (CTMS), and in particular :
  - Data collection report, July 2005 ;
  - Interim Report, September 2005 ;
  - Immediate Action Plan (IAS), volume 1: Report, December 2005 ;
  - Final report volume 1, Main Report: Development of Medium and Long Term Plans, March 2007.
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- Stadnicki, Roman, 2006, “Des portes de Sana'a aux nouvelles entrées de la ville: reformation d’espaces de sociabilité”, *Espaces et sociétés*, vol.3, n° 126, p. 119-138.
- Stadnicki, Roman, 2008, “The Greater Sana'a: multipolarity and new forms of urbanity in the capital of Yemen”, *Annales de Géographie*, vol.1, n° 659, p. 32-53.
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- World Bank, April 2008, *Royaume du Maroc, Secteur des Déplacements Urbains : Note de Stratégie Sectorielle*, Rapport No. 40199-MOR.

## **ANNEX 2 – List of key persons met in Sana'a during the consultant team's mission**

### **Ministry of Transport (MOT)**

- Mr. Khaled al-Wazir, Minister of Transport of the Republic of Yemen ;
- Mr. Ali Mutaafi, Deputy Minister at the Ministry of Transport ;
- Mr. Ahmed A. Mayad, Assistant Deputy Minister at the Ministry of Transport ;
- Mr. Gamal A. Alshawbali , Head of Follows Unit for Yemen Railway Feasibility Study.

### **Capital Secretariat of Sana'a**

- Mr. Moeen Hashem Al-Mahaqri, Deputy Mayor for Technical Affairs ;
- Mr. Hamzah Al-Ashwal, Head of Central Projects ;
- Mr. Mohamed Al-Kibsi, engineer attached to the main crossings projects ;
- Mr. Othman Shawka, in charge of the CTMS study and attached to the main crossings projects ;
- Mr. Nameer Zaynal, in charge of the City Development Strategy for Sana'a.

### **Traffic Department, Ministry of Interior**

- Colonel Yahya Zaher, Chief of Traffic Police for Yemen ;
- Colonel Nadeem Al-Terzi, General Manager for Traffic Police in Sana'a.

### **Sana'a University**

- Dr. Abud Al-Salam and Dr. Abdullah Al-Meswari.

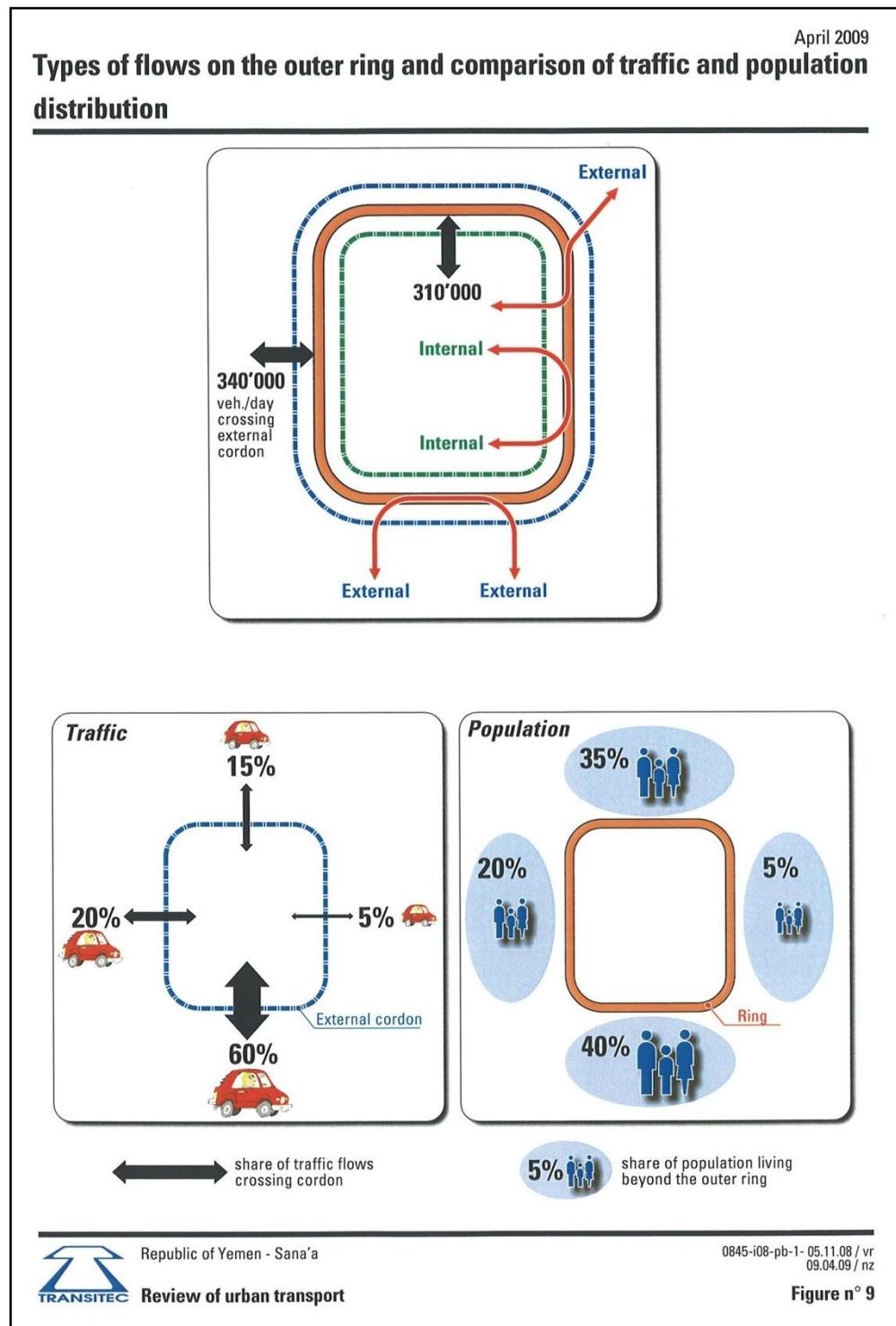
### **ANNEX 3 – Analysis of traffic flows crossing the internal ring road**

A comparison was made between the distribution of traffic flows crossing the outside cordon and of the population living on the external side of the cordon. This analysis shows the following main features of traffic:

- the majority of traffic flows crossing the cordon are located south of the perimeter. This corresponds to 60% of traffic flows (between 180'000 and 200'000 vehicles per day) ;
- there is a remarkable correspondence between traffic flows and population on the western and eastern sides of the cordon (respectively 20% of traffic flows and of population on the western side and 5% of traffic flows and of population on the eastern side). However, the same observation can't be made about the northern and southern sides of the cordon ;
- the proportion of the population living north of the cordon is much higher than the proportion of traffic flows crossing the cordon on this side, probably because of the presence of an important low-income population living in spontaneous housing and a lack of economic activities ;
- the proportion of traffic flows crossing the cordon on its southern side is much higher than the proportion of the population living south of the cordon. This can be explained by the presence of numerous economic activities, notably in Haddah.

These results are shown schematically in the graphs on the following page.

## Types of flows on the outer ring and comparison of traffic and population distribution



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