•• **These surveys also show a high percentage of students**: 70% of the population in the countries of Africa, the Maghreb and the Caribbean are aged under twenty-five and 50% are under fifteen. In all the developing countries, the organization of the school bus service is a major concern.

The problems are twofold:

- How to provide for heavy traffic flows concentrated into restricted time periods and corridors, which require large, unprofitable vehicle fleets;
- How to address the problem of fares.

Different solutions have been adopted:

- Students in Tunis, who account for 30 to 40% of the traffic, use the scheduled services. They give rise to fare compensations that do not cover the entire cost, the difference being paid for by companies.
- In Morocco, public operators are entirely responsible for the school bus service, with compensations that do not fully cover the cost.
- In Africa and Central America, students use the scheduled services. Fare compensation is non-existent in Central America, and inadequately applied in Sub-Saharan Africa when transport is provided by public corporations.
- However exceptions do exist, such as in Libreville where the school bus is operated by a state-managed company and is subsidized. Transport is now entirely free for students. The transport company is unable to renew the vehicle fleet for two reasons: State transport subsidies have been reduced and there is no political will to ask for contributions from households.
- In Cameroon, to make up for the total lack of public transport since Sotuc went into liquidation, the Cameroon Teachers' Association is endeavouring to set up a special mutual-benefit type of transport service. Aid has been sought from France for this initiative.

The characteristics of transport supply

▼ Supply capacities to be mobilized

•• **On the busiest road sections**, the transport capacities offered by minibuses or midibuses require a regular fleet of vehicles that is not consistent with the road characteristics. In Abdijan, for instance, on the Abobo and Yopougon roads, where traffic exceeds 10,000 people per hour and per direction, the minibus equivalence to the Sotra standard and articulated buses would require 8 minibuses per minute and per bus route[16].

Public transport systems are determined from peak hour demand on the busiest sections, from medium and long-term forecasts and from the possibilities of integrating these systems into the urban fabric. Urban and population growth in the cities under study, which have one or more million inhabitants, has already caused peak hour traffic on the busiest corridors to exceed 10,000 travellers per hour and per direction. This lends credence to the idea that heavy systems must be adopted quickly.

The matching of transport modes to traffic is summarized in the following table. The average capacity per mode takes account of local conditions, which are different from European standards of comfort. These figures form the low end of the range.

Transport mode	Shared taxis (1)	Minibus services (2)	Midibus services (2)	Bus services (2)	Exclusive R.O. W buses (3)	Articulated buses (3)	Tramway	Light rail	Heavy rail
Hourly capacity per direction	320 *(4x20x4)*	600 *(30x20)*	900 *(45x20)*	2,000 *(100x20)*	7,200 *(60x120)*	9,600 *(60x160)*	15,000 *(60x250)*	40,000 *(40x1000)*	70,000 *(30x2300)*

(1) for 20 taxis making 4 trips per hour with 4 passengers.
(2) on the basis of a 3-minute interval at peak hour (20 vehicles per hour).
(3) on the basis of a 1-minute interval at peak hour.

- Buses must be suitable for local operating conditions and road conditions. At present, the ranges of national vehicle manufacturers do not include this type of vehicle, although a more thorough investigation of the Karossa vehicle must be made, which is a standard, articulated bus, a few of which are currently in service. In Central America and the Caribbean, the most common vehicle is the Brazil Mercedes-Benz.

- As regards railway vehicles, Alstom has just developed a modular tramway, Citadis, with a highly expandable capacity and a price considerably lower that that intended for the European market. Alstom may also produce a vehicle derived from Citadis at an even lower price.

Heavy rail modes require costly investment in infrastructure and rolling stock. It is therefore advisable to focus financial effort on the existing lines (Abidjan, Dakar, Kinshasa and the cities of South Africa) and/or lines that can be rehabilitated (Mauritius, San José in Costa Rica, Lagos, Lusaka). At all events it is essential to preserve urban railway rights-of-way from any building work or use that might prevent them from going back into operation.

In the absence of existing railway lines, an effective, less expensive temporary solution is to implement traffic plans that reserve certain lanes exclusively for public transport or to build exclusive rights-of-way for buses.

The experience of Latin American cities, and particularly that of Curitiba, is instructive in this respect. In Curitiba, the bus right-of-way has been a key component of urban policy. Over a long period,

Dakar "Train Bleu" – Société Nationale des Chemins de Fer, Senegal.

investments were regularly made and organizational and technological innovations introduced. The system has now reached its limits in terms of the capacity offered and a transfer to a heavier transport mode, such as the tramway, is being considered.

The introduction of a new heavy rail system is a radical technological, organizational and financial change from a bus system, particularly for countries that have forfeited their railway culture. There are no examples other than Tunis in the area under study. However, projects are underway and under discussion in various countries: Casablanca, Oran, Algiers, Mauritius, Cape Town, San José in Costa Rica, Santo Domingo, San Salvador, Havana. Studies involving manufacturers, operators, financial institutions and ministries can thus be initiated with policy-makers on these projects, which are subjected to heavy international pressures.

•• **The operating costs of high-capacity vehicles (standard and articulated buses) are much lower, per seat-kilometre provided, than costs of small vehicles such as minibuses or microbuses**. Calculations made in Cameroon on the basis of second-hand vehicles operated under comparable conditions, have shown a cost, per seat-kilometre provided, of CFAF 20 for minibuses, CFAF 3 for standard buses and CFAF 30.4 for taxis (1995). In 1995 in Abidjan, the cost per seat-kilometre provided (fixed costs not included) for Sotra buses was around CFAF 5.3 and for gbakas was CFAF 9 to 10. But informal practices make it necessary to bring these costs into line with those of Sotra. The kilometric cost advantage of small vehicles is the result of operations below the most basic standards. In Abidjan, informal operating of gbakas reduces the main expenses in the following proportions: 50% of standardized expenses for tyres/maintenance, repairs, 75% of standardized payroll expenses, no change in payroll costs for 6 years, hardly any fixed costs (compared with around 30% for Sotra) and no write-off. However, the road condition often makes it necessary to use small vehicles that also have the advantage of being easier to repair and require less investment in training.

The slow maturing of the Casablanca rapid transit system

Introducing a heavy transport system of the tramway, light rail or rapid transit type into an urban area is a long drawn-out process. Between the time of the decision- which generally results in a political act involving a decision at governmental level or by the municipal council with the government's backing - and the opening of the service, more than ten years may pass. In developing countries, the macroeconomic consequences of a project of this size require a national decision. For the Casablanca transit system, the most recent projects under debate concern a high-capacity "light rail" system, partly underground and partly at grade, on an exclusive right-of-way. The first feasibility studies of a priority line on a reserved track date back more than twenty years. In the 1970s, studies by Sofretu financed by France and studies by JICA with a grant from Japan, had both concluded on the need for a priority corridor (North-South corridor of the Casablanca urban area) and on the feasibility of a light rail project on this corridor, for which traffic forecasts were in excess of 15,000 people/hour/direction by the year 2000. The project was reactivated in 1992 at the request of the Highest Authorities of Morocco. A group was then formed of the companies Systra/Alstom, and Bougues, the leader, which made a proposal for the construction of a first line about 10 kilometres long over the already-identified layout.

This project has received official backing from France, which has decided to finance the feasibility studies of the first line by a grant of F 30 million. These studies by the Bouygues group should dispel any uncertainty concerning the construction and operating of the system: the setting up of a regulatory authority in charge of the project and coordination with the bus system, operating conditions, fares, financing and studies of the preliminary design of the system.

Organizing supply around a ranked network

Transport supply must be structured so that the provision of rolling stock matches the corresponding traffic flows.

Transport modes can be organized in:

- Mainline services on busy routes (railway mode or bus service that may or may not be on an exclusive right-of-way);
- Neighbourhood services forming a feeder network linking up the mainline services and providing local access to some districts using vehicles of lower capacity but more suitable for the road conditions (midi and minibuses);
- Organizing taxis at feeder points to enable travellers to transfer between modes in satisfactory conditions of safety and comfort;
- Networking around organized intermodal terminals forming interchange points for all modes (taxis, midi and minibuses, urban and interurban buses, railway modes). The organization of these intermodal terminals, which go beyond the concept of the railway station, is key to good operating of the system (coordination of modes, rota system, schedule reliability). Taxis and small operators will only follow modal split rules if they will continue to receive sufficient income. Allocating areas of coverage departing from intermodal terminals should consolidate their potential customer base and discourage them from competing with the other modes in their area.

Road and traffic conditions

Road conditions and traffic organization are two key factors of public transport profitability. Climatic conditions have a considerable effect on the roads. The heavy rains in tropical regions cut up the roads and make traffic circulation difficult. Even “truck chassis” types of buses sustain damage that may be heavy (axles, transmission) or lighter but troublesome and expensive (punctures, engine mounting problems, etc.). Breakdowns reduce vehicle availability and therefore affect the day-to-day survival of and revenue from the transport system. But they also affect vehicle lifetime and therefore costs. Repeated failure of automotive components, which requires repairs in often hazardous conditions and with spare parts that may be of doubtful origin, will shorten vehicle life. It is

Exclusive busway in Abidjan.

therefore essential for roads to have a foundation structure (load-bearing capacity), pavement design (wearing course), behaviour change (mechanical strength), drainage and waterproofing, that is appropriate for the weather conditions, to make the transport system sustainable and be certain of the lifetime of the rolling stock.

Urban traffic conditions and management are also key to successful public transport. To improve these conditions, traffic plans that rank the road priorities must be drawn up. This requires efficient urban road signs, traffic lights and surface marking. The road must be signposted to facilitate traffic flow with areas reserved for public transport wherever possible (reserved lanes, bus stops, exclusive rights-of-way, etc.).

But no measure will be efficient unless the regulations are enforced. A successful traffic plan and road ranking require a control system to be set up based on existing structures and legal measures. It is important for the responsible authority to make an effort to legalize these measures.

▼ Choice of equipment and conditions of maintenance

•• Choice of equipment

Several parameters are key to these choices:

- The choice between new and used equipment

  As explained earlier, it is only a temporary expedient to adopt secondhand European vehicles because the next wave of secondhand vehicles on the market will be equipped with electronic components unsuited to local conditions of maintenance and use. It is preferable to have the chassis and engine fitted with bodywork tailored to these local conditions, in an assembly centre able to cater for a large enough geographical area to make the investment pay (e.g. Carici in Abidjan for West Africa, Mercedes-Benz in Brazil).

  There are three advantages to this solution:
  - It brings down vehicle prices
  - The transport of parts from the producer countries is less expensive than the transport of vehicles and the lowest payroll costs in Europe;
  - It creates jobs and wealth for local benefit;
  - The vehicle bodywork and interior and exterior trimming take better account of the requirements of local use.

- Vehicle size
  - The characteristics of each vehicle type must be examined in depth with manufacturers and local experts;
  - The operating characteristics must match the vehicle type.

  It is quite possible to operate vehicles with different capacities on different routes but the management of a composite fleet on the same route presents greater or lesser difficulties depending on the use:
  - It is possible to replace standard vehicles running at peak hours by midi or minibuses during off-peak hours, providing the standard vehicle fleet is used for other services. It remains to be proved whether or not this is more profitable.
  - However, it is extremely difficult to manage vehicles with different capacities and commercial speeds running on the same route. Small vehicles have shorter stopping times and faster service. The road must therefore be wide enough to permit overtaking.

  For this reason, it is theoretically advisable to continue to allocate routes on the basis of a specific vehicle.

- The homogeneity of the vehicle fleet facilitates maintenance operations.
  At all events, it is important to have an efficient after-sales service to monitor the vehicles - a local company for the bodywork and a dealer firmly established nearby for the mechanical components, in order to shorten spare parts procurement times, which are a major cause of idle vehicles.

•• Conditions of maintenance

These are essential to ensure the sustainability of the equipment but they must be re-engineered in the light of audits performed on the public corporations. Maintenance overmanning, excessively sophisticated, expensive tooling and exclusive contracts for the supply of spare parts have over-inflated maintenance costs without ensuring the availability and good

Maintenance facility in Santo Domingo.

condition of the vehicle fleet - quite the reverse in many cases. It is therefore essential to control these costs. However, field studies have shown that some theoretically attractive solutions do not provide sufficient guarantees (but this does not call into question operator-managed maintenance).

- Field studies have shown that at present, local garages do not provide a viable solution in Africa and the Caribbean, particularly for major repairs, owing to the sizes of the fleets requiring maintenance. This is particularly true when a number of lines are started with vehicles covering the same annual distance. For maintenance of a network's buses to be provided in local garages, the standby fleet would have to be increased (bus maintenance and repair are not necessarily priorities in a garage workload) and local garage facilities would have to be upgraded. In Central America, local garages are used more often, in San Salvador, for instance.

- A second solution has also been explored. Under a maintenance contract with the vehicle manufacturer, all maintenance and servicing could be subcontracted to local dealer facilities. However, dealers' responses make this solution unfeasible, as it would require an extension of their facilities, which is not what they want. As a rule, dealers prefer to send their employees out to customers' own facilities.

The fleet volumes, vehicle availability requirements and specific nature of the vehicles, have caused most of the networks to set up specialist facilities with a legal status that guarantees independent management: a private company, a GIE, or specification-based concessioning to a private operator. A prerequisite for putting any vehicles into service is to set up a maintenance facility. This is urgent in order to preserve the technical skills developed in the public corporations. Specific financing arrangements must be provided to meet the initial investment cost. In the Maghreb and Central America, the biggest operators have their own maintenance facilities[17] and garages have the capacity to provide maintenance for small operators.