"THE MÉTROBUS NETWORK OF ROUEN – ONE POLICY FOR THREE MODES OF TRANSPORT"

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Abstract :

**"THE MÉTROBUS NETWORK OF ROUEN –
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The last two decades have seen major developments in new high performance transport technologies suited to the provision of public transport of medium-sized cities or conurbations.

- New LRT systems first appeared in Nantes and Grenoble, and were immediately seen as a possible solution to Rouen's problem of how to reunite the two banks of the Seine. A light rail also offered two politically attractive possibilities: revitalizing the hollowed-out city center, and overcoming the increasingly harmful dominance of the automobile.

- Rouen's subsequent choice of the guided TEOR lines showed how a metropolis with limited financial resources could reliably meet higher demand than that provided by buses at reasonable cost.

- Although the bus is the only conceivable mode for very remote areas, Rouen has been able to adapt it in terms of both design (low floors, pollution-free standards), and operation (segregated right-of-way and location of connecting stops) to complement the other two modes as feeder services, thereby ensuring easy and barrier-free access for all passengers to all modes.

Métrobus network has become a showcase for medium-sized networks which combines in an efficient way three different modes of transport.

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1 – GENERAL OUTLINE OF MÉTROBUS NETWORK

The Rouen Conurbation in northern France is a large metropolitan community (some 400,000 inhabitants) composed of 37 districts (communes) with public transport organized by the Rouen Conurbation authority (*"l'Agglo de Rouen – Haute Normandie"*).

In the last 10 years, this body has followed a policy of developing the urban public transport network ("Métrobus") based around the construction of two light rail lines and a performing bus service (34 lines) complemented by the development of the Rouen East-West Transport project (TEOR).

During the 10-year development period, Métrobus network passenger kilometers have increased by 22%, while trip numbers have grown by 56% and revenue by 64%.

2 – LIGHT RAIL

2.1 – Historical Review

The geography and location of Rouen imposed several major constraints on transportation; the conurbation is bisected by the River Seine and the city of Rouen is surrounded by several elevated plateaus at 150 m. In addition, the city has an ancient and historic center.
These three elements created severe difficulties for urban transport operations and have thus hindered development of efficient mass-transport system.

The final decision to build the Rouen light rail (2 lines) was made in 1990 following 10 years of feasibility series.
The transport capacity and structuring effect of a light rail were major factors in the decision to build the north-south light rail on segregated right-of-way lanes.

2.2 – Description of Rouen's light rail

Figure 1 Rouen's Light Rail Network

The two light rail lines follow the routes of the two most heavily used bus lines and was also based on population density and industrial workforce.

The lines cross five rural districts – Rouen, Petit-Quevilly, Grand-Quevilly, Sotteville and Saint-Etienne-du-Rouvray.

They have two branches on the south side of the river Seine that link up to form a shared section between Saint Sever station and the terminus at Boulingrin.

The light rail is running wholly on its segregated own right-of-way lanes.
The right-of-way on the north side of the city mostly runs in a 1.7 km tunnel with 4 underground stations (Beauvoisine, Gare-Rue-Verte, Théâtre-des-Arts and Palais-de-Justice). The river Seine is crossed on a road bridge. The tracks on the south bank are mostly elevated, but there are three underground intersections (Place Joffre, Boulevard de l'Europe and Avenue Jean Rondeaux) and one underground station (Joffre-Mutualité).

There is signal priority for light rail at all road crossings in order to allow regularity of service and better average operation speed.

Figure 2 Right-of-way for light rail

Table 1 Summary of priority measures for light rail

The twin-directional rolling stock, built by Alstom, is a standard French tramway, made up of two articulated bodies mounted on two driving bogies and a low-floor middle section on a central carrying bogie.

The Rouen Conurbation Subway Company (SOMETRAR: *« Socíeté du Métro de l'Agglomération Rouennaise »*) was granted the franchise to finance, build and operate the Rouen light rail, while the Rouen Public Transport Company – TCAR, a Connex subsidiary (group: Véolia Environnement) operates the Métrobus network and assumes both the financial and operating risks.

Table 2 Light rail key figures for 2003

2.3 – Performance assessment

It has exerted a strong and visible "public transport on its exclusive right-of-way"-effect: considerable impact on Rouen's businesses, the metropolitan structure and in a broader meaning it has been a tool for overall urban development.

Rouen's light rail has proven that it had the qualities that are usually attributed to public transport on its own right-of-way: capacity, comfort, regularity, frequency, speed, accessibility, etc.

In Rouen commercial results can be seen from year to year: About 60,000 daily passengers carried and a total of 15 million passenger per year. Moreover, the light rail has played a role in driving the overall results of the Métrobus network.

Furthermore, its use of high-level architectural features matching the surrounding environment has added to the city's attractiveness. And finally, the light rail has gone beyond its primary transport role to become a development tool through its effect of revitalizing public urban spaces and the city centre.

Figure 3 Palais-de-Justice-station

3 – ROUEN EAST-WEST TRANSPORT PROJECT (TEOR)

3.1 - Historical Review of TEOR Project

Soon after services started on the first Rouen light rail line in December 1994, the organizing authority ('District' at that time) studied various options for building an exclusive right-of-way line on the east-west axis. However, the solution had to:
Have the capacity to serve a populous university campus, regional hospital and the Rouen Heights district
Be able to handle the grades required to reach the Rouen plateau at an elevation of 150 m
Match more-patchy demand due to the lower population densities and fewer jobs than on the north-south axis
Be easily financed in the light of financial constraints imposed by repayment burdens for the Rouen light rail and other new obligations

Various technologies were explored, including a light rail, single-guideway tyred tramway (TVR, Transport sur Voie Reservée), urban cable car, and buses. At the end of 1997, the authority decided to build three new TEOR lines on an exclusive right-of-way using the TVR concept that would be integrated with the Rouen light rail opened in 1994.

The objective of the 'District' was to operate a mass-transit system on an exclusive right-of-way through the east-west axis of the Rouen conurbation.
The system would offer good operations speeds, frequency, regularity and comfort equivalent to a tramway commensurate with available financial means and citizens' transportation needs.

3.2 – Description of TEOR lines

The three TEOR lines, serving on the right (north) bank of the Seine the heavily populated valleys and plateaus in the east and west of Rouen, run in the city center on a shared segregated right-of-way lane.

- Line T1: Mont aux Malades in Mont-Saint-Aignan – Alfred de Musset in the heights of Rouen/Bihorel (16 km including 26 stations)
- Line T2: Mairie-V. Schoelcher in Notre Dame de Bondeville – Durécu in Darnétal (12 km including 25 stations)
- Line T3 : Bizet in Canteleu – C.H.U. Charles Nicolle in Rouen/Franqueville-Saint Pierre (20 km including 41 stations).

Figure 4 TEOR lines (phase 1, fully developed by the end of 2006)

After finishing the development phase in the city center the shared section will be about 4 km with 11 common stations between Mont Riboudet and C.H.U. Charles Nicolle. It will run wholly on segregated lanes.

Depending on the sections, TEOR lines will run after the end of phase 1:
- 31% of lines in protected lanes (which can not be crossed or used by other vehicles)
- 14% of lines in reserved lanes (which can be crossed by other vehicles)
- 55% of lines in normal rad traffic

Figure 5 TEOR right-of-way lanes

The concept of the TEOR lines is to provide to the passengers every day travelling conditions which can be compared with light rail, thanks to
new infrastructures which assure a high schedule speed
high performance technically innovative rolling stock with innovative technical features
high quality station infrastructure

Construction plans called for two phases:
Phase 1 consists of the complete T1 and T2 and a part of the T3 on section running on its own right-of-way, with completion by 2006 (50 stations)
Phase 2 with completion of T3 after 2006 to serve final total of 70 stations.

The Rolling stock on these 3 TEOR lines will consist of 66 Irisbus-built Agora-type articulated vehicles with optical guidance in order to permit perfect accessibility the stations. However, pre-production testing of two Irisbus CIVIS vehicles (articulated bus with electric powered wheel axles) resulted finally in adoption of the proposed optical guidance technology on the Agora articulated vehicles.

3.3 – Current situation

So far, only the western ends of the T1 and T2 lines and part of T3 line have been opened. The current 41 stations (16 fully completed) are served by 38 Agora articulated vehicles fitted with optical guidance, as well as by the two CIVIS testing-vehicles.

The optical guidance system which is installed in all TEOR vehicles is used only when docking in station. This docking system pulls the vehicles to within 50 mm of the platform offering barrier-free access to all passengers and eliminating the need for wheelchair ramps, etc., when the self-service doors open.

At any time the driver can switch from guided to manual operation without stopping or slowing down.

Table 3 Summary of priority measures for TEOR in 2004

Figure 6 Agora articulated vehicle at stop with ground lines for optical guidance

Table 4 Key figures of TEOR for 2003

3.4 – Performance assessment

Only part of the TEOR project has been completed so far-the sections in the city center and to the east of Rouen will be built from 2004 on. As a result, it is difficult to assess the performance accurately.

Up to now the completed segregated right-of-way exceeds 10 km, art structures have been realized and the vehicles in operation are very comfortable and use the optical guidance. The public has thus profited from the benefits which were expected of this project: circulation on exclusive right-of-way lanes, regularity, accessibility and comfort.

People are making close to 30,000 daily trips which means that the TEOR lines are seeing substantial increases in ridership of 10% to 30% compared with passenger numbers on the former bus lines, and undoubtedly, the attractiveness of this mode of transport will increase as soon as the city center is fully developed.

The TEOR-concept seems to offer an interesting and a good quality alternative to communities wanting to avoid massive costs for a heavy mass-transit system by integrating this concept with other transport lines on a previously built segregated right-of-way.

4 – THE BUSES

4.1 – Short description – hierarchical organization of the bus network

The services offered by the Rouen light rail and TEOR lines outlined above are complemented by bus services organized vertically around the exclusive right-of-way lines as follows:

1) Backbone bus network
   Buses in this network operate services radiating from or feeding into the light rail and TEOR lines at frequencies of 12 minutes or less.

2) Complementary bus network
   These are typical bus services running at frequencies of between 12 and 25 minutes.

3) Extended bus network
   Regions with very low population densities are mostly served by smaller minibus-type vehicles.

4) Interurban coach network
   Long distance travel between urban perimeters is achieved using interurban coaches.

5) School bus network
   When there is no regular bus service, school buses provide links between residential districts and educational areas when schools start and end.

Table 5 Bus key figures for 2003

4.2 – Development policy for the bus network Example of LISOR (Liaison Sud-Ouest Rapide)

Following the successful example of TEOR, the Rouen conurbation organizing authority (l'Agglo de Rouen - Haute-Normandie) has decided to put in place the same development policy for the main bus lines in order to provide a better service quality. The aim was to reach the service quality offered by TEOR.

The LISOR bus line which connects the towns from the south-west of the conurbation to the city center is a good example of this policy.

Figure 7 LISOR running under the fast express road Sud 3

This policy is based on:

- a line study which showed the most direct route possible and also the possibility of realize if necessary new infrastructures (in the case of LISOR: use of a new carriage way running under the current fast express road which exits Rouen from the south and benefits from facilities which improve the commercial speed.
- The construction of right-of-way when approaching "critical places" of the general circulation.
- Giving buses priority at road junctions.
- Developed stations with elevated platforms and quality equipment.
- Low-floor vehicles, fully accessible to wheelchair users and providing the most comfortable facilities (e.g. air-conditioning).

Based on this policy, the Rouen conurbation authority decided to develop one of the busiest bus lines of the network. It re-structured and improved its facilities along this line.

Figure 8 Interchange station for bus and light rail

4.3 – Equipment

Ideally, customers using a transport network based on different modes each utilizing different technologies should not view the network as multi-speed.
Thus, equipment introduced for the right-of-way lines has to be also beneficial to the bus lines.

Various solutions have been adopted on the Rouen Métrobus network as follows:

- Installation of an Operating Assistance System (SAE) on all light rail, TEOR and bus lines.

- Installation of a Passenger Information System (SIV) terminals in all light rail and TEOR stations, as well as in 12 major bus connection stations. Some information is also provided by in-vehicle electronic displays on all transport modes.
- Network-wide magnetic ticketing.
- Through-ticket vending machines throughout light rail and TEOR lines (expected by 2004).
- Same-level barrier-free platforms on light rail, TEOR and Liaison Sud-Ouest Rapide (LISOR) bus line (extension to other bus lines in progress).

5 – CONCLUSION

Despite the particular context of the Rouen conurbation with its various constraints of urban environment and geography, Rouen has developed its urban public transport network in an efficient way.

- Light rail: Connection between both sides of the river Seine.
- TEOR: Transport running on its own right-of-way adapted to its topography and to a population already widely spread.
- Buses: Essential complement to the heavy modes of transport in order to serve the rest of the conurbation and a good geographic coverage in outlying zones.

The last two decades have seen major developments in new high performance transport technologies suited to the provision of public transport of medium-sized cities or conurbations.

New LRT systems first appeared in Nantes and Grenoble, and were immediately seen as a possible solution to Rouen's problem of how to reunite the two banks of the Seine. A light rail also offered two politically attractive possibilities: revitalizing the hollowed-out city center, and overcoming the increasingly harmful dominance of the automobile.

Rouen's subsequent choice of the guided TEOR lines showed how a metropolis with limited financial resources could reliably meet higher demand than that provided by buses at reasonable cost.

Although the bus is the only conceivable mode for very remote areas, Rouen has been able to adapt it in terms of both design (low floors, pollution-free standards), and operation (segregated right-of-way and location of connecting stops) to complement the other two modes as feeder services, thereby ensuring easy and barrier-free access for all passengers to all modes.

Launched in December 1994, the Métrobus network has experienced a spectacular development of its commercial results since 1993 (the last full year without light rail services).

Table 6 Key figures Rouen's Métrobus network 1993-2003

The success of light rail has served as a model for developing the TEOR network. The same will be done in future for the bus system, i.e.:

- a mode of transport running on its own right-of-way lanes
- comfort of vehicles
- development of fully-equipped stations
- low-floor accessibility
- re-structuring of the whole public transport system
- technical and technological innovation

Métrobus network has become a showcase for medium-sized networks which combines in an efficient way three different modes of transport.

PHOTO Raymond HUE

Mr. HUE is Chairman and Managing Director of TCAR. He graduated from the Ecole Centrale des Arts et Manufactures de Paris in 1967, and has held various engineering and managerial positions at the Centre d'Etudes Techniques de l'Equipment Normandie-Centre and TCAR. He is also Vice President of UITP and President of the Light Rail Division of UITP.

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Table 1 Summary of priority measures for light rail

Length of tunnel section	1.7 km
Total length of underground section	2.2 km
Number of stations	31
Of which, underground	5
Number of intersections	3
Number of crossings with signal priority for light rail	79
Number of parking spaces for light rail having a deterrent effect on car using in the city center	530
Journey speed	19.06 km/h

Table 2 Light rail key figures for 2003

Total length of light rail lines	15.1 km
Number of trains	28
Journey-speed	19.06 km/h
Headway on shared section during peak hours	every 3 minutes
Headway on each line during peak hours	every 6 minutes
Kilometer performance in 2003	1.427 million
Trips made in 2003	15.233 million
Trips/Kilometer in 2003	10.67

Table 3 Summary of priority measures for TEOR in 2004

Length of operation way on protected lanes	9.4 km
Length of operation way on reserved lanes	4.5 km
Length of operation way on ordinary road	11.7 km
Number of fully developed stations	16
Total number of stations	41
Number of crossings with priority for TEOR	32
Number of parking spaces for TEOR having a deterrent effect on car using in the city center	1000
Journey speed	16.48 km/h

Table 4 Key figures of TEOR for 2003

Length of the TEOR network	25,6 km
Number of Vehicles	
Agora buses	38
Pre-production CIVIS	2
Headway on shared section during peak times	every 3 minutes
Headway on each line at off-peak times	every 4 minutes
Kilometers performance in 2003	1.658 million
Trips made in 2003	6.854 million
Trips/Kilometer in 2003	4.13

Table 5 Bus key figures for 2003

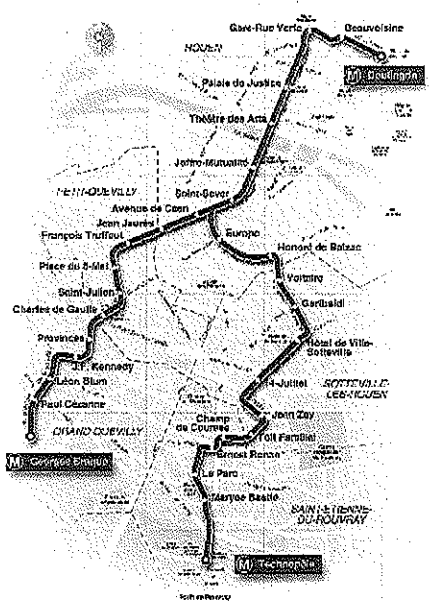
Number of regular lines	34
Length of line	460 km
Number of stops	1,600
Total number of buses	226
Standard buses	162
Articulated buses	48
Midibuses	16
Journey speed	17.32 km/h
Kilometer Performance in 2003	10.021 million
Trips made in 2003	17.631 million
Trips/Kilometer in 2003	1.76

Table 6 Key figures Rouen's Métrobus network 1993-2003

	1993	2003	%
Kilometers	10,677,201	13,106,353	22.75%
Trips	25,316,618	39,718,479	56.89%
Journeys (*)	21,582,796	30,779,288	42.61%
Revenue	9,893,787 €	16,235,990 €	64.10%
Trips/Kilometer	2.371	3.030	27.81%
Revenue/Journey	0.458 €	0.527 €	15.07%

(*) : Trips without counting connection trips.

Figure 1 Rouen's Light Rail Network



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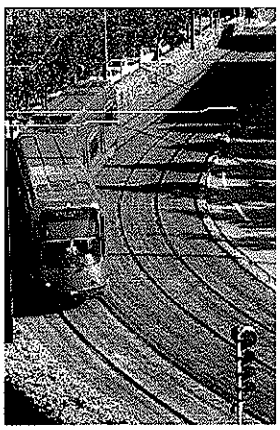
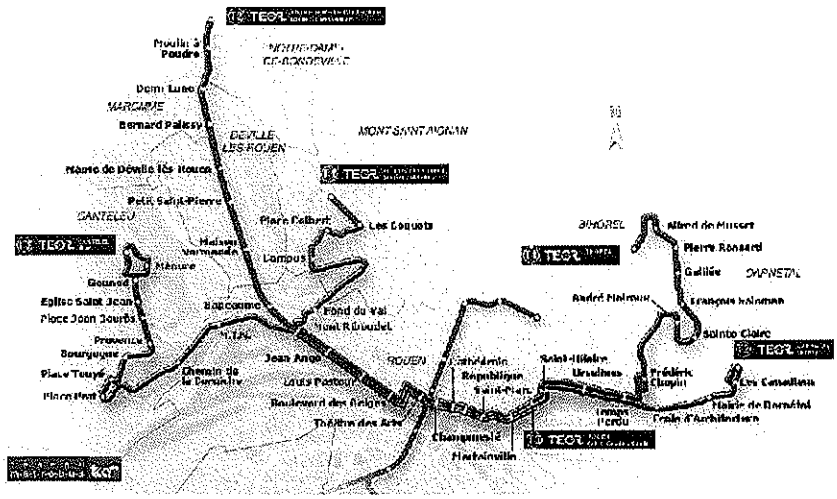


Figure 3 Palais-de-Justice-station

Figure 4 TEOR lines (phase 1, fully developed by the end of 2006)



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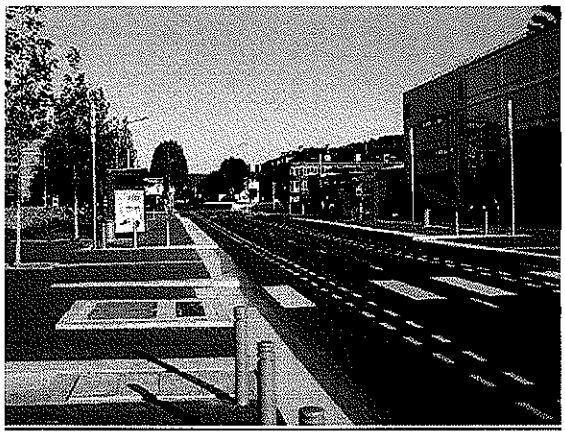

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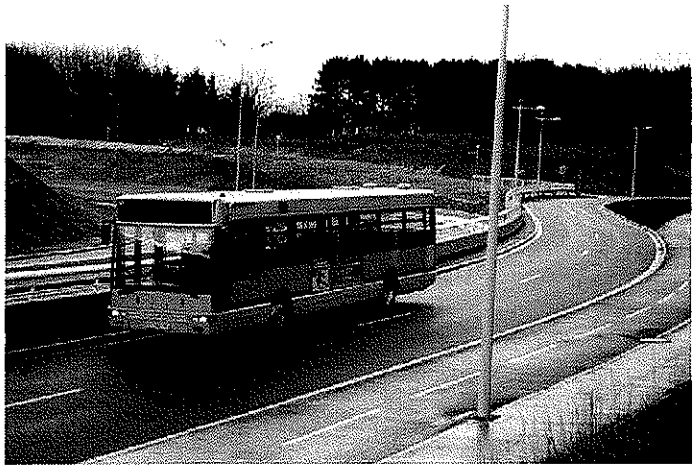

Figure 8 Interchange station for bus and light rail

Photo Raymond HUE