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Sustainable funding for urban public transport

From forecasting to decision-making

French towns that have made a commitment to developing public transport in recent decades have not always reaped the budgetary rewards of their investments. A research project financed by the ministry's Research Division as part of the Predit programme of research and innovation in land transport, whose overall diagnosis has been confirmed by recent developments, has tried to shed light on this situation and sketch out prospects for the future in the form of four scenarios for changes to public transport funding between now and 2015. This was extended through further research with a more operational perspective, focusing on the methodology for analysing the performance of public transport lines.

The research project "Prospective pour un financement durable des transports public urbains" (forecasting for the sustainable funding of urban public transport), coordinated by the Laboratoire d'économie des transports (Transport Economics Laboratory) in Lyon, conducted between 2006 and 2008, aimed to explore the possibility of ensuring the future of urban public transport. It used a sample of 103 provincial towns, of which 22 have over 250,000 inhabitants, 34 have 100,000 to 250,000 inhabitants and 47 have fewer than 100,000 inhabitants.

The research established that revenue per trip fell by 0.6% p.a. and revenue per vehicle-kilometre by 0.7% p.a. between 1995 and 2005, despite a 0.67% p.a. increase in kilometre supply. Similarly, although ridership increased by 0.6%, the rate of use fell by 0.11%. However, the study noted significant differences depending on the size of the town, and these differences have persisted since 2005.

For a comparable sample, including 100 networks and 96% of the traffic on the 130 networks covered by the 2010 annual survey of urban public transport carried out by Certu, DGITM (General directorate for infrastructure, transport and the sea), GART (Group of Transport Authorities) and UTP (Public and Rail Transport Union), the following years (2005-2010) confirmed these trends: while the kilometre supply by public transport continued to increase regularly, revenue per trip fell further and revenue per kilometre travelled was more stable. Only the rate of use was an exception, but solely in the larger networks, which benefit from their own dedicated public transport lanes, and without this increase really having a positive effect on revenue.

The end result was a reduction in the average coverage of expenditure by revenue (revenue/expenditure), which fell to about 35% in 2010 (for the 100 networks) from nearly 45% in 2000, and even to only 31% across all 130 networks. In Germany, conversely, this rate rose on average from 55 to 75% between 1990 and 2010.

The conclusion of the research was that the "public cost" of public transport, defined as local authorities' contribution to cover the difference between the total cost of the networks (investment and operations) and the allocated revenues (commercial revenue and the transport tax or VT paid by companies with more than nine employees), risked becoming unsustainable in France. A "business as usual" (BAU) projection for 2015, based on a linear extrapolation to 2015 of the public cost trend for the towns concerned (see figure 2 on page 3) between 1995 and 2005, certainly gave grounds for this fear.

In fact later data (2005-2010) from the annual survey cited above suggest a stagnation of total resources, including the local authorities' contribution. But although the contribution has finally been kept under control, this is at the expense of a significant increase in the VT (see figure 1), which cannot continue indefinitely as its level is capped. In addition, the VT is a tax on salaries, which is subject to criticism in a period of increased unemployment. Supposing that kilometre supply continues to increase at the same rate (having risen from 27.7 to 31.6 vk per head of population served between 2000 and 2010), ridership risks failing to keep pace (except perhaps in certain large cities due to the existence of attractive transport using dedicated lanes and urban travel plans that discourage car use). The combination of these factors thus threatens the financial balance of the system, as the research conclusions suggested.

So how can a funding crisis be avoided? To answer this question, a model was constructed to simulate the total cost of public transport, separating out all the levers that can be influenced (command variables) in order to observe the predictable results (output variables).

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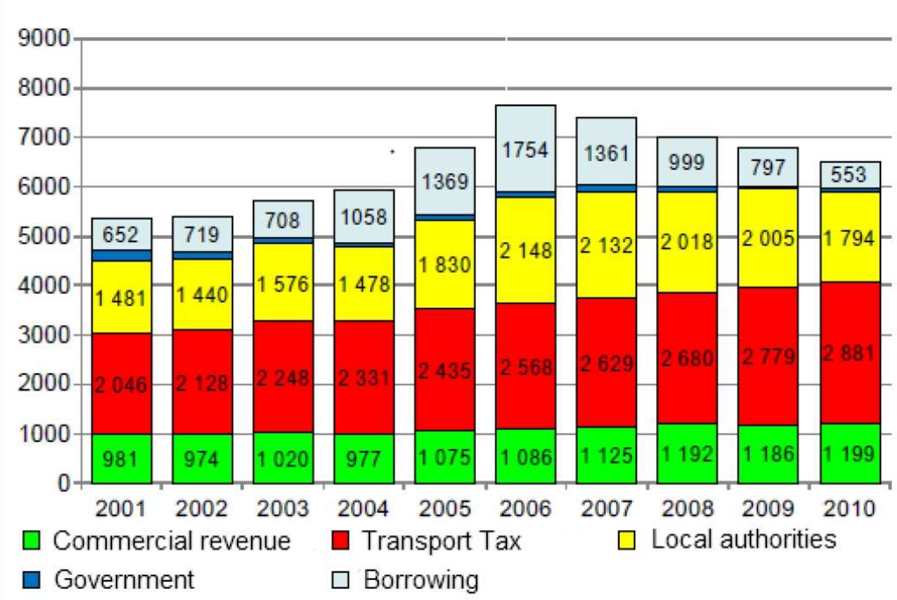
Figure 1: Evolution of funding resources for urban public transport (excluding Ile-de-France)

In millions of euros 2010



Source: GART 2011 (The year 2010 in urban transport)

Four scenarios to shed light on the future

Four contrasting scenarios for 2015 were thus constructed, all giving better results than the BAU scenario but requiring specific efforts.

The first three scenarios illustrate the room for manoeuvre that urban transport authorities have, while the fourth focuses resolutely on the perspective of sustainable mobility, assuming a significant additional cost (see figure 3 and the more detailed description of the scenarios on pages 3 and 4).

The first scenario assumes that the increase in kilometre supply continues. But it suggests remedying the networks' financial situation based on objectives that can only be met through deregulation and a rise in fares.

The second scenario involves maintaining the revenue/expenditure ratio at the 2005 level with two additional goals: stabilising expenditure per employee at the 2005 level and increasing commercial revenues.

The third scenario essentially focuses on resources, aiming to stabilise the public cost proportion of the total resources at the 2005 level.

The fourth scenario contrasts strongly with the other three. It incorporates the target of reducing greenhouse gas emissions by 20%, with a significant reduction in car use for urban travel, which leads to a considerable annual increase in the public cost for the urban transport authorities.

Towards an aggressive funding strategy

The fourth scenario and, to a lesser extent, the first three call the current mode of funding into question, recommending a transition from a defensive attitude to aggressive action.

Questioning the relevance of the effort made to gain customer loyalty through attractive season tickets is a test of the will to change. These season tickets reduce the revenue per trip, because the increased number of season ticket holders does not compensate for the loss of revenue associated with transferring customers from other ticket types. Research shows that urban transport authorities feel obliged by their social role to keep fares moderate, which risks hindering any efforts to initiate a virtuous circle towards greater ridership. At equal purchasing power, season tickets on the Lyon and Paris networks are among the cheapest in Europe thanks to the VT.

Only if the service makes a leap forward in quantity and quality will drivers make the comparison between the price of public transport and the cost of using their car and choose to leave the vehicle in the garage, as in some European cities. Berlin reorganised its network in 2005, after comparing the times taken by car drivers and public transport passengers to cover a variety of routes. The Metrolines network, created from this process, is based on 26 high-traffic lines (less than 10 minutes at peak times, 10 to 20 minutes off-peak), running at high speed, with stations about 800 m apart. It operates 24 hours a day, 7 days a

GLOSSARY (sources: INSEE, Eurostat, UTP and B Faivre d'Arcier)

Cost per kilometre: operating cost divided by vehicle-kilometres produced
Travel: series of consecutive trips with one or more transfers
Ridership: ratio of traffic to the population served (urban transport zone)
Production or **Kilometres produced**: kilometres travelled by all vehicles, across all the services of a network, including subcontracting.
Kilometre supply: ratio of production to the population served (urban transport zone).
Urban transport zone (PTU): area of jurisdiction of the urban transport authority (AOTU) within which the VT transport tax is due.
Population served: population of the communes served (may not correspond exactly to the population of the urban transport zone).
Commercial revenues: revenue from the network's customers, excluding any compensatory revenue from the urban transport authority.
Rate of use: ratio of passenger-kilometres to kilometres produced
Coverage rate (expenditure/revenue): ratio of commercial revenue to operating expenditure (excluding investment in France)
Traffic: number of trips carried out on all the network's services.
Vehicle-kilometre: unit of measurement of production (one vehicle travelling one kilometre).
Trip: a passenger's ride on a single transport line without transferring.
Passenger-kilometres: the product of the number of trips and the total distance travelled in each trip.
Passenger transported: a physical person carried for all or part of a route (excluding staff dedicated to operations).

Description of the four scenarios

① Reducing the public cost

The first scenario combines four variables: on one side, a reduction of 10% in the expenditure per employee (salaries, energy, maintenance, share issues) and of 10% in the number of employees per million vehicle-kilometres, and on the other side a rise of 20% in the ridership in passenger-kilometres and of 20% in revenue per trip.

The result is impressive: compared with the no-change scenario, operating expenditure drops by 19%, commercial revenue leaps upward by 44% and the public cost plummets by 47%, while the ratio of revenue to expenditure of the major networks climbs from 38% to 67%.

These levels of performance involve structural changes in how networks are operated, such as subdividing lines into lots or negotiating new collective labour agreements. They also involve revisions to fares achieved by aiming at more demanding customers and using the resources of ticketing technology.

This means concentrating on lines with strong commercial potential and, in general, questioning the performance of individual lines.

② Stabilising the ratio between revenues and expenditure

The second scenario involves maintaining the revenue/expenditure ratio at the 2005 level. It considers two complementary directions.

The first is to stabilise expenditure per employee at the 2005 level, i.e. a reduction of 5 to 7% compared with the BAU scenario by 2015, and to cut the number of employees per kilometre produced, with a reduction of 13 to 26% compared with the BAU scenario depending on the town (7 to 11% through stabilisation alone). These are ambitious objectives.

The second is to increase commercial revenues via the rate of use (more trips in relation to the kilometres produced). The simulation shows that the effort required varies considerably depending on the size of the network. In large cities, where the rate of use is already fairly good, it needs to increase by 2.2% compared with the BAU scenario (assuming annual growth of 0.8% between 2005 and 2015). In medium-sized and smaller towns, the difference compared with the current situation needs to be considerable, with growth of over 20%. In all, the "public cost" is somewhat reduced for small and medium-sized networks, but not for large networks.

Scenario 2 involves seeking savings in the way production is organised, which may include revising delegation contracts. This scenario thus places the question of internal and external productivity, i.e. better performance on each line, at the heart of the issue. Stabilising the ratio of revenue to expenditure is thus achievable, but subject to certain conditions.

③ Restricting the "public cost"

The third scenario focuses on resources, and does not include any effort to reduce costs (investment or operations). The goal is to stabilise the "public cost" as a proportion of the total resources at its 2005 level (31 to 33% of the total, depending on the size of the town, compared with 37 to 39% by 2015 in the BAU scenario).

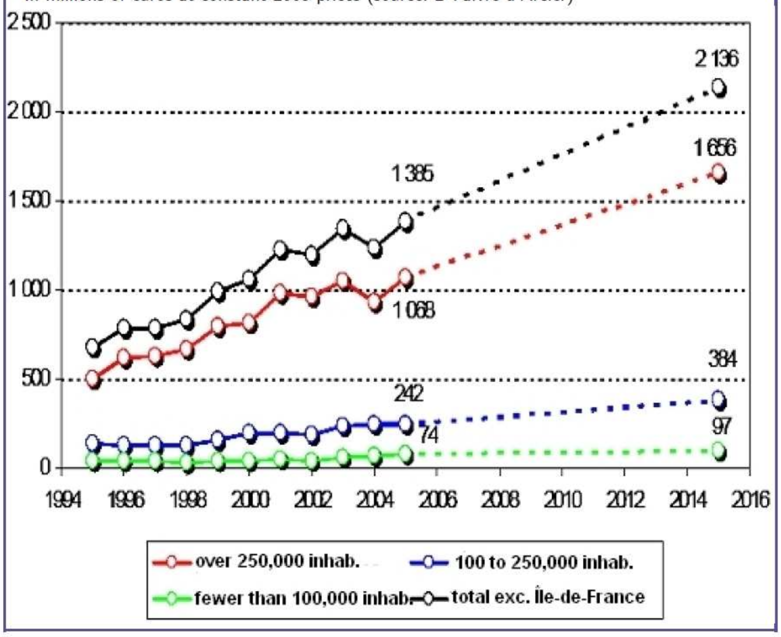
Stabilising the "public cost" as a percentage does not necessarily mean reducing the public contribution in absolute terms: excluding Île-de-France, there would still be an increase of €600 million compared with 2005. This target presupposes €430 million of new resources, including €337 million for big cities, where the public cost is highest. It would be necessary to work on two variables simultaneously: +4.7% a year for the VT, compared with 3.3% otherwise, and +40% for the revenue per trip compared with the no-change scenario.

Adding growth in the rate of use (up to 1.8%/year), we obtain a drop in the "public cost" proportion of 15 to 19% compared with a continuation of the current situation. But this cost still rises by 38% in small and medium-sized networks and 42% in large networks compared with the 2005 conditions.

This scenario highlights the difficulty of stabilising the "public cost" proportion, particularly in two areas. Firstly, negotiating with the contributing businesses about an increase in the VT would be sensitive, especially in the current economic climate. Secondly, the possibility of

Figure 2: Extrapolation of the public cost of public transport

In millions of euros at constant 2005 prices (source: B Faivre d'Arcier)



significantly increasing network ridership while also increasing fares will require energetic measures, particularly in terms of Urban Travel Plans (PDU), to strongly encourage large numbers of drivers to abandon their cars in favour of public transport.

④ Increasing provision for sustainable mobility

The fourth scenario, resolutely different from the others, takes an approach based on sustainable mobility. It incorporates the target of reducing greenhouse gas emissions by 20% by 2020, and assumes a radical choice to reduce the level of car use, particularly in the form of PDUs penalising cars and giving priority to public transport.

It is an ambitious scenario that sets high targets for increasing supply and ridership, with corresponding commitments in terms of resources. It may involve developing transport in dedicated lanes, which multiplies the possibilities for connections, with increased trip numbers of 60 to 70% in large and medium-sized networks and about 50% in small networks.

Four variables are affected, with ambitious targets for change on a large scale:

- the rise in the number of kilometres produced per head of population would be 25% compared with 2005 in large networks and 20% in the rest. This leap forward assumes a rate of growth three to four times higher than that observed between 1995 and 2005.
- the rise in the number of trips compared with the kilometres produced between 2005 and 2015 would reach 30% in large cities, 27% in medium-sized cities and 22% in small cities, representing a significant modal shift.
- the revenue per trip would rise from €0.60 to €0.75 in large cities, from €0.36 to €0.45 in medium-sized cities and from €0.37 to €0.40 in small cities.
- the "other costs" (depreciation, repayments etc.) would rise by 30% to 40% compared with the BAU projection.

The "public cost" per head of population would thus rise sharply: over 5% a year.

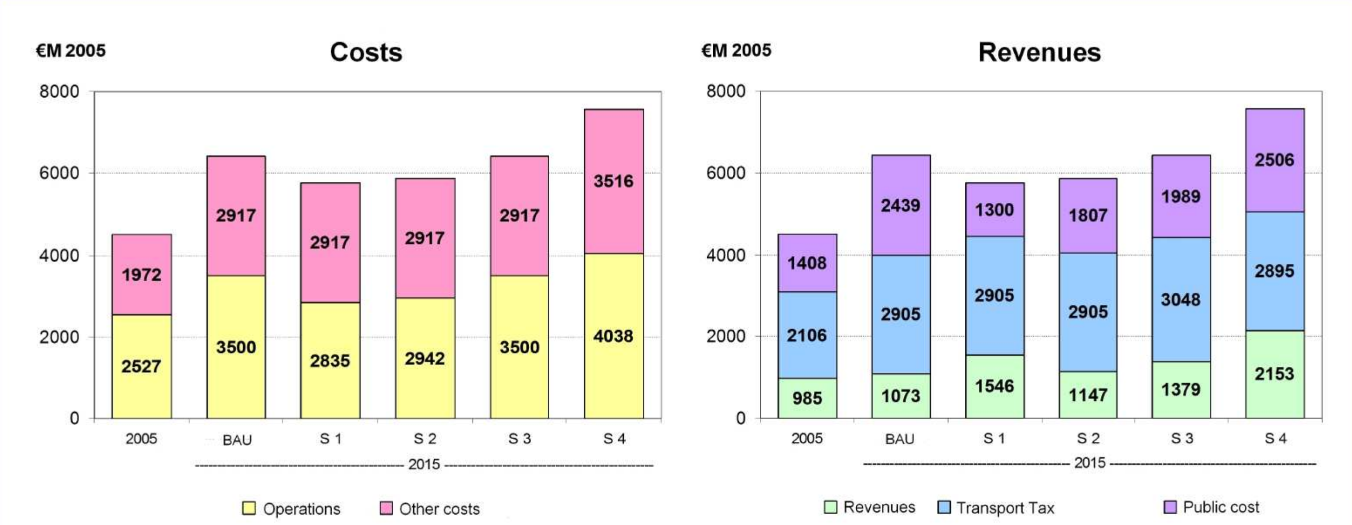
Despite the doubling of revenue due to the rise in fares and the increased numbers of trips, the "public cost" would still be higher, with the VT remaining unchanged in this scenario. This cost would reach €118.87 per head of population in 2015, and up to €200 in large networks, compared with €73.06 in 2005 and €115.72 in the no-change simulation. Even if it were possible to control operating deficits through users' contributions, absorbing the 20% reduction in kilometres travelled by car would require a new funding strategy not only for everyday operations but also for the investments required to respond to such strong growth in demand for public transport.

To find out more:

Prospective pour un financement durable des transports publics urbains (Forecasts for the sustainable funding of urban public transport), led by Bruno Faivre d'Arcier (LET), September 2008, Predit final report no. 06 MT E045

Available from the ISIDORE database of DRI publications: :
http://www.developpement-durable.gouv.fr/La-base-de-donnees-Isidore.html

Figure 3: Comparison of costs and revenues for the scenarios across all 103 networks



week, and its cobweb layout makes connections easier. Result: revenues have increased by 22% over three years and trips by 21 million a year, while operating costs fell by €9.5 million.

Winning new customers also involves strengthening the network around areas with high economic potential, while, for example, choosing transport on demand rather than extending lines in low-traffic sectors (Karlsruhe), subcontracting lines with little commercial potential (Rome, Stockholm) and transferring funding for "social" fares to the general social budget (Barcelona).

A wide range of options

In France, almost half of resources (48.3% on average in 2010 for 175 networks according to GART) come from the VT paid by business. Stronger growth than simple linear evolution is conceivable, but with certain reservations.

Scenario 3 proposes raising the VT from €138 to €158 per head, a rise of 4.7% a year. But such a measure would require changes to legislation, which currently limits the scope of the VT. Annual growth of 4% would require the terms of the tax to be revised: its geographical scope (beyond the urban transport zone), the minimum number of employees above which companies are taxed, or the rate applied.

The search for new resources in scenario 4 can also be envisaged. There are many European examples here, too, of incentives to cut car use (urban tolls, eco-taxes, taxes on capital gains for property near public transport). Other sources of cost reductions are to be found in privatisation, as in scenario 1: subdivision into lots, public-private partnerships, greater competition, subcontracting.

An overhaul of fares should also be accompanied by improvements in productivity. Brussels cut its debt in half between 1994 and 2004 (from €500 to 250 million) thanks to a business plan that reviewed all the facets of network optimisation: production per kilometre of network, capacity, frequency, service speed, quality and safety. The revenue/expenditure ratio thus rose from 35% to 45%.

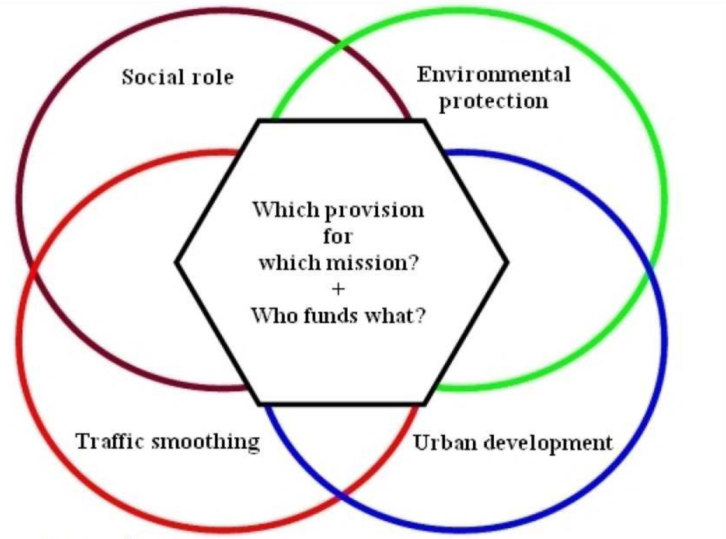
Finally, as previous studies funded by the ministry's research division under the Predit programme have shown, public service delegation contracts provide the potential for increasing productivity (Transaction costs, actors' strategies and operator efficiency in the urban passenger transport sector, Baumstark et al., LET, 2005).

A new network architecture

A new technical network hierarchy thus needs to be put in place, controlling all areas of spending to avoid increasing network coverage that would merely add to the existing supply without helping to remedy the financial situation.

The global architecture of the networks has to be rethought: feeder lines leading to major lines, optimum structuring of the network to organise connections better, concentration on high-potential lines, substitute services at the ends of lines, increased service speed. Depending on the case, this restructuring may involve dedicated public transport lanes, gridding between the centre and the inner suburbs or frequent bus services.

Figure 4:
The four main missionsfor urban public transport



Source: B. Faivre d'Arcier

An approach based on public-service missions

The mission-based approach (figure 4) involves questioning the nature and structure of the proposed transport supply and measuring how funding decisions impact on each of these missions. This approach thus demonstrates that the implicit and explicit equivalence between the social role of public transport and "social" fares funded from transport budgets is no longer relevant, unless the three other missions are abandoned for lack of resources.

Choosing a sustainable mobility scenario makes it possible to ensure environmental protection, smooth traffic and urban development. As for the social role of public transport, which dominates in large and medium-sized towns, this must remain but must no longer be the sole guide of how networks are organised. The future of our towns depends on the ability of public transport to win over a large number of car drivers who are much more sensitive to the quality of the service than its price. In return, their willingness to pay a higher price (as demonstrated by the sums they spend every month on their cars) allows us to consider increasing fares in order to ensure more resources to improve the networks.

In search of a new business model

The response to the results of the research project, alongside the economic and financial context, has encouraged French transport authorities to think deeply about the future of their networks.

The author of the research project's final report has taken part in internal work at GART. He has also presented his work to several transport authorities around France and abroad. At the conference to celebrate GART's 30th anniversary in March 2011, he recalled the threefold need to ensure global consistency in travel and urban planning policy, increase network performance and redefine pricing principles.

GART, meanwhile, has formulated recommendations along the same lines: restructuring networks and improving their commercial efficiency, rethinking fare policy and identifying new resources.

Transport authorities are seeking more and more to limit their costs, striving to rationalise their provision through a more hierarchical organisation of their lines (Nantes, Lyon with Atoutbus etc.) and even by reducing the distances they cover. At the same time, thinking about pricing and the revenue/expenditure ratio is continuing. Transport authorities are thus actively seeking a new business model to guard against the threat of financial imbalance.

The international survey carried out during the research project showed that this tendency to reconsider transport policy as a whole, aiming to moderate supply and increase ridership, is to be found in many European countries. These restructuring efforts often help improve the financial situation.

A methodology for measuring performance

The conclusions drawn from this forward-looking work led to a second research project, financed by the ministry's research division and completed in May 2012, more operational but still along the same lines as the first. Covering performance measurement for urban public transport lines and entitled APEROL (improving the economic performance of networks by optimising lines), this project stimulated great interest among transport authorities. The hypothesis underlying the research is that the potential performance improvements lie primarily in the network architecture. Montpellier and Toulouse provided the context for the research (and Grenoble was used for a doctoral thesis associated with APEROL).

APEROL aims to construct a methodology for analysing the performance of urban public transport networks, one of the keys to their financial stability. The research focuses primarily on bus lines, which constitute the most important element of transport supply. The notion of performance covers productive efficiency, the incentives included in delegation contracts, the attractiveness of public transport supply and its ability to satisfy the goals of public travel policy.

The research emphasises two main dimensions of performance. The first is commercial efficiency (the research does not cover productive efficiency), including the rate of use (number of trips in relation to kilometres travelled), which varies from 0.1 for certain bus lines to several dozen for Paris' RER railway system. But there is also a second dimension, effectiveness, interpreted as the degree to which public policy objectives are achieved in terms of the missions presented in figure 4.

A typology of lines was prepared, based on three main functions: high volumes (concentrating passenger flows on main lines in dense zones, including via feeder lines), connection (access to high-volume lines in dense zones) and diffusion (access to high-volume lines from outlying areas). This results in a distinction firstly between major connecting lines (serving the central business district) and secondary connection lines, and secondly between major diffusion lines and secondary diffusion lines. Commercial efficiency was modelled, demonstrating that the main variable remains the number of runs per day, and that below 100 runs a day transport supply elasticity of demand is low. The model also showed that the best commercial efficiency of connecting lines comes from a large number of short trips, which may be made by bike or even on foot.

Three series of indicators are proposed for gauging the contribution of each line, including the rate of use of the line by each population category (with regard to the social role), the number of vehicle-kilometres avoided at peak times (for the line's contribution to reducing congestion) and the total ratio of emissions avoided to the total emissions of the buses on the line (the line's contribution to reducing CO_2 emissions).

Defining the indicators generated for each transport line resulted in a scoreboard enabling multi-criteria performance comparisons between lines. These criteria are: provision, use, commercial efficiency, social role, decongestion and CO_2 emissions. This makes it possible to establish a diagnostic for each line and to make comparisons with other lines in the network.

We therefore have a method for analysing performance that can be applied to any urban transport network. However, the initial results highlight the need for caution when making comparisons between networks, given the diversity and incompleteness of the data (as well as the difficulty of accessing existing data). But developments in ticketing technology, GIS (geographical information systems) and Open Data should enable progress to be made in this regard.

There is also the later possibility of monetising the positive externalities of the line (decongestion, CO_2, etc.) to relate the public cost borne by the transport authority to the social benefits produced by the line.

These research projects, which have generated consistent interest from all the actors of urban transport, have certainly achieved their aims: after a forecasting phase of coming up with scenarios, designing a tool to aid in decision-making in support of public policy.

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