Development and Implementation of Greater Manchester's Light Rail Transit

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Greater Manchester will soon be constructing the first new-generation light rail transit (LRT) line to involve street operation in Great Britain. The 31-km first-phase system makes extensive use of existing suburban railway infrastructure, and provides new highway-based links across the city center. This paper describes the background of the project, the options considered, and the development of the present scheme through a period of major administrative and regulatory change. A 3-week demonstration of a light rail vehicle, sponsored by manufacturers, strengthened support for LRT, and government approval has now been obtained to proceed to tender stage. Private sector involvement in funding and operation is to be sought. Conclusions are drawn on the approach needed to advance a cost-effective LRT project.

COMPARED WITH OTHER EUROPEAN countries, the United Kingdom has until recently neglected light rail transit (LRT) as an urban transit mode. Now the scene is changing rapidly. In 1980 Tyne and Wear Metro in Newcastle upon Tyne brought light rail technology to Britain, and the automated London Docklands Light Railway took developments a step further in 1987. Both are fully segregated high-platform systems.

The next system will almost certainly be in Manchester, and will exploit fully the flexibility of LRT, including on-street operation. The Greater Manchester project developed in a potentially hostile environment—the Metropolitan County Council had been abolished and bus services had been deregulated. By mid-1988, however, it is anticipated that the pre-tender stage will be under way.

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BACKGROUND

Greater Manchester is a conurbation of 2.6 million people in the industrial Northwest of England (Figure 1). It boasts the world's first passenger railway station (Liverpool Road in Manchester), opened in 1830 on the Liverpool and Manchester Railway and now surrounded by a thriving museum complex. Manchester's railway industries once exported locomotives and components to many parts of the world. The historic major industries of coal, cotton, and heavy engineering have declined and been replaced by new, higher-technology industries. But local companies still make a significant contribution to railways, with GEC supplying electric traction equipment; Whipp & Bourne, dc switchgear; and Davies & Metcalfe, brake equipment.

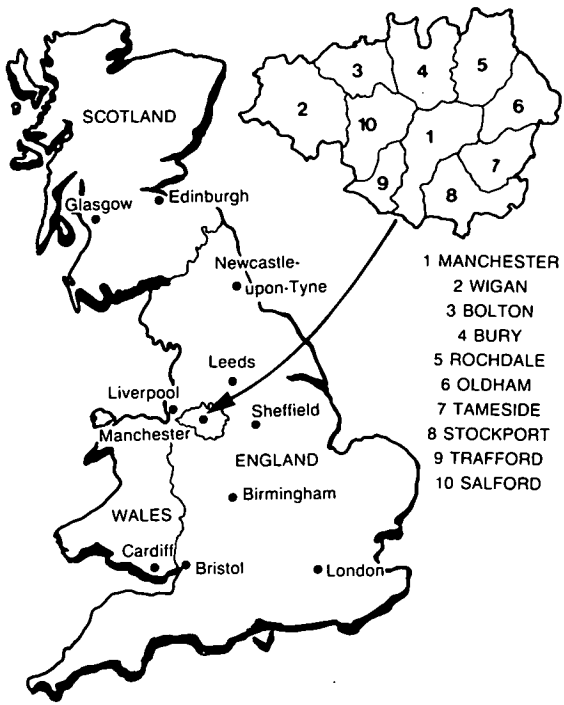

FIGURE 1 Greater Manchester location plan.

About 350 million passenger-journeys per annum are made on public transport, all but 25 million on the extensive bus network. The rest are rail journeys on the 16 radial commuter lines operated by British Rail (BR) under an agency agreement with the Passenger Transport Executive (PTE). The

PTE was set up in 1969 to plan, operate, and coordinate all transit services in the metropolitan county, but since deregulation in October 1986 it has ceased to operate buses and become primarily a planning and financing body.

The rail network suffered from lack of investment in rolling stock and infrastructure, and from having four different traction systems (25 kv ac, 1,500 dc OH, 1,200 dc third rail, and diesel). But the major problems were poor accessibility to the central business district (CBD) and the lack of any north-south cross-city rail link. The rail network was in two virtually separate halves, one north and one south. Five stations, including two intercity terminals, serve the CBD but all are on the periphery (see Figure 2).

The first proposal to build a cross-city rail tunnel between Piccadilly and Victoria was made in 1839. An amazing array of alternative solutions was proposed over the next century, including underground railways, streetcar

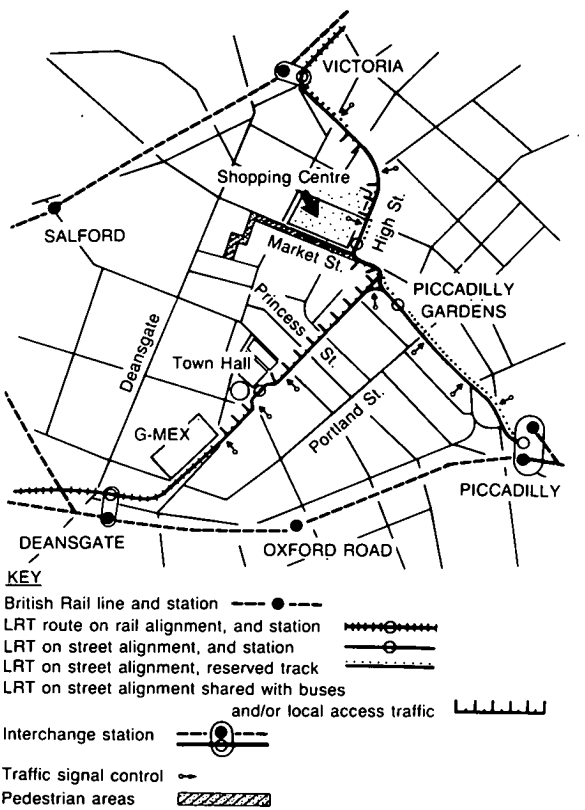

FIGURE 2 Manchester City Centre—existing British Rail lines and proposed LRT lines.

tunnels, monorails, and busways. None was ever built. In the 1970s the "Picc-Vic" tunnel was designed to link suburban lines north and south, similar to Philadelphia's Center City Commuter Tunnel. But even though it obtained parliamentary approval, funding was denied and the tunnel plans were scrapped in 1977.

Then in 1982 the Greater Manchester Metropolitan County Council (GMC), which was responsible for all strategic highways, planning, and transportation policies, decided to set up a joint study team with the PTE and BR. The main objective was to find a sensible and practicable solution to the rail network problems, bearing in mind the likely shortage of capital funds, and the £18 million (U.S. $31 million) annual operating subsidy being paid to BR.

OPTIONS CONSIDERED

The study brief was wide. Any reasonable solution was to be examined, including those previously discarded. Two categories were considered, namely "conventional" solutions based on the existing commuter rail technology and "unconventional" solutions embracing everything else, including light rail transit (LRT) and busway. In addition two base cases were defined, against which any option could be tested. The first base was the existing rail system and the second was a no-rail base, or all-bus solution. The latter was required by the government's Department of Transport (DTp), which insisted that each existing rail line be justified, let alone any investment in new lines. Each investment option entailed the use of existing BR suburban alignments and the creation of new cross-city center links. Existing track and signaling would be used if appropriate, and some traction power supply equipment could be reused, but not rolling stock.

The "conventional" rail options included the Picc-Vic tunnel and some lower-cost commuter rail tunnel alignments through the city center. These had been well studied and documented previously. To operate any unconventional system, it would be necessary to segregate movements from any BR operation, whether intercity, provincial passenger, or freight. Therefore the first exercise was to examine each local rail service to see if it could be segregated from the BR network. It was found that five existing local passenger lines could be segregated, including two of the busiest, together with a former passenger line that closed in the 1960s but that passes through a dense residential area. This made six lines that conveniently approached the city center at three key locations, Victoria Station in the north, Piccadilly Station in the southeast, and the former Central Station in the southwest. Various routes linking these three points were considered in tunnel or on the surface, depending on the mode. LRT was the only mode that could operate at

either level because other rail modes cannot operate on-street and buses in tunnel were not considered acceptable.

At the first assessment, all system options that were not fully developed and proven in urban transit service were eliminated, together with all fully automated driverless systems. The latter were not deemed appropriate for the types of existing rights-of-way, or for an area with very high unemployment. Thus all forms of monorail, and the VAL, Transit Expressway, and UTDC/ICTS systems were discounted.

The short list of potential unconventional systems then consisted of LRT with tunnel links, LRT with surface links, busway, and guided busway. These were the subject of feasibility studies carried out by consultant engineers Mott, Hay, and Anderson to assess their technical advantages and disadvantages and their capital costs (*1*). In parallel, transportation study modeling was undertaken to assess their effects on patronage and passenger benefits.

Table 1 gives some of the initial findings. It was apparent that all the options would attract similar levels of patronage, although the figure for LRT with tunnel links was slightly higher. Capital costs varied much more widely, however, with LRT with surface links having the lowest cost. It seemed likely, therefore, that LRT would offer the best value for the money.

TABLE 1 RESULTS OF FEASIBILITY STUDY AND INITIAL SCHEME TESTS

Option	Capital Costs (£ millions Nov. 1982)			Forecast Peak Period Patronage
	Fixed Facilities	Rolling Stock	Total	
Conventional rail in tunnel	136.4	19.5	155.9	11,350
LRT with surface links	47.9	37.6	85.5	11,450
LRT with tunnel links	65.9	37.6	103.5	12,050
Busway	92.0	16.0	108.0	11,350
Guided busway	110.5	17.0	127.5	11,350

This conclusion was confirmed by further economic appraisal. The detailed cost/benefit evaluation then concentrated on comparing LRT with the existing rail base and also with the no-rail base. This showed a very strong case for retaining rail services. The benefit of LRT over existing rail, i.e., its marginal benefit, was less strong but still significant. Based on the results of these studies, the GMC unanimously agreed to proceed with the LRT option, to seek parliamentary powers for the key city center links, and to seek government grant aid for construction.

SYSTEMS PLANNING

The proposed LRT network was not developed in isolation, but in close cooperation with BR, taking account of their plans to develop their intercity and provincial passenger services. BR had already decided to develop Manchester's Piccadilly Station as their intercity hub and remove the remaining intercity trains from Victoria. Thus the overall rail strategy for the county included some short new BR rail links and a spur line to serve Manchester's rapidly expanding international airport (*2*). The airport link still awaits government approval, but the other new links are already in service.

The LRT feasibility studies identified a 100-km six-line network (see Figure 3) comprising three cross-city routes. Although the total estimated cost of this network was extremely modest by American standards, less than £100 million (U.S. $175 million) at 1982 prices, it was clear that the government would not entertain a grant application for the whole network as had been the case with the Tyne and Wear Metro. Despite its obvious success, the Metro was still regarded in official financial circles as extravagant and not to be repeated. Tyne and Wear Metro cost £248 million for a 55-km network, but this included some major civil engineering construction, including bridges, tunnels, and viaducts.

A first-phase system was therefore defined, taking in the two most promising commuter lines, those from Manchester to Altrincham and to Bury, and

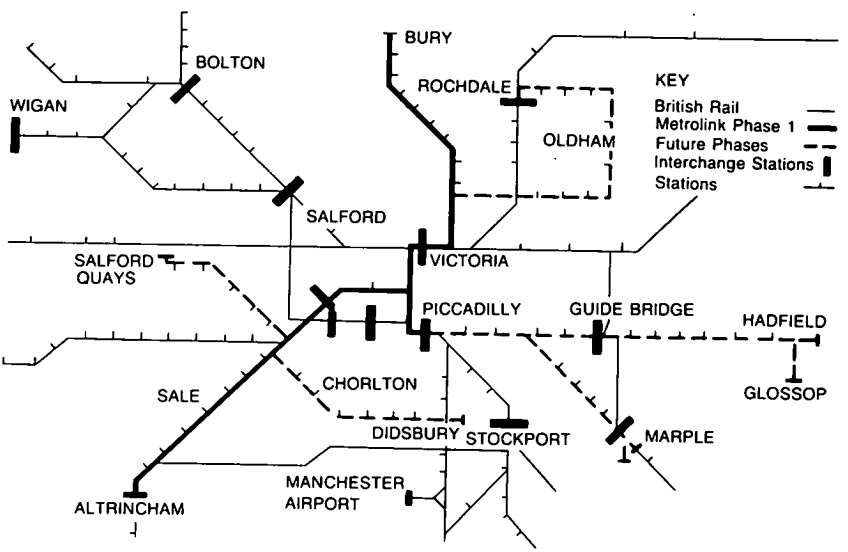

FIGURE 3 Greater Manchester's British Rail and LRT lines circa 2000.

the 3-km section of new surface tracks across the city center, mainly on-street but with some private right-of-way. Some sections will be shared with buses and others with mixed traffic. This phase 1 system totals 31 km and is estimated to cost £43 million at 1986 prices, including rolling stock (35 cars), power supply, signaling, and control. Existing BR track (25 km) and stations can be used, with minor modifications. At present the Altrincham and Bury lines carry 6 million passengers per annum. It is estimated that this will increase to 10 million on conversion to LRT. For the past 3 years the main effort has gone into advancing phase 1.

For any new section of railway in Britain, parliamentary powers are required. A first parliamentary bill was deposited in November 1984 seeking powers to construct the city center sections. Legislation referring to street tramways had not been seen in Parliament for some 40 years, and one aim of this bill was to test the waters in Parliament as well as in Manchester. A second bill was deposited in November 1985 seeking the remaining powers needed to complete the phase 1 system, including various works on the Altrincham and Bury lines (*3*).

These two bills created remarkably little opposition and achieved almost unanimous political support across party lines. Extensive public consultation during the options study proved worthwhile. The bills passed through the House of Lords and House of Commons committee stages unopposed, but progress was still rather slow. By late 1987 they were in the final stages.

Obtaining parliamentary powers is relatively simple compared with obtaining grant approval. This is because parliamentary procedures are clearly documented in standing orders, but there are no comparable rules for government grants. An application to the Department of Transport was made in July 1985 for a 50 percent capital grant for phase 1 construction, together with the necessary borrowing powers to enable the GMC in its role as Passenger Transport Authority to fund the remaining 50 percent (*4*). This started a long and thorough scrutiny of all the assumptions and estimates made in the economic and financial evaluations.

ABOLITION AND DEREGULATION

By then two major changes had appeared on the horizon, neither of which could have been foreseen at the time of the initial studies. First, the metropolitan county councils were to be abolished nationwide by the government. Second, bus services were to be deregulated and privatized and the PTE was to be reduced to the role of a planning and financing agency, losing its fleet of 2,500 buses. The PTE did, however, retain its powers over local rail operations.

The GMC was abolished in March 1986 and its functions, including that of Passenger Transport Authority (PTA), passed to a bewildering array of joint boards and committees, controlled mainly by the 10 metropolitan district councils. Control of the PTE passed to the new PTA, which was composed of 30 elected members from the 10 district councils. The PTA very quickly affirmed its unanimous support for LRT. Thus abolition did not have a major impact, except that some impetus was lost during the transition period.

Deregulation was potentially rather more significant. It meant the end of integrated transport planning. Bus services would be determined by bus operators on purely commercial criteria and the PTE would only let contracts by tender for services that were judged socially necessary but that were not being provided commercially. The DTp asked what effect bus deregulation would have on the case for LRT. In truth, nobody knew.

Instead of just waiting to see what happened, the PTE commissioned some market research to examine in more detail the factors affecting submodal split between bus and rail using the stated preference technique. From this a model was developed for detailed testing of options. In addition the actual changes and trends were monitored closely.

The market research suggested that existing rail passengers would be fairly resilient to bus competition, except where a through bus could offer a reduced total journey time compared with feeder bus and rail. Even then the relatively low frequency of many bus routes and their peak period journey times meant that transfer from rail to bus would not be automatic.

Bus deregulation took place in October 1986. While the situation has been somewhat fluid, practical experience has tended to support the conclusions of the market research. There has been comparatively little competition between bus and rail services and none that has posed any serious threat to rail traffic. In fact, after deregulation rail traffic increased, in some cases by significant percentages. This was due partly to an overall reduction of some 20 percent in bus mileage, and partly to the reliability and consistency of rail services in a sea of changing bus services.

The results of the market research were incorporated in a revised submission to the DTp (*5*). To cut a long and fairly complex story short, agreement was finally reached with the DTp in July 1987 that the case for LRT was robust. The Secretary of State for Transport then indicated that the scheme looked promising but that the government wished to examine options for private funding. The PTE had already retained merchant bankers as financial advisers but the DTp decided to appoint their own advisers.

Funding is also being sought from the European Economic Community. Preliminary discussions have suggested that a grant under the European Regional Development Fund, possibly amounting to 30 percent of the capital cost, may be obtained. However, under current rules, this reduces the DTp

contribution and still leaves the PTA to raise its 50 percent, either from the Public Works Loans Board or other sources such as the European Investment Bank.

PROJECT LIGHT RAIL DEMONSTRATION

In March 1987 LRT was given a major boost, not just in Manchester but throughout the United Kingdom, by a unique demonstration of the rail industry's faith in British LRT proposals. A group of manufacturers, including GEC Transportation Projects, Balfour Beatty Power Construction, Fairclough Civil Engineering Limited, and British Rail Engineering Limited, set up a 3-week demonstration of a light rail vehicle (LRV) in Manchester with the support of the PTE and BR (*6*).

A 2-km section of lightly used freight line in east Manchester was made available by BR, which also provided power at 750 v dc overhead using a static electric multiple unit to step down from the main line 25 kv ac feeder supply. A temporary timber station, part of a new low-cost station in the PTE's ongoing program, was erected by Fairclough. New overhead was provided by Balfour Beatty, including examples of overhead equipment currently being supplied to the Tuen Mun LRT system in Hong Kong. The LRV was Docklands Light Railway car number 11, provided by GEC with assistance from Linke Hoffman Busch. Static exhibits included typical sleeper and grooved rail track and modern shelters.

Over 10,000 people traveled on the car, including members of the public, over two weekends. Professionals and politicians from every conurbation in Britain visited the demonstration. The Minister of State at the Department of Transport, David Mitchell, formally opened the proceedings accompanied by the chairmen of British Rail and the other sponsoring bodies.

There can be little doubt that Project Light Rail had a significant effect on raising awareness of the Manchester scheme with extensive media coverage, including television. It also encouraged a number of other cities to consider LRT more seriously.

TOWARD IMPLEMENTATION

In January 1988 the Secretary of State for Transport made a statement in the House of Commons that effectively authorized the PTE to proceed to invite tenders for phase 1, but on the basis of a concession to design, construct, operate, and maintain the system. All the assets, including rolling stock, will remain in the ownership of the PTE. The government believes that this

approach will encourage the greatest contribution to the project from the private sector. If satisfactory bids are obtained, the government will provide a 50 percent grant. In February 1988, the two parliamentary bills received royal assent, becoming Acts of Parliament. They give the PTE the legal powers necessary to construct and operate the LRT system.

Steps had already been taken to initiate a number of pre-tender activities, including the appointment by the PTE of a project manager. Activities now under way include detailed site surveys, establishing statutory undertakers service diversion requirements, developing rolling stock specifications, and developing central area design parameters, particularly in regard to stations and pedestrian areas.

Particular attention has been given to the needs of disabled or mobility-impaired passengers. After study of a range of solutions including those used in Calgary, Buffalo, Portland, Sacramento, and the various European low-floor car designs, a decision was made to develop a high-platform, high-floor car design. A single sliding step will give access from the few medium-height platform stations in the city center, and these will incorporate a shallow ramp access to a short high-platform at the first door, similar to Buffalo's.

Consideration has also been given to the form of contract to be adopted. After review of all options and the experiences of broadly comparable projects, it was decided to seek a single contractor for the entire project under a two-stage design and build tender. The government's January announcement means extending the scope of this tender to include operation. It is expected that the first-stage tenders will be solicited in autumn 1988, with the second-stage tender (on which the contract will be awarded) being solicited in early 1989. Construction could then commence in mid-1989 and operation in 1991. The response to the initial advertisement inviting contractors to register their interest has been encouraging, and strong competition is likely for first-stage tenders. In June 1988, the project was relaunched under the name Metrolink (Figure 4).

FUTURE PLANS

Even before the phase 1 system had been approved, pressures were growing for extensions to the phase 1 network. Most notable is a proposed extension to Salford Quays, the former Manchester docks area that is now being extensively redeveloped in a manner not unlike the London Docklands (*7*). A good mix of land uses, including residential, commercial, retail, and leisure, should ensure good traffic levels for an LRT line. A feasible alignment has already been defined with close cooperation from Salford City Council. A parliamentary bill was deposited in November 1987. Adjacent to Salford Quays is Trafford Park, once one of the largest industrial estates in Europe

FIGURE 4 Metrolink LRT train in Market Street, City Centre, Manchester—artist's impression.

and now under the control of a new Urban Development Corporation, which is keen to explore the role of LRT to encourage potential developers.

Elsewhere in the conurbation, extensions are being considered in discussion with the appropriate district councils, again making use primarily of existing rail alignments but with short extensions to exploit LRT's capability of gaining good access to town centers.

The remarkably low cost of the scheme has been achieved by making maximum use of existing rights-of-way, both rail and road, and by avoiding costly civil engineering works such as tunnels or viaducts. The existing rolling stock is life-expired and needs replacing anyway.

In developing the Manchester scheme, visits have been made to a large number of existing systems in Europe and North America. Lessons have been learned, both from good practice and bad. It is hoped that Manchester will be able to demonstrate the best practices in a number of aspects and will indeed prove to be a new system success at an affordable price.

CONCLUSION

Greater Manchester will soon have its cross-city rail links after 150 years of trying. But why have so many previous attempts failed? What lessons can be

To succeed, any scheme must be technically sound, financially viable, administratively feasible, and politically acceptable. Too often in the past, Manchester sought the best solution but could not fund it, or politicial differences could not be resolved. The present LRT scheme has evolved from careful analysis of the problems and possible solutions, drawing extensively on market research and on relevant current experience in other cities. Great importance was given to public consultation, both to inform and to obtain comments from a wide range of local groups including users, traders, businessmen, and politicians. For example this indicated at an early stage that considerable support existed for LRT, but very little for busways.

It is essential to involve all the professional groups concerned, including highway and planning authorities, bus and rail operating agencies, and central and local government departments. The joint study team of GMC, BR, and the PTE brought together a wide range of expertise and resources.

Perhaps most important of all is to find the technology appropriate to the task, and to local circumstances. If Manchester had sought a solution involving expensive tunnels or high-technology automation, it could well have had to wait another 150 years.

ACKNOWLEDGMENT

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