Feasibility of potential radial corridors for guided urban transport technologies in Greater Belfast

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Abstract

This case study reviews part of a 15 month evaluation of guided urban transit for the Greater Belfast area carried out by a joint Universities land-use transportation unit (JULUTU) from the two universities named above.

The existing transport scene is set by considering some basic parameters such as current public transport ridership, car ownership and central area parking in the private and public domain. Recent and future short term infrastructure changes in transportation are described and the effects on transportation patterns of changing land use within the Laganside city river development are forecast. Three radial corridors were screened positive for guided transit from the first stage of the economic and ridership evaluation. The methodology for establishing these three potential guided transit corridors is considered and discussed in the light of the changing political climate.

1 Background

The joint Universities research team was appointed by the Northern Ireland Transport Holding Company in April 1991 to consider alternative urban transport technologies, and in particular, guided transit for the Belfast Metropolitan area. Publication of the final report took place in December 1993 [1].

However, transport policy is now poised to alter course since the publication of the Royal Commission's report in October 1994 [2]. Although the
Government has as yet not officially responded, it is apparent that it is not totally convinced by the Commission's report. Para. 11.47 of the report states:

"We recommend that the government make more reserves available for new light-rail systems so that they can be built within a reasonable time in those conurbations for which they are an integral part of an overall transport strategy".

Despite the lack of response, there has already been a rethink on the UK committed roads programme with cutbacks in expenditure in the November 1994 budget.

Recently within the Belfast area, a new planning vision report on the City Centre has been published [3], the £89m Cross Harbour Road and Rail Link approaches and bridges have opened to traffic and a major urban dual carriageway road scheme in the south east of the city through an environmentally sensitive area has been abandoned by the Department. In the authors' view, with changes in the political and transport policy climate, the stage is now set to consider once again alternative technologies as an integral part of any new transportation strategy.

Although this paper looks at the engineering and environmental factors affecting potential urban radial corridors, a brief discussion of the existing transport patterns in the greater Belfast area is initially considered.

2 Urban Structure and Transport

The Belfast Urban Area is best characterised as a medium density settlement based on axial lines with outlying sub-centres, most notable of which are Lisburn, Bangor, Comber, Newtownards, Carryduff and Carrickfergus. This is the area defined as the Belfast Metropolitan Area in the current study (see Fig. 1).

Within the time horizon of the study to the year 2030, the opportunity presented itself for an alternative public transport to provide a focus for urban growth and support desired land-use patterns. However, the basic form of the Belfast Urban Area BUA surrounded by green-belt is more or less established, and there is likely to be a stabilisation of the population by 2030 at approximately its current level. Therefore radical changes to the existing land-use pattern are unlikely. Hence, while urban structure as a whole might be marginally altered by light rail in a more sustainable direction (encouraging denser development and thus limiting sprawl and dispersal), the major impact of
light rail or other technologies on sustainability would have to occur within the present urban structure.

The most recent review of transportation within the Greater Belfast Area commenced in August 1985 for the period up to the year 2001 [4]. A further review is scheduled to be commissioned and will have to include major changes of cityscape within the area. The most notable recent change is on a 14.5 acre site within Laganside where a £15m 200 bedroom hotel, a £20m concert hall, a parks marina and a multi-storey car park along with office and shop developments are under construction. These projects coupled with the river Lagan clean-up scheme and major regeneration of the city's dockside will have repercussions on the city's transportation requirements.

3 Car dependency and the future for public transport in Belfast

Notwithstanding the rural nature of Northern Ireland, the Province exhibits substantially greater expenditure on private transport than other rural areas of the United Kingdom or the Republic of Ireland. The private vehicle fleet is younger in age terms while car ownership overall is only marginally less than the United Kingdom figure. Expenditure on public transport is extremely low at around 5% of transport expenditure. Belfast itself, however, enjoys a low level of car ownership [0.24 cars/person in 1989] similar to the more disadvantaged industrial cities of Great Britain. On the other hand, the supply of road and parking space is among the most generous.

In marked contrast, public transport use is the lowest per capita in the United Kingdom for peer group urban areas. In this respect, the city has witnessed an unparalleled decline in bus use since the late 1960's. Until the last few years the stringent funding had forced a reduction in in-vehicle comfort level while the limited availability of shelters contributed to a decline in the image of bus travel. As a result, the 'transit habit' in Belfast had been broken and the car/taxi based life-style firmly established.

In contrast, rail has benefited from the dispersal of population and a government policy in recent years which has provided unprecedented levels of capital investment as well as retaining a substantial subvention towards recurrent costs. The opening of the cross river rail link and a new proposed station in central Belfast are example of this. Nevertheless, until rail achieves adequate penetration of the Central Business District its potential in-vehicle time advantages are negated while the limited size of the network, the large costs of extending heavy rail systems and the current absence of coordination with the much larger bus network also limits the use made of an infrastructure
capable of serving substantially larger number of users. There are now proposals to set up a combined bus and rail authority which could change the public transport network considerably.

4 Preliminary identification of corridors and the technologies

Corridor screening criteria were developed from previous studies both within the United Kingdom and abroad and thence applied to Belfast conditions.

From the assessment of theoretical and operational characteristics of various transport modes, a number of conclusions were drawn:

- The capacity of most operational systems tend to be found in the lower end of the potential capacity for each mode as specified by manufacturers' figures.
- In the majority of UK cities, the issue does not appear to be one of capacity but realising a minimum viable level of demand.
- In most cases, appraisal of Light Rail Transport (LRT) is undertaken in comparison with the conventional bus system currently obtaining in the city in question (and existing rail service if this exists).

There are a number of factors which influence the quantifiable elements of screening criteria for alternative public transport technologies. Minimum viable ridership for any technology will reflect for instance availability or otherwise of suitable rights of way including the opportunity to exploit the use of existing infrastructure. The local unit costs associated with construction and operation of transport facilities, site conditions, the length of the proposed system and the degree of peaking in the area served are other factors. The availability of 'additional' supra-national funds could also affect the threshold obtained. The ability of any proposed technology to achieve such thresholds in a particular locality will in turn reflect the existing base market for public transport, the improvement in the relative attractiveness of public transport potentially afforded by the alternative technology and restraint whether passive or active of car use in areas served by the proposed technology. In turn, these conditions will reflect land use considerations including residential densities and degree of concentration of commercial activities and employment in downtown areas.

5 Alignment opportunities

The following corridors (see Fig. 1) met the agreed base patronage and potential journey time criteria defined under this process:

Eastern Approaches (A) - Bangor
Eastern Approaches (B) - Dundonald/Comber
Southern Approaches (A) - Ormeau/Saintfield Road
Southern Approaches (B) - Lisburn
Western Approaches - West Belfast
Northern Approaches (A) - Antrim Road
Northern Approaches (B) - Shore Road

The overview of opportunities consisted of three elements:

1. Operations : including existing carriageway or other alignment considerations.
2. Capital Costs (fixed infrastructure).
3. Environmental Planning Issues.

From previous work, it was apparent that the assessment of opportunities should be restricted to Light Rail Transit (LRT), Guided Light Transport (GLT) and Busway (Guided and Unguided). This decision was taken on the basis of capacity/demand considerations and unit costs of construction for alternatives. Conventional bus priority measures were excluded from consideration as they were regarded as being sub-strategic measures.

In the case of the environmental planning assessment, this was based on a check-list of criteria drawn from the literature. Fieldwork involved site investigations of the alignment options to obtain information on the basis of which each would be scored against the relevant criteria.

6 Operations and capital costs

Where entirely new alignments were identified, additional assessment involved the suitability and impact of new infrastructure, the opportunities for and impact of tunnelling, where necessary, and the integration of new infrastructure with existing transportation networks. An initial objective for the engineering section of the project was to obtain suitable mapping at 1:1250 or 1:2500 scale of all the potential corridors within the Belfast area. However, this objective was refined to consider coarser 1:10,000 scale mapping of the area supplemented by large aerial photograph mosaics due to the extent and cost of the work involved. Where areas were considered to be particularly sensitive, 1:1250 scale mapping of the corridors was evaluated. Existing transport corridors were used wherever they were available. In the preliminary assessment, corridors were considered on five radial approaches to the City Centre. In particular, the Southern Approaches (A) covered a corridor width of at least half its length which produced seven preliminary lines for evaluation.
Typical cross-sections for shared surface and segregated on-street running of LRT or guided bus were prepared to determine minimum operational widths and swept path alignments on different classes of urban road [5]. In the more sensitive areas, horizontal geometric parameters were checked to ensure that they were within the appropriate design standards. As far as vertical control was concerned, it was generally considered that most routes were within the maximum gradients specified by the technologies [6].

For the costing of each alternative, lengths of routes were categorised as being at grade, elevated or in tunnel and whether they were on street or segregated. Unit costs were derived for different types of LRT and guided bus running, allowing for track and formation, stations or stops, and signal control [7].

7 Environmental planning assessment

All potential corridors were subjected to a broad environmental assessment sieve, drawing on recent transportation studies in Britain. Fieldwork was generally based upon a check-list drawn from the literature.

It was found that, in general terms, environmental considerations (defined as visual effects, severance and impacts on townscape, property and amenity) do not constitute an overriding constraint along the corridors investigated (Fig. 2) as compared with the potential impact of road improvements required to accommodate a car-based transport provision over the study period. The overall environmental quality of the potential corridors is mostly of a type which would absorb the environmental impact of LRT or bus-based systems, provided that individual sensitive buildings or small areas were protected at the detailed design stage. In fact, in some cases, the introduction of a consistent linear design element would prove an environmental benefit.

Segregated running on median strips is precluded among many major radial routes in Belfast because of the restricted carriageway widths. Therefore, in environmental terms, segregated running along current and former railway lines or sub-surface operations, wherever possible, offers the best solution for operation in environmental terms. Notable exceptions are pedestrianised or traffic calmed areas in which LRT, or other electrified modes can contribute to the environmental quality.

8 A basis for a refined corridor assessment

Notwithstanding the improvements currently being or recently made to public transport infrastructure serving Belfast the study team consideration of
improvements which are warranted in a number of travel corridors within the Belfast Metropolitan Area. The proposals are based on the premise that public transport can offer a realistic alternative to the private car for many trips to/from the city centre providing certain requirements are met. These encompass both general criteria as well as conditions specific to individual corridors. In general terms, the following conditions are required to be met:

1. Full penetration of the Central Business District.
2. Operations free from the congestion generated by other vehicles, where possible by a separate facility (busway or guideway) to ensure a running speed competitive with the private car.
3. A quality image in keeping with self-esteem of car users.
4. Good quality of travelling and waiting environments.
5. High levels of frequency.
6. High levels of information provision including real time information.
7. Coordination of timetables between services on a corridor basis and through ticketing.

The use of these criteria as a sieve in the process of selecting the most promising corridors and technologies underpins the recommended strategy.

In relation to mode image, it is now generally recognised that LRT enjoys a superior image to conventional bus operations. The major question mark relates to the performance of guided buses and express coach operations. In relation not the latter, the evidence does indicate that such operations marked professionally, with a separate identity from the ordinary bus and in conjunction with a package of traffic management measures, high quality waiting facilities and information provision can enjoy an enhanced image compared to the bus. However, it will be unlikely to match the performance of LRT in this regard. Image in part reflects perceived levels of comfort including general ambience of the travelling environment. In this regard, the bus even in guided mode has not shown itself to be capable of matching the best levels achieved by modern Light Rail Vehicles (LRVs).

Recent interest in guided buses in the UK has stemmed from a bus industry feeling threatened by the possibility of large numbers of LRT systems. In part, this is due to the legal and regulatory frameworks attaining in Great Britain. Absence of operations on the ground in the UK generally forces reliance on hypothetical responses by the market to the mode.
9 Conclusions

Three radial corridors Eastern Approaches (B), Southern Approaches (A) and Western Approaches were selected for the recommended strategy. Refinement of the 'long list' of alignments to produce a systems concept which could prove cost-effective in an individual corridor, depends on a number of conditions. Such conditions fall into five main areas;

(i) a substantial actual or potential market for public transport,
(ii) right of way opportunities which permit any technology to demonstrate a substantial improvement over existing conditions both by public and private modes,
(iii) environmental pressures emanating from existing patterns of travel demand, and
(iv) land use characteristics and development pressures,
(v) security of the system for both users and the public.

Fulfilment of these 'conditions' does not necessarily demonstrate that a case does exist for alternative technologies. Nevertheless, it does provide a basis for now focusing further analytical work leading to strategic recommendations, which may result from incoming investment through the peace process. Also, the fifth condition is not now so critical.

10 References

Fig. 1

Light Rail Transit Construction by Corridor and Alignment

KEY

- ON ELEVATED STRUCTURE
- AT GRADE
- CUT & COVER
- IN TUNNEL
- EXISTING RAIL CORRIDOR
- ON STREET SHARED SURFACE
- ON STREET SEGREGATED TRACK

NEW FORMATION TRACKWORK
Fig. 2

Environmental Constraints and Opportunities

KEY

**OPPORTUNITIES**
- SEGREGATED TRACK
- WIDE CARRIAGeway
- POSSIBLE ROADSIDE RESERVATION

**CONSTRAINTS**
- ACTIVITY GENERATOR
- LINEAR SHOPPING
- RESTRICTED CARRIAGeway
- JUNCTION CONFLICT
- POTENTIAL PROPERTY DEMOLITION
- POTENTIAL LANDSCAPE CONFLICT