An Economic Critique of the LUAS Project

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Given Dublin's notorious traffic congestion it seems logical to welcome the coming of the LUAS light rail system. Andreas McGrath and Katie Mooney, however, warn us not to accept it without reservation. They question the projected benefits, both environmental and time saved, but ultimately concede that economic concerns may have to yield to political will.

Introduction

The LUAS light rail system was born out of the Dublin Transport Initiative (DTI). It will cost £137m at 1998 prices (excluding preliminary study costs) and is discounted at a rate of 5%. This is a new approach to transport planning in the Dublin area, and is 75% funded by the E.U. The committee, appointed by the minister of the Environment, and called the "Dublin Transportation Review Group", has representatives from Local Authorities and CIE. This group has recommended the expansion of all existing modes of transport, with emphasis on public transport, and the introduction of a light rail system, which can be run on or off the road. We find that the evidence gathered to date is at odds with the broad aims of the DTI, and also with the overall objectives of the Dublin Transport Policy.

> *'The elements of the work carried out by the DTO [Dublin Transport Office] were:*
> - *Selection of the most appropriate public transport modes (Bus, QBC, DART, LUAS or Metro) for each part of the conceptual network, based on the passenger flows.*
> - *Development of a set of viable transport strategies for Dublin in 2016, informed by strategic studies of the suburban rail network, the bus network, the eastern bypass and the national road network'* (Dublin Transportation Office, 2000).

We have decided to review the LUAS under the following headings:

1. Economic Value Added
2. Environmental Impact Analysis
3. Capacity Issues
4. Light Rail Transit (LRT) versus Bus (QBC)
5. Conclusion

We have decided to concentrate our analysis on Line A, in order to compare like with like (tables and data) and to avoid confusing juxtapositions of figures gathered from various sources. To this end however, it must be noted that the same transport model was applied to Line B. Line C has also been left out as it consists of 100 metres or so, which joins Store Street (Line A terminus) with Connolly Station (Amiens Street). This is to try to integrate heavy rail and light rail more cohesively, and so does not take into consideration any population's transport requirements. This line at one time was envisaged as a "travelator" line (moving floor, as in airports). *"The Inquiry does not recommend the termination of the line [A] at Store Street...The Light Rail System would be considerably enhanced by the integration of the system with the transport hub that is Connolly Station" (Department of Public Enterprise, 2000).*

Economic Value Added

Several reports were produced between the years 1994 – 1998 on behalf of the government and at great cost. These were carried out by a transportation Consultancy; Steer Davies Gleave with specialist input from McHugh Consultants (Land Use Issues). Their reports were produced in phases or technical reports encompassing all of the areas we have decided to review.

Steer Davies Gleave published a lengthy Cost Benefit Analysis (Steer Davies Gleave, 1998) of the LUAS Light Rail System. Both the Financial and Economic Evaluation assumed that:

- The scheme opens on 1st January 2003
- The evaluation period is 30 years
- The discount rate is 5%

This is a Government benchmark rate, used to evaluate large public projects.

Figure 1: Financial Evaluation

	Present Value (£m)
Revenue	73
Operating Surplus	5
Capital Cost	-137
	-132

Source: Steer Davies Gleave, "LUAS Line A Cost Benefit Analysis"

From figure 1 we can see a largely negative Financial Net Present Value (NPV). From this, several points must be noted.

Inherent Capital costs do not include study costs. The revenues flowing from LUAS are dependent on the system being on time in accordance with their proposed schedule. This complexity gives rise to (among other things) a proliferation of maintenance and supply contracts, which are very specialised. (The millennium dome had 2700 subcontractors!)

Many of these contracts escape proper accountancy procedures and it is a growing problem. That is, they are in effect medium and long term charges on the operation which are not shown on the balance sheet, but over time they may crop up on the profit and loss account.... mostly as losses! Couple that with the need for esoteric skills and job descriptions many of which are being invented as we speak and you have a recipe for disaster.

Outlined in Figure 2 are the Economic Net Present Values (NPV) evaluated at several discount rates compared with the Government benchmark used in the original CBA.

Figure 2: Sensitivity Analysis

	PV @ 5%	*PV @ 10%*	*PV @ 11.5%*	*PV @ 13%*
User Time Savings	506	308.5	273.0	244.0
Non-user Time Savings (Cars)	-81	-49.4	-43.7	-39.1
Non-user Time Savings (HGV's)	11	6.7	5.9	5.3
Vehicle Operating Cost Savings	11	6.7	5.9	5.3
Accident Savings	2	1.2	1.1	1.0
Total Benefits	**450**	**273.7**	**242.2**	**216.5**
Operating Costs	-68	-41.5	-36.7	-32.8
Capital Costs	-137	-83.5	-73.9	-66.1
Total Costs	**-205**	**-125.0**	**-110.6**	**-98.9**
Economic NPV	**245**	**148.8**	**131.6**	**117.7**

We see that the Economic NPV is almost halved using a more realistic and applicable discount rate. The comparative discount rates were chosen for their application in other international Light Rail Systems [*Croydon = 10%, Docklands Light Railway = 11.5%, Manchester = 13%* (Morgan, S. Health and Safety

Manager; Light Rail Project Office)].

The internal rate of return is unchanged at 11.7% as the revenue streams were left unchanged from the original CBA.

The subjective nature of Cost Benefit Analysis (CBA) has often led to uneconomical projects in the past. The Community Support Framework (CSF) Evaluation Unit has published general problems arising from CBA (CSF, 1999). They have found a lack of consistency in the main parameters used and a tendency towards undue optimism in the estimation of Socio-economic benefits. Specific weaknesses included are:

1. *Unrealistically low shadow wage rates*
2. *Lack of clarity in identification of the counter factual*
3. *Use of base line scenarios of doubtful plausibility*
4. *Problems with the treatment of taxation*
5. *The choice discount rate*

SOURCE: PROPOSED WORKING RULES FOR COST BENEFIT ANALYSIS, CSF EVALUATION UNIT JUNE 1999

They noted also,

> *the studies are generally commissioned by the sponsoring department or agency and that a political decision to undertake the project has often been taken in advanced of the CBA* (*Ibid.*)

We find that many of these shortcomings are applicable to the LUAS Cost Benefit Analysis. In particular, the *Lack of clarity in identification of the counter factual* is evident in the absence of comparison between the LUAS and the Bus in terms of like-with-like comparison. Many tables in the Steer Davies Gleave studies compare economic NPV of the LUAS with that of the DART. However, although the issue of comparison with Bus is pertained to, explicit data is not readily presented. The *use of base line scenarios of doubtful plausibility* is inherent as the main thrust of the LUAS is to attract car users into the public transport system thus alleviating the traffic congestion.

> *Demand Management... is designed to encourage a transfer of trips, especially at peak periods, from the private car to sustainable modes of transport such as public transport (Dublin Transportation Office, 2000).*

However as shown in the Steer Davies Gleave report, time savings are a meagre 3 minutes (Steer Davies Gleave, 1993). *The choice discount rate* as we have pointed out is unusual in public projects of this capacity.

Capacity Issues

The Public Relations supplement published in the Irish Independent (Saturday, 14th January 2001) has raised several questions in relation to the capacity capabilities of the provisional timetable. The supplement boasts that I tram can carry as many as 168 cars or 235 people, and forecasts the following:

Figure 3: Forecast Demand

Forecasted Demand	*Peak Hours*	*Off-Peak Hours*
Number of People	>4800	>1800

Source: Steer Davies Gleave. "Cost Benefit Analysis for LUAS Line A"

Figure 4: Frequency of LUAS

Frequency	*Peak Hours*	*Off-Peak Hours*
Minutes	*5*	*12*

Source: LUAS PR supplement, Irish Independent.

A closer look at these published figures suggests that the LUAS Line A will be under capacity in 2006, just three years after being introduced. This is obviously a major problem, as its function is stated as '*To alleviate traffic congestion by providing an incentive for transferring from cars to public transport*" (DTI). The arithmetic is follows:

Peak Hours

Expected: 4800 users (Steer Davies Gleave,1998).
Capacity: (235 people per tram every 5 minutes) X (12 trams per hour) = 2820 users

Shortfall: 1980 users per hour, equivalent to an extra 8.5 LUAS trams per hour
Revised Timetable recommendation: One tram every 2.8 minutes.

Off- Peak Hours

Expected: 1800 users per hour[1]
Capacity: (235 people per tram every 12 minutes) X (5 trams per hour) = 1475 users
Shortfall: 625 users per hour, equivalent to an extra 8 LUAS trams per hour
Revised Timetable recommendation: One tram every 7.5 minutes.

There are 22 Light rail Vehicles (LRV's) currently on order, at a cost of £1.1m each. To meet the LUAS' expected peak hour demand, incorporating the Revised Timetable Recommendation (above) a further 5 LRVs would be required. This would add an extra £5.5m onto the capital costs, bringing the Financial NPV down to an altogether unacceptable -£137m.

It must be noted however, that these demand figures represent a conservative estimate. This figure is based on population projections, and does not take into consideration the phenomenon of "latent demand" which is observed on large-scale public projects (Barrett & Mooney, 1981). The reduction of car lanes and possible inner city population growth could far outstrip these expectations.

Environmental Impact Analysis

A stated main advantage of the LUAS is that it will be relatively pollution free. We are of the opinion that this is somewhat of a misnomer.

- Electricity is required to run the LRV's. This puts extra demand on fossil burning power stations.
- Electromagnetic radiation emitting from overhead wires is of indeterminate danger.
- All other externalities arising from the construction of the LUAS e.g. the rat problem. Visual pollution of unsightly wires, incongruity of modern platforms on old streets.

Some technical points need to be understood for the fair comparison of the

[1] See figure 3

LUAS to other modes of transport. Due to the lack of comparison between the LUAS and QBCs, we have examined like-with-like figures for fuel consumption between these two modes. The Equivalent Fuel Consumption (EFC) of a four-car 30-meter train carrying 190 passengers (based on 4 per m^2, each passenger has 2.69 ft^2) is 5kwh/km^2. Allowing for generation and transmission losses of 65.8%, this gives a real "fuel consumption" at the power station of 14.62kwh/km. Using diesel oil (also known as fuel oil) with an energy value of 10.8kwh/liter, as a common standard, it is thus consumed at the rate of

1.35 litres/km or
2.18 litres/mile or
0.48 gals /mile or more familiarly as
2.086 miles per gallon for LUAS

Dublin Bus has provided a provisional figure of 5.68 miles per gallon for a bus capable of carrying 88 passengers. Using the simple ratio 88/190 to adjust for passenger carrying capacity this equates to: 2.63 miles per gallon for buses of equal capacity. Moving the emission point of the products of combustion from the route of the LUAS to the atmosphere above Ringsend, makes no difference to global warming. Localised pollution is the issue in question. Diesel engines running on fuel oil produce a known spectrum of pollutants, which are undesirable, and the damaging effects of which have been costed (ibid). Engines are available producing negligible health damaging pollutants when run on light gases and hydrogen, but which still produce the equivalent CO2 burden.

Briefly, on the subject of transfer of car ownership, Steer Davies Gleave has prepared a forecast for the private car transfer on the Tallaght – Dublin route. We see a very modest car saving of 794 cars out of a total of 183,910. This equates to a saving of 0.43% on account of the introduction of the LUAS. Further to that, and given the capital cost of the system, this is a value of £86,272 placed on each car taken off the road!

[2] This figure was obtained from the Light Rail project Office engineer.

Figure 5: Modal Trips Totals – Person trips 2006 morning peak hour

	DTI strategy (with LUAS line A) Tallaght - Middle Abbey Street	*DTI Strategy No LUAS*
Car	183,116 (-794)	183,910
Bus	59,091 (-2854)	61,945
Rail/LRT	28,684 (+3597)	25,037

Source: Steer Davies Gleave. "Cost Benefit Analysis for LUAS Line A"

LRT Versus Bus (QBC)

The choice for electric power over diesel-engine vehicles is one that is at the heart of this section. A well-known fact in relation to this debate is that electric powered vehicles lose a great proportion of their efficiency in the transition between generation and application. Diesel engines however, retain up to 100% efficiency between combustion and torque.[3] Electric power indeed removes some pollution from the areas of operation (specifically, urban areas with high population concentration) but transfers the pollution from local areas to power station chimney stacks (albeit at a higher level). The Total Primary Energy Requirement (TPER) (Department of Public Enterprise,2000) is a measure of all energy consumed in Ireland, and is higher as a result of the introduction of LUAS than an alternative strategy using Diesel Buses in QBC's. Furthermore to this argument, and somewhat of an aside, advancements in catalytic converter technology has allowed internal combustion engines to run at near-silent and near-zero emissions levels for most of their operating lives.

[3] Torque is measured in Newton Meters and is a measure of force exerted on the axle of a vehicle. Generally it applies to the pulling power capabilities and holds a directly proportional relationship.

From an economic standpoint then, we can observe that a bus system has the following advantages over a LRT system:

- **Massive Cost Savings:**
  Rolling Stock - £90,000 per bus v. £1.5m per LRV
  Infrastructure – Virtually no investment required for QBC. Only minor alterations for road surface, signposting and right of way. Huge Costs facing LRT system for road alterations, track laying, station building etc.

- **Capacity Issues**
  Following from the previous section, a less capital-intensive system will mean that more capacity can be offered for the same budgetary allocation.

- **Efficiency**
  Wastages through electrical transistors, transformers and sub-stations mean that a bus-based system will use fuel inputs more efficiently than an LRV based system.

- **Flexibility**
  Guided Vehicles (requires tracks) offer less flexibility than non-guided vehicles, enabling faster and more responsive alterations to services in reaction to changes in urban sprawl and population density.

Conclusion

When a Government decides to commit to a large public project such as the LUAS, many conflicting standpoints present themselves and one would be naïve to think that economic considerations alone drives the political engine. With this in mind, it seems that Ireland is not only trying to keep up with the Jones' but the Blair's, and the Schroeder's! Image considerations play a large part in decision-making. 'Progressive and Modern' are often the buzzwords banded around the dark corridors of Leinster House when discussing how best to spend our tax euros. Reasons given for LUAS include:

> *...a bright, modern and efficient form of transport [LUAS] will be unveiled. In my opinion it will be just the start of an era when Dublin*

> *can shed its image of congestion and poor public transport to that of taking its place among other modern European capitals* (Mary O'Rourke, Minister of Public Enterprise).

From a local Authority point of view, *"at this stage, so much has been said and spent that I think 'Just build the thing"* (Owen Keegan, Director of Traffic, Dublin Corporation). From DTI's viewpoint,

> *...proud of its history and heritage [Dublin], its unique character conserved, a fit setting for Government and national centres of excellence.* (Dublin Transport Initiative, Transport Modelling Technical Volume 6, 2000).

Although these are hardly valid economic arguments, one must accept their weight in political and public circles.

From an integration point of view, a lack of cohesiveness and a reliance on Victorian train tracks means that the LUAS shall be confined to its own bespoke tracks. This will prevent full integration of the transport system (Metro, LUAS, Bus, DART) and thus will prevent the realisation of major economies of scale and scope.

Unfortunately work has already commenced on line A, so no conclusion would suffice without addressing how to optimise this compromised situation. If the DTI is to realise its startegy of transferring car users to public transport, the LUAS will only play its part if operated in conjunction with a realistic road pricing system.

We have shown conclusively that an electric system offers no major environmental benefits above and beyond a more conventional bus system. If the environmental issue is to be pursued the only recommendation is to strive for hydrogen or fuel cell vehicles in the bus sector.

Although Dail Eireann seems to be the last stop for approval of the LUAS system, the last stop shall ultimately be the commuting public's stamp of approval.

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