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Editor
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DBFO - DEVELOPING THE OPERATOR ROLE

David Clements, PFI Director, W S Atkins Consultants Ltd

David Clements was able to bring to the meeting W S Atkins experience as a major player in DBFO (Design, Build, Finance and Operate) projects under the PFI (Private Finance Initiative). The company was involved in a number of projects around the country, some of which are under construction:

- Bridgend Hospital (on site)
- A50/A564 Stoke-Derby road (on site)
- A30/A35 Bere Regis-Exeter road (on site)
- DLR Lewisham extension (on site)
- Hereford Hospital (preferred bidder)
- Wythenshaw Hospital (preferred bidder)
- Rochdale Hospital (preferred bidder)
- HAPMS project (preferred bidder)
- PRESTIGE project for LT (preferred bidder)
- and various consultancy assignments.

The company performs a number of roles in PFI projects including:

- architect/designer
- technical advisor
- financial advisor
- bank's technical advisor
- facilities manager
- minor equity partner, and
- lead partner.

The speaker illustrated how the role works in practice with a special company formed from a consortium which then enters into the DBFO contract with the Secretary of State, and where the Highways Agency (HA) has executive responsibility for its administration. Atkins is part of Connect Roads Ltd which has two other equity partners: Balfour Beatty (part of BICC plc) and Philipp Holzmann AG. Connect has won two road contracts: for the A50/A564 (Stoke-Derby) and A30/A35 (Bere Regis-Exeter).

Development of PFI

Early PFI schemes which had been completed included the Channel Tunnel, Dartford Bridge, Second Severn Crossing and Manchester Metro Phase I.

PFI really got off the ground in 1992 with proposals to carry out 1,150 projects which had a capital value of £27 billion. These schemes had a total NPV (net present value) of £40-60 billion

Types of PFI

Schemes can be:

- free-standing which earn a return on equity through direct charges to the public,
- where services are sold to the public sector through shadow tolls (as opposed to the end user),
- joint venture such as Channel Tunnel Rail Link (which has a public sector subsidy).

Government's objective for PFI

The objectives of government are to:

- transfer risk to the private sector;
- create certainty;
- increase value for money - 15% better "value" than existing methods of procurement. It is arcane since it is not clear how government calculates the value of risk transfer;
- minimise financial contribution of the public sector.

Risks Transferred to Private Sector

Under the PFI contract, the private sector is generally asked to take the following risks:

- construction and operational cost overruns;
- delay in delivery of service;
- design of the underlying asset not delivering the agreed service; and
- changes in law, including tax law changes, which impose additional or increased costs on the operator - this is a problem since this is outwith the control of the DBFO Co.

By using PFI, the government attempts to transfer to the private sector the following risks which may be unique to each project:

- **Protestor action** - The increase in direct action has placed extra costs on projects. After negotiation there is generally a project specific, risk-sharing arrangement between the HA and the DBFO Co.
- **Latent defects** - Negotiations found that the private sector generally accepted this risk, In future, all bidders will have bid on the basis of accepting this risk for all new projects
- **Traffic** - The HA calculates traffic projections for a new road which are kept confidential. A probability distribution for traffic based on actual against forecasts for a large number of schemes is used in the evaluation of bids (which include the bidders view of traffic growth). This is important to the government since under- or over-forecasting of traffic affects the value for money and, if too optimistic, may make the proposed structure financially unstable.

Source of Finance

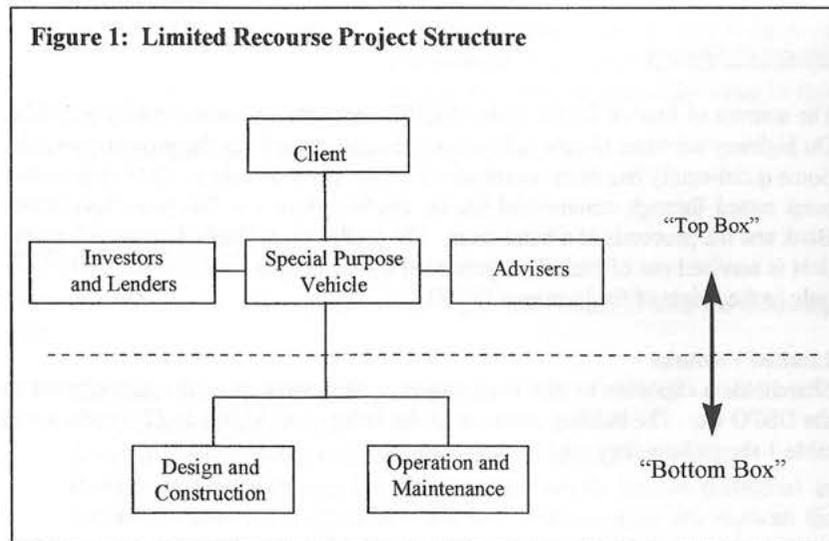
The sources of finance for the costs of DBFO projects are usually equity and debt. On highway schemes to date, all pure equity has come from the project sponsors. Some quasi-equity has been contributed by third party investors. Debt finance has been raised through commercial banks, funding from the European Investment Bank and the proceeds of a bond issue. The facilities are "limited recourse", as the debt is serviced out of cash flow generated by the project road and the banks look only to the assets of the borrower DBFO Co.

Limited recourse

Shareholders exposure to risk is contained to the extent of equity commitment to the DBFO Co. The bidding costs are of the order of £750,000 to £2.5 million and table 1 shows how they are typically made up.

Cost item	Costs (£'000)
Resource costs	100 - 500
Bidder's legal advisers	200 - 750
Bidder's other advisers	100 - 500
Financial advisers	250 - 750
Bank's legal advisers	50 - 250
Bank's technical advisers	20 - 100
Bank's insurance advisers	10 - 50
Model audit	10 - 50
Documentation	10 - 50
Total	750 - 2,500

The structure of limited recourse project is shown in figure 1.



Ordinary shareholders have the highest risk in terms of their investment but they have the potential for the highest return. Ranking of the risks for each form of capital in the project is:

Paid out last	ordinary shares	Highest risk
	preference share capital	
	subordinated loans	
	mezzanine finance	
Paid out first	senior debt	Lowest risk (but also lowest return)

DBFO Road Programme

By March 1997, eight DBFO projects had been launched by the Highways Agency and six consortia to a total estimated capital value of £563.2 millions. Table 2 lists these schemes (Tranche 1 and 1A) and the consortia. Tranche 2 which consists of seven further DBFO projects (one procured by the Scottish Office) with a total estimated capital value of £730.3 million is now being bid for by potential consortia.

Scheme	kms	capital value (£m)	Consortia
Tranche 1			
A69 Newcastle-Carlisle	83.2	9.4	Roadlink
M1-A1 Motorway link, Leeds	28.8	214	Yorkshire Link
A1(M) Alconbury-Peterborough	20.8	128	RMG
A417/A419 Swindon-Gloucester	51.2	49	RMG
Tranche 1A			
A50/A564 Stoke-Derby link	56.0	20.6	Connect
A30/A35 Exeter-Bere Regis	100.8	75.7	Connect
M40 junctions 1-15	121.6	37.1	UK Highways
A168/A19 Dishforth-Tyne Tunnel	116.8	29.4	Autolink

Characteristics of DBFO

The main characteristics in the developing DBFO road programme include a 30 years concession period (plus a 10 year residual life), a special purpose company, the use of shadow tolls (free to end-user) and traffic/maintenance risk absorbed by the operator. Because periodic maintenance contracts are included in the DBFO agreement, it is important for the consortium to have forecast the split between light and heavy vehicles with a reasonable degree of accuracy. However, there is a potential element of high risk since there is not much knowledge of how pavement structures will behave with heavier lorries.

Payment mechanisms

There is generally a hierarchical payment system with availability payment the highest priority, maintenance and other services following on. The speaker hoped that after these payments had been made there will be some profit.

Shadow toll structures perform an important role in the payment system. The HA pays the DBFO Co an amount based on the number and type of vehicles using the road, with adjustments made for lane closure and safety performance. The payment is based on three criteria:

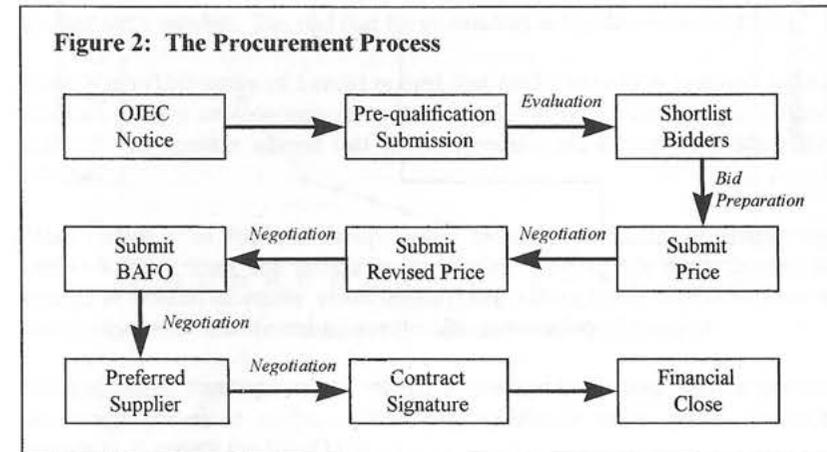
- (i) Usage/demand: Differ within different traffic bands and dependent on the length of vehicle (used as a proxy for weight). Bidders tended to opt for four bands with the lowest band representing a cautious view of traffic and tolls within that band set at a level that would cover the servicing of debt but would not provide a return on equity. The top band receives zero toll. Shadow tolls increase over time with an indexation formula.
- (ii) Availability of service: Once a scheme is open to traffic, a Permit to Use is issued and 80% of the full payment is made to the DBFO Co. When construction works are completed, a Completion Certificate is issued with the DBFO Co receiving 100% of full payment. The payment is reduced when it is anticipated that third party debt has been repaid. At this point revenue in excess of operating and maintenance costs is solely return on equity.
- (iii) Performance is divided into two components: safety performance payments and lane closure charges.

Safety is measured by accident saving before and after the scheme is operational with the DBFO Co receiving or penalised by 25% of the economic cost of each personal injury accident avoided/incurred over the long term average (with a cap).

Lane closures cause significant disturbance and delay to the road user. A deduction is made from the toll payment depending on the number of lanes closed, the duration of closure, the expected traffic flow at time of closure and the economic value of user delay. This only applies to lane closures within the control of the DBFO Co and not, for example, for closures required by the police or utilities.

Procurement process

The DBFO procurement process begins once a project has been identified, is affordable and a business case has been made through COBA (cost/benefit analysis). Figure 2 shows the process for procuring a project, beginning with a notice to contract in the Official Journal of the EC (OJEC). The average time from placing the notice to commencement of contract was 16 months in the case of a Tranche 1 and 1A project.



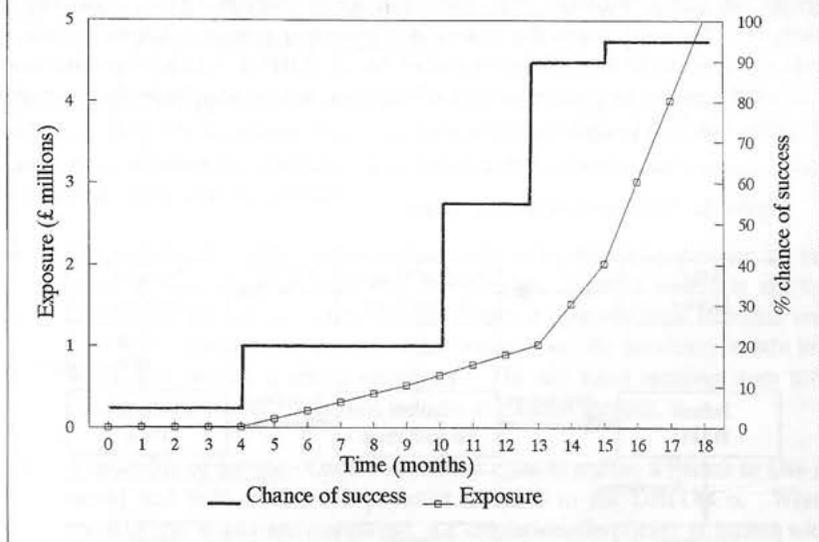
The exposure in PFI projects is potentially 5% of the cost of the scheme.

Table 3: Financial exposure in PFI project (example for £100m project)

Phase	Duration	Exposure (£'000)
Prepare pre-qualification	2 months	10
Interview/selection	2 months	5
Prepare bid	5 months	500
To preferred bidder	4 months	500
To financial close	2 months	1,000
To full effectiveness	3 months	3,000
Totals	18 months	5,015

As the procurement process unfolds the financial exposure increases but, at the same time, each further step increases the chance of success. Figure 3 indicates the relative changes in exposure and the chance of success as the process develops.

Figure 3: Financial exposure compared to the chance of success



Overview

There are a variety of road schemes within the PFI framework which, at present, are inefficient to operate with only 13% of the network transferred at the completion of Tranche 2. With more being transferred, economies of scale will become apparent in maintenance of a larger network. The HA is promoting route managers and this would lead to route and network strategies developing which the DBFO companies could play a part.

The DBFO roads programme is the most successful part of the PFI programme due to HA experience of processing large projects. The government also "got away" with risk transference because the construction industry was in recession.

Discussion

Peter White began the discussion by stating that, traditionally, the state can raise money cheaply (typically at 6%). Therefore, private organisations will be more expensive. In reply, the speaker thought that was fair comment, adding that the difference between public and private borrowing is a particular issue.

Peter Gordon (University of Westminster) suggested that with 15% share capital, a risk premium is required by investors. David Clements thought that HA minimised returns, making projects less attractive. Banks are looking at minimum ratios of 1.4:1 (revenue:costs), i.e. a 40% safety factor.

Richard Davies (KPMG) asked what happens if there is insolvency. The bank have step-in rights and take over the contract and identify another provider before HA takes over the project. This is unlikely since it is not in the government's interest. The real fear for contractors is legislative changes.

Chris Nash (University of Leeds) opined that traffic growth is required for road schemes to have an economic return but that this is now contrary to government policy. The speaker agreed that traffic forecasts are critical to bidding for a scheme

Mike Collela (The Portland Group) asked about the possibility of transferring a DBFO scheme from one franchisee to another. David Clements thought that change of control of equity would be difficult, although PFI Executive now say that equity can be transferred 12 months after completion of a project.

On a question about generated traffic, a new guidance note with a policy to discourage generated traffic. Obviously, additional traffic within reasonable bounds is of benefit the DBFO Co.

Notes of talk taken by Konrad Aspinall, W S Atkins International Ltd

Further reading:

DBFO - Value in roads: a case study on the first eight DBFO road contracts and their development. Highways Agency and Private Finance Panel, March 1997.

THE FUTURE FOR RAIL FREIGHT IN THE UK

Julia Clarke, Director, Rail Freight Group

The meeting of the Group on 16 April was devoted to a talk by Julia Clarke on the future for rail freight. This was a further 'episode' in our series of talks on the now-privatised rail industry, but this time on freight rather than passenger, which until now has tended to get the most attention, with its complex regulatory and franchising framework for the passenger train operating companies.

Julia is Director of the Rail Freight Group and started by saying a few words about this Group and its significance for the rail freight business. Its membership of around 140 is concerned with infrastructure, operators, equipment suppliers and customers. It contributed to the discussion and representations made during the making of the Railways Act 1993 and claims some influence upon the final form of that Act. Currently it is very active concerning the future regulation of the industry, lobbying the government, promotion of rail freight, and dispensing information upon the industry generally. Of major concern to the Group at present is the lack of investment to enhance the capacity of rail infrastructure for freight, the onset of the 44 tonne lorry and the absence of 'a level playing field' for rail vis-à-vis road for the movement of freight. The Group is involved in education programmes and a proposal for the formation of a 'code of practice' for Railtrack. In short, anything to do with promoting the cause of rail freight, its competitive relationship with road transport and contractual relationship with rail infrastructure is the business of the Rail Freight Group.

Julia's own background and experience has made her a 'natural' for this involvement. Starting as an economist in the Department of Transport Julia went on to get experience in market research before taking-up consultancy, where she was closely involved with Section 8 grants (grants to freight forwarders for the rail infrastructure and equipment necessary to ensure the transfer to and keeping of specific traffics on rail). The setting-up of the Rail Freight Group followed, and her career took a practical turn to a 'close-up' of the operational problems faced by the rail freight industry when she became a non-executive director of English, Welsh & Scottish Railways (EWS), with particular interest in track access negotiations, public affairs and regulatory matters.

Having sketched-in her own position in the freight industry Julia proceeded to outline the structure of her talk. She said there are four questions which need to be addressed concerning the future for rail freight in this country. These are:

- does the structure set-up by the 1993 Act work so far as the freight industry is concerned?
- will the form of sale adopted for the BR freight businesses promote growth of rail traffic?
- has there been a change in the competitive balance between road and rail?
- will a new government correct some of the currently perceived failures of the current arrangements?

(In the discussion of these questions which follows, the reviewer has included many of the subsequent comments made by members of the audience at the place where the speaker's initial comment was made, rather than at the end of the evening's proceedings)

The essential features of the 1993 Act of relevance to the freight industry are:

- the separation of operations from infrastructure and the creation of Railtrack
- the establishment of the Rail Regulator whose duties include the promotion of rail freight and the promotion of competition
- the provisions of Sections 17 & 18 under which the Regulator approves access agreements between Railtrack and train operators
- the track access conditions, particularly those provisions relating to changes in the network
- the freight facilities grants (FFG) and track access grants (TAG) as successor(s) to the old Section 8 grants and provided for in Sections 139 & 140 of the 1993 Act
- a system of licensing for freight train operators
- provisions for 'open access' to the infrastructure

The track access charges which emerged have proved to be unsatisfactory in some respects to the industry, and, by the representations which were subsequently made by the rail freight industry on their structure and level, some success could be claimed in obtaining a recognition of the importance of avoidable cost in determining the minimum level of these charges for marginal traffic. The track

access conditions to which all operators must 'sign-up' included procedures to cover changes to the network and the introduction of new rolling stock.

In discussing whether the Act could be considered to work Julia was mostly concerned with the failure of particular parts of the Act to live up to expectations, and the failure to include other provisions in the Act which could have been included to help ensure that the stated objectives for the future privatised rail freight business could be met. In particular, Section 17 (the imposition, by the Regulator, of access agreements and their terms on Railtrack) has not been used; the provisions for coping with changes in the network are limited; there is no protection for freight against a proposed closure of a line; no mechanism for strategic investment; the grants for encouragement of rail freight are inadequate; and Railtrack, itself, is averse to risk and has no strong incentive to promote freight. (In fact, Rail Freight Group anticipated some of these shortcomings but were unable to get things like closure protection for freight lines into the Act.) As practical examples of this catalogue of short-comings of the Act, Julia referred to the history of Piggy Back gauge enhancement (costs range from £100m to £300m, and there is no indication as to who is to fund this expenditure), the possibility of freight being squeezed out of the WCML because of a prospective shortage of line capacity due to the introduction of tilting trains, the disposal of property and the systematic erosion of freight capability by removing temporarily redundant running junctions and private siding connections as track is renewed. (Speaker's note: Since presenting this talk Railtrack have begun to address a number of these issues in a positive way which is very welcome.)

During the question & answer period, and relevant to the problem of enhancing freight infrastructure capacity, Derek Done asked if the Central Railway project had a future. In reply Julia said that Central Railway 'was dead but won't lie down'. The problem was that it appeared to be a very expensive proposal, not fully thought through, and the traffic forecasts were unrealistic.

Moving onto the form of sale adopted, the speaker said that four out of the six freight businesses have now been sold to EWS (the three trainload freight businesses, and the parcels business, which includes, inter alia, royal mail). Railfreight Distribution's sale to EWS was still awaiting approval by EU. Only Freightliner remains in separate hands - a management buy-out. It is, however, important to point-out that the 'open access' provisions of the privatisation process have been exploited by a (currently) small number of large undertakings e.g. National Power with the movement of coal to power stations in the Yorkshire area. There could be more of these 'open access' agreements in the future. But operators have found that safety requirements are stringent and therefore costly, as is the required insurance cover and the necessary driver training.

EWS was intent upon taking advantage of economies of scale, in terminal services, wagon provision etc. inherent in the ability to run as one business, what was, albeit for a short period, five separately accountable parts of the rail freight industry. There was now a strong freight company to counterbalance Railtrack and the twenty five passenger TOCs, with an ability to invest and take a long term view of the prospects for rail freight in this country. Contrary to the expectations of government when the privatisation process was started, there is comparatively weak 'on-rail' competition, which, in the opinion of the speaker, is more than offset by the vastly more important strong 'off-rail' competition.

During the discussion period Michael Colella (The Portland Group) asked in which area the speaker expected there to be the greatest growth potential. Apparently it is in the area of less than trainload traffics. But Freightliner needs a gauge upgrade in order to accommodate larger containers. Moreover, a multiplicity of specialised equipment is needed in wagons and terminals to accommodate the increasingly sophisticated requirements of these traffics. Julia pointed-out, in support of her claims regarding less than trainload traffic, that the Enterprise wagon-load service was currently the fastest growing area of EWS's business. Don Box thought that BR's switch of traffic from less than trainload operation to trainload operation had been overdone. Those comparatively short distance freight flows which are characteristic of this country and which could only justify less than daily trainload operation tended to result in poor utilisation of locomotives and wagons. Derek Done (Derek Done Associates) commented on the significant decline in the number of private sidings still operational.

The result of the sale of the rail freight business, in the form that it has finally taken, is to produce one dominant company serving a wide spread of traffics, which in its drive for growth in rail freight carryings has been able to offer discounts to existing customers, invest in new locomotives and wagons and introduce significant productivity and efficiency improvements. Nigel Harris (The Railway Consultancy) referred to the debate about the presence or otherwise of economies of scale in rail operations. Julia thought that economies of scale did exist in terms of the number of customers served. Currently there were only about one hundred.

As part of the process of correcting the failures of the inherited structure of regulation and track access charges, and in reply to a question from John Dodgson (NERA), Julia said that EWS has managed to negotiate a new track access agreement with Railtrack. This will replace some 200 separate access agreements formerly negotiated by the BR freight businesses. It will deal with the charging arrangements for new flows of traffic requiring new routings, without the cumbersome requirement of new and additional access agreements. It is expected

to take the form of a five-year contract and will be formalised soon on receipt of the Regulator's agreement.

Dealing with the final two questions, which have, possibly, most interest to transport economists concerned with future prospects, Julia listed a number of issues and decisions which have come to the fore recently and which could affect the future road/rail balance. Some of these were favourable to rail - others not so. Firstly, there had been a review of the scope of rail freight grants to encourage traffic to rail. These now included grants for freight wagons. The practical application of these new provisions left much to be desired, however (see Colin Poole's talk to the TEG 'The Work of the Rail Regulator', of October 1996). Indirectly to the advantage of rail was the work of SACTRA and the recent substantial cutting of the roads programme. The findings of the Royal Commission on Environmental Pollution continues to make the case for a modal shift from road to rail, but, unfortunately, government action is still lacking in making aspirations a practical reality. It is also somewhat difficult to understand how an aspiration for carrying more traffic by rail can be reconciled with the proposal to introduce 44 tonne lorries onto our roads. But in answer to a question from Michael Colella, Julia said that she saw no problem with the 44 tonne lorry provided it was taxed appropriately. And in spite of all the research into road pricing there is nothing practical beyond experiments promised for the next few years. It was expected that there would be some increase in rail traffic through improvements in operational efficiency and marketing, but nothing startling unless the 'environmental' balance between road and rail was changed in favour of rail.

In reply to a comment from Derek Done on the effectiveness of road pricing in achieving a better balance between road and rail freight movement, Julia suggested that a move away from the present road lorry taxation system of a fixed amount per annum towards something akin to that in operation in New Zealand would be helpful in achieving a better balance between the infrastructure charging conditions faced by rail vis-a-vis road haulage. The New Zealand system is a tax varied by gross vehicle weight and distance, thus bearing most heavily on long-distance heavy vehicle operation where the balance between road and rail most needs to be redressed.

Finally, Julia dealt with what could happen under a new government. Labour, in opposition, has stated that the Regulator should, and would by a Labour minister, be given direction and advice by the Secretary of State for Transport. (Reviewer's note: This general 'toughening-up' of regulation has already been confirmed by the statements of the new Minister of Transport). Labour has also indicated an intention to set-up a Strategic Rail Authority (SRA). Julia then spent a little time

in discussing what this new authority could do and how it would fit into the present structure of DoT, ORR, OPRAF, Railtrack and HSE.

Julia suggested two possible models:

- The SRA absorbs the remnant of the British Railways Board (BRB), takes over the residual advisory and directional roles of the Department of Transport, including advice to the Rail Regulator, and takes direct control of OPRAF. The obligation of the Rail Regulator to promote competition could be removed and perhaps replaced with targets for freight growth
- A more ambitious SRA would replace the BRB, and the Rail Regulator would be restricted to competition issues, licence conditions and approval of access agreements. The SRA would have three principal divisions viz. Safety & Standards (taken from Railtrack); OPRAF; and a freight division administering grants and promoting investment for freight in the network.

Julia then proceeded to fill-out some of the detail as to the SRA's possible responsibilities in the second model. It would take budget and policy objectives from the DoT and set targets for Railtrack. The latter's Network Management Statement (currently demanded by the Rail Regulator) could become a Plan submitted to the SRA for approval. Of particular concern to the freight business(es) could be the SRA's insistence on changes to this plan to reflect freight requirements in major track renewal and enhancement schemes, and powers to safeguard property and assets from premature disposal. There was a need for strategic planning for freight (reviewer's note: and for passenger!). Freight flows do not have the stability of passenger flows - they come and go - and this characteristic of freight must be reflected in the assessment of long-term infrastructure requirements. Public funding (subsidy) would be dependent upon satisfactory delivery of the Plan by Railtrack. Reference was made earlier to a 'Code of Practice' for Railtrack which the Rail Freight Group was anxious to promote. This could include provision of information and an obligation to consult widely. This 'Code of Practice' could be monitored and enforced by the SRA.

A possible variation on this, second, model might be the expansion of the present OPRAF to become the SRA. It was thought that establishment of the SRA would require relatively small legislative changes, whichever of the above 'models' was adopted.

There were a number of questions and comments upon the concept of a Strategic Rail Authority and possible changes to the structure of the railway industry with a new government. John Crawford asked: 'who would form the SRA?' The

possibilities ranged from a completely new organisation, a combination and strengthening of present regulatory and franchising bodies to the reconstitution of the British Railways Board (under a new name, presumably?). Derek Done wanted to know if there was any possibility of re-nationalising Railtrack. Julia's view was that this was not a possibility, but she thought there was much to be said for diversion of subsidy direct to Railtrack rather than through the train operators.

Julia claimed, in her concluding remarks, that the market for rail freight was there. There is a strong public demand for the increased movement of freight by rail, and industry itself is supportive of this. A new approach to the structure of the freight carrying industry is needed to achieve these aspirations. Her talk and the discussion which followed emphasised the weaknesses in the present arrangements which may be summarised as:

- the comparative disinterest of Railtrack in the promotion of freight traffic (Speaker's note: But see earlier comments on Railtrack's change of attitude since this talk was presented)
- the absence of strategic planning for the requirements of rail freight as a whole
- the absence of a satisfactory environmentally conscious balance between road and rail and of mechanisms (particularly fiscal and road pricing), to achieve that balance

Reported by Don Box

MODELLING NATIONAL VEHICLE EMISSIONS IN THE ROAD AND RAIL SECTORS

John Dodgson, National Economic Research Associates

John Dodgson began this work while at the University of Liverpool with the assistance of the Economic and Social Research Council who were funding the University's project on *Transport and Global Warming*.

With the rapidly growing transport sector, there is concern about the environment and the prospects for sustainable development. Transport is the fastest growing contributor to carbon dioxide (CO₂) emissions in the UK, and there are concerns about the effects of local emissions on health. The work described by the speaker developed models that looked at the impact of the transport sector on atmospheric pollution.

Transport emissions

The latest assessments show that, if uncontrolled, emissions will lead an unprecedented increase in global mean temperatures of between 1½ and 4 degrees centigrade by 2100. The transport sector contributes to emissions of a number of greenhouse gases, including CO₂ and nitrous oxide. In addition, transport contributes to emissions of carbon monoxide (CO), nitrogen oxides (NO_x) and volatile organic compounds (VOCs) which, as precursor gases, react in the atmosphere to produce greenhouse gases, most notably tropospheric ozone (O₃).

Growth in transport demand

Table 1 sets out some indicators of travel trends since 1970. Total passenger transport has grown from 403 billion passenger kilometres in 1970 to 689 billion (+171%) in 1994, and surface (road and rail) freight transport has grown from 110 billion tonne kilometres to 157 billion (+312%) over the same period. The absolute level of passenger rail use has remained constant but its share has fallen from 9% to 5%. Bus and coach use has fallen both relatively (15% to 6%) and in absolute terms (-28%) from 1970 to 1994. Compared to public transport, use of cars and vans doubled between 1970 and 1994 to become 87% of all passenger kilometres by 1994.

Thus, the changes shown in table 1 mean that the modes with the greatest potential for pollution have grown fastest.

Indicator	1970	1994
Passenger kilometres (billions)		
- total	403	689
- car and van	297	596
- bus and coach	60	43
- rail	36	35
Percent of total passenger kilometres		
- by car	74	87
- by bus & coach	15	6
- by rail	9	5
Freight tonne kilometres carried by road and rail	110	157
Percent of all tonne kilometres carried by road	63%	65%

Source: *Transport Statistics Great Britain*

Growth in energy use and emissions

Associated with the growth in road transport has been the rise in fuel use, increasing by nearly 90% since 1970, and now accounting for a quarter of total final energy consumption. This growth of traffic and energy use has led to increases in atmospheric pollution. Although lead emissions have fallen, table 2 shows that all other pollutants have risen between 1970 and 1994. Road freight transport is a major source of black smoke emissions.

Emission	1970		1994	
	Thousand tonnes	%	Thousand tonnes	%
Sulphur Dioxide (SO ₂)	101	1.6	113	6.9
Nitrogen oxides (NO _x)	620	27.0	1,169	52.7
Carbon Monoxide (CO)	2,926	63.2	4,346	89.9
Volatile Organic Compounds	749	34.2	898	40.5
Black Smoke	101	9.8	248	58.2
Carbon Dioxide (CO ₂)	66,000	9.9	124,700	22.8

Source: *Digest of Environmental Protection and Water Statistics (annual)*, DOE, HMSO

Modelling the Impacts

Structure of models

The model uses estimates of car stock which disaggregates the car fleet by nine engine size categories and sixteen vintages. Total carbon emissions, which are directly related to fuel consumption, are calculated as the sum of the product of annual kilometres and fuel consumption for each engine size and vintage. Average fuel consumption is derived from government information for cars of each age based on three types of driving condition: urban cycle, 90 km/hr and 120 km/hr.

The effects of fuel prices were modelled since they influence car ownership, the demand for travel (kilometres per annum by different vehicle types) and fuel consumption. Changes in fuel prices have lagged effects on fuel consumption by varying annual kilometres driven and car ownership in the short term while fuel efficiency changes in the longer term as newer cars get absorbed in the car fleet. A constant petrol price elasticity of -0.15 was employed in the model.

Public transport demand distinguishes six type of service:

- British Rail InterCity,
- South east suburban rail services,
- Regional railway services,
- London Underground,
- local bus services in London, and
- local bus services elsewhere.

Forecasting equations for public transport were based upon single-equation, constant elasticity models of demand, with demand depending on the mode's own fare, GDP and the price of petrol. The public transport models were disaggregated to give time trends based on data in Transport Statistics for Great Britain (TSGB) and using elasticities from other studies. Income was used to estimate demand.

Modelling forecast scenarios

Four scenarios were modelled as indicated in table 3:

Scenario	Motor fuel prices	Public transport fares
Base scenario	Constant at 1996 level	Constant
Motor fuel price scenario: Scenario 1	Fuel taxes increased by 5% a year from 1996 on the mean net price projections of Energy Paper No 65.	Constant
Scenario 2	Fuel prices doubled between 1994 and 2005 and constant thereafter	Constant
Public transport fare scenario	Constant at 1996 level	Reduced by 50% in 1996

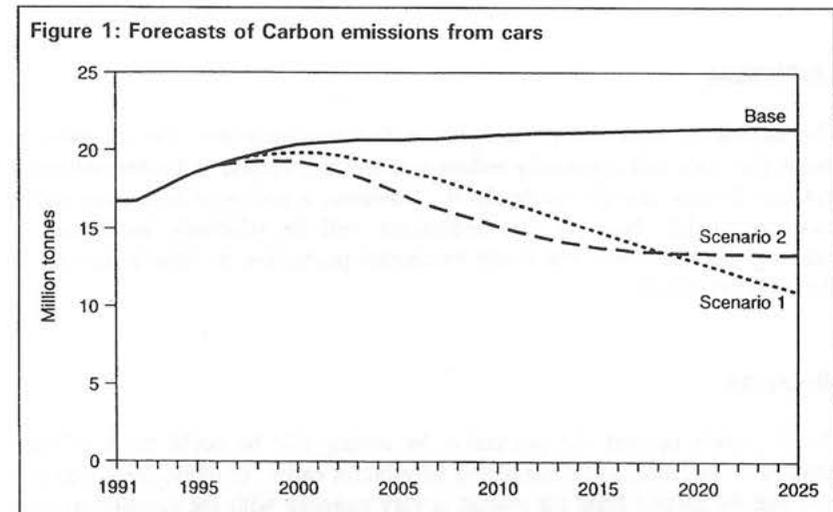
Two motor fuel price scenarios were tested against a base where fuel prices and public transport fares were held constant at 1996 levels:

1. Scenario 1 models the government's commitment to increase real fuel duty by at least 5% per annum. These duty increases were imposed upon the average of the "low" and "high" forecasts of the net price of motor fuel given in the Department of Trade and Industry's 1995 energy use forecasts¹.
2. Scenario 2 models the recommendation that real motor prices should double between 1994 and 2005 given by the Royal Commission on Environmental Pollution (RCEP) in their Eighteenth report². After 2005, scenario 2 assumes that real fuel prices are held constant.

¹ *Energy Projections for the UK 1995-2020*. Energy Paper no. 65, HMSO 1995. The "low" forecast assumes constancy in real net prices, while the "high" forecast allows for a modest increase.

² Royal Commission on Environmental Pollution, *Transport and the Environment*, Eighteenth Report. HMSO, 1994

The projections of fuel price are combined with forecasts of GDP and car ownership, and with assumptions that real car prices and public transport fares remain constant. These were fed into the car model to derive forecasts of emissions of CO₂, NO_x, CO and VOCs up to 2025. Figure 1 gives an example to show the changes in carbon emissions from cars up to 2025. It shows that emissions from cars continue to rise, peaking in 2000 under scenario 1 (5% price increase) and in 1999 under scenario 2 (RCEP doubling). Carbon emissions would return to the 1991 level by 2006 under the RCEP scenario and by 2011 under the government scenario. There are dramatic reductions in emissions of NO_x, CO and VOCs due to the introduction of catalytic convertors but after about 2005 these emissions start to increase again.



Public transport fares reductions to encourage a switch to public transport use were tested separately as an alternative policy to achieve reductions in car emissions. This assumed a halving of fares on all public transport modes - bus, rail and underground - from 1996 onwards. Such a reduction would increase demand for those modes in line with their own-price elasticities and would reduce demand for car travel via cross-price elasticities. Although in practice

there would be some reductions in average emissions per passenger-kilometre, the model assumed passenger loadings and, therefore, emissions per passenger-kilometre as fixed.

In terms of electrically-powered transport, marginal fuels - coal and natural gas - rather than base load fuels such as nuclear and hydro-power and their emissions were considered.

With these lower public transport fares, emissions from cars, compared with the base of constant fuel prices and fares, are only cut by a little under 1½%. Increasing use of public transport shows that total emissions of carbon rise by 2½% in 2000 and by 2.9% in 2010. Total emissions of NO_x and VOCs also rise while CO falls.

Conclusions

The modelling work described by John Dodgson indicates that increases in motor fuel duty will eventually reduce emissions of carbon and other pollutants in Great Britain, though not by 2000. However, a policy of increasing public transport modal share by fare reductions will be relatively ineffective in reducing car emissions, and could be counter-productive in total emissions by the transport sector.

Discussion

David Starkie opened the discussion by saying that he could think of other policies to test, such as the scrapping of vehicles early. In reply, John Dodgson said that the second hand car market is very complex with the decision to scrap very dependent on the price. The model can be used to test policies however those vehicles with poor emissions need to be targeted.

Don Box asked what would be the effect of passengers of a 50% reduction in fares. The speaker said that elasticities used were -0.3 for buses and -1.0 for InterCity journeys.

DB: was there any parallel effect on public transport finances; JD: very little.

David Starkie asked if the models took account of vehicle speeds and whether the model was sub-divided by road type. John Dodgson replied that although

this had not been done originally, the later development of the model for the DoT built in six road types to measure fuel consumption. DS: a policy to enforce speed limits would cut fuel consumption.

Reported by Laurie Baker

Further Reading

Melinda Acutt and John Dodgson (1996), *Policy Instruments and Greenhouse Gas Emissions from Transport in the UK*, Fiscal Studies, vol 17 (2), pp 65-82.

TEG NEWS**MEETINGS 1998**

The first three meetings for 1998 have been arranged as listed below. They will be held at 5.30 for 6pm at the University of Westminster (usually in room 205) which is at 35 Marylebone Road, London NW1 5LS. The building is on the south side of Marylebone Road, close to Baker Street Underground Station.

- January 28 **Structure of the Rail Industry**
Prof Bill Bradshaw, Centre for Socio-Legal Studies, Wolfson College
- February 25 **Global Airport Privatisation Trends**
Michael Colella, Portland Group
- March 25 **Cross-Channel market**
Roger Vickerman, University of Kent
- April 22 **Demand Forecasting, Financial and Economic Appraisal of Rail Schemes in London**
David Warren, Rail Planning Manager, London Transport Planning

ANNUAL GENERAL MEETING

The TEG Annual General Meeting is to be held on **25 February 1997 at 5 pm**, before the monthly meeting, at the Transport Studies Group, University of Westminster, 35 Marylebone Road, London NW1 5LS

Please note that the current chairman, Professor Peter White, wishes to stand down. Therefore, the Committee welcomes nominations for this office, and any of the other posts.

TEG POLICY ON MAILINGS

From time to time, the Group receives requests to mail members with notices such as forthcoming conferences or job vacancies. These notices are circulated on behalf of the organisations for a payment to cover mailing costs and a modest contribution to Group funds. Distribution of such notices does not imply

endorsement by the Group, and are simply sent because they may be of interest to members. The Group has not, and will not, release its mailing list which is retained exclusively by the Group; all mailings being sent directly by the Group.

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