OFFICE *of the*
RAIL REGULATOR

THE PERIODIC REVIEW OF RAILTRACK'S ACCESS CHARGES: USAGE CHARGES

A TECHNICAL CONSULTATION DOCUMENT

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Contents

1. Introduction and summary

Background

1.1 The basis for the current usage charges was set out in *Railtrack's track access charges for franchised passenger services: developing the structure of charges* a policy statement of the Rail Regulator (November 1994). That document described the usage charge as being "designed to recover the maintenance costs for wear and tear caused by individual trains running over a particular type of track". For the franchised passenger operators, usage charges currently represent around 3% of the total track access charges for the original endowment of rights.

1.2 The cost estimates on which charges were based at that time were derived from a model developed by BR, called mini-MARPAS. This model was developed for engineering purposes as a resource management tool. Its use for pricing purposes was therefore not ideal. The resulting cost estimates were based on national averages for particular types of rolling stock. They did not include the costs of inspecting the track and signalling costs since these were considered not to be "normally variable to individual train movements".

1.3 In the November 1994 conclusions, the then Regulator stated that the approach used to estimate the variable costs associated with operator activity would need to be refined. It was recognised at the time that the resulting variability of passenger charges was low. Services run under supplemental track access agreements pay the same usage charge. The present usage charges may therefore penalise Railtrack for increasing use of the network. Freight charges are subject to individual negotiation (and approved by the Regulator).

1.4 As part of the current periodic review, the Regulator asked Railtrack to carry out a programme of work to understand better what drives costs on its network. This included an assessment of how maintenance and renewal usage costs vary in relation to key drivers. Railtrack subsequently retained AEA Technology to assist in this work. They have developed a set of track damage models, which are a key input into the estimates that Railtrack has made of usage costs. The Regulator has retained Booz Allen & Hamilton to review the work undertaken in this area by Railtrack and AEA Technology and to assist him in developing proposals for Railtrack's usage

charges. He is publishing their report at the same time as this document. Copies may be obtained from the ORR library and from the ORR website[1].

1.5 The October 1999 periodic review document on the incentive framework sets out the criteria on which the Regulator believes that the structure of charges should be based. In the context of usage charges, the Regulator believes it is important that charges should:

(a) incentivise Railtrack, train operators and funders to ensure the efficient utilisation and development of the network;

(b) not unduly discriminate between users of the network; and

(c) be practical, cost effective, comprehensible and objective in their operation.

1.6 The October 1999 periodic review document also includes comments on issues of principle concerning whether usage charges should be cost-reflective. In addition, it discusses the suitable definition of the incremental usage costs for charging purposes. Specific issues on which the Regulator has invited comments include:[2]

(a) whether charges should be based on costs reflecting the efficiency achievable at the end of the control period (such that usage charges remain constant through the control period) or whether they should be reduced over time in line with expected improvements in efficiency;

(b) whether the incremental costs of freight should be assessed in terms of the impact on the actual mixed passenger and freight network, or a notional freight only network; and

(c) whether the incremental costs of traffic should be based on the impact of increased usage in the short term (i.e. during the price control period in question) taking into account the lags in the renewal process and the actual age profile of assets, or whether they should reflect the long term impact on maintenance and renewal costs.

1.7 This document consults in more detail on the issues involved in determining usage charges. It is therefore part of the consultation process on the overall incentive

[1] The ORR website is at http://www.rail-reg.gov.uk

[2] These issues are discussed at paragraphs 3.4 to 3.12 of *The periodic review of Railtrack's access charges: The incentive framework*, Office of the Rail Regulator, London, October 1999

framework. The Regulator will be publishing his provisional conclusions on the incentive framework in spring 2000. His final conclusions on the periodic review as a whole will be published in July 2000.

1.8 Chapters 2 and 3 describe the background and Railtrack's approach to these issues. Chapters 4 and 5 outline the Regulator's views:

(a) Chapter 2 describes the relevant maintenance and renewal costs and identifies those which vary with usage;

(b) Chapter 3 explains Railtrack's methodology for estimating usage costs, and describes the possible charging dimensions proposed by Railtrack;

(c) Chapter 4 discusses Railtrack's methodology. This includes the main issues arising from the Booz Allen & Hamilton review and the Regulator's assessment of Railtrack's treatment of renewals expenditure. It also sets out the different methods by which usage charges could be determined; and

(d) Chapter 5 contains the Regulator's assessment of the options for developing usage charges for the next control period. It also describes a possible refinement to the charging mechanism, which would reflect the potential impact of track and vehicle maintenance on costs.

1.9 Consultees are invited to comment on the principles raised in this paper in general and also on the specific consultation questions (listed together in Annex 1). Responses to this consultation should be sent to:

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to arrive **no later than 21 December 1999**.

1.10 Respondents should indicate clearly if they wish their responses to remain confidential to ORR. Otherwise these responses may be placed in ORR's library or quoted from by the Regulator. Where a response is made in confidence, it should be

accompanied by a statement summarising the submission excluding confidential information, which may be quoted from by the Regulator or published.

Summary

Elements of usage costs

1.11 Several elements of Railtrack's maintenance and renewal costs are likely to vary with the number of trains run. The setting of the usage charge will be informed by estimates of these costs:

(a) the most significant incremental costs are associated with track assets, which consist of the track itself, sleepers, and ballast;

(b) the number of trains crossing an underbridge on the railway network also impacts on the level of maintenance and renewal activity required; and

(c) the maintenance of signals and the renewal of electrification assets may be affected to a limited extent by usage.

Railtrack's proposals

1.12 Railtrack has derived estimates of usage costs for track, structures, signalling and electrification assets. It estimates that usage related costs represent around 20% of its current total maintenance and renewal spend.

1.13 Railtrack has developed detailed bottom-up engineering models, derived from the mini-MARPAS model, to estimate track usage costs. The estimates from these models alone are significantly higher than those used to derive existing charges. The most significant reason for this is the increase in assumed unit costs.

1.14 In addition, Railtrack argues that further cost elements should be included in usage costs to reflect the effect on underbridges, signals and electrification assets. Railtrack has provided top-down estimates for these additional elements, and proposes to develop a further detailed engineering model for the most significant element (underbridges).

1.15 Railtrack has submitted to the Regulator that the most cost-reflective basis on which to charge would be per consist mile by consist type, but that the current vehicle mile basis would be adequate. It has also raised the possibility that usage charges should vary according to geography, such that they more fully reflect the costs of running trains over different parts of the network.

The methodology for estimating usage costs and treatment of renewals expenditure

1.16 Booz Allen & Hamilton have reviewed Railtrack's usage cost model. They have commented that this model generates internally consistent estimates for individual vehicle types. The results accord at a high level with what Booz Allen & Hamilton would expect. In Booz Allen & Hamilton's view around 15-20% of maintenance and renewal costs vary with the number of trains run on a railway network.

1.17 However, Booz Allen & Hamilton have made a number of criticisms of the approach taken by Railtrack. The bottom-up approach used to quantify track related costs is extremely detailed, but may not take into account all the relevant cost drivers. The appropriateness of the level of detail applied at some levels is also questioned given various high-level assumptions and "calibrations", which need to be made.

Proposals for developing the base level of usage charges

1.18 Booz Allen & Hamilton have recommended that the Regulator use a top-down approach to estimating usage costs. Their approach is described in more detail in their report to the Regulator. It allocates an overall variable cost to groups of vehicle types based on an understanding of the underlying cost drivers. Booz Allen & Hamilton have suggested that the work undertaken by AEA Technology could be used to group similar vehicles together and to inform the allocation formula.

1.19 Booz Allen & Hamilton also recommend that charges should be based on a different measure of maintenance and renewal aggregated expenditure. Railtrack's approach estimates the long-run effect of traffic on maintenance and renewal costs. By contrast, Booz Allen & Hamilton have recommended that charges be based only on maintenance and renewals expenditure for the relevant control period. While the former would lead to more stable charges, the latter approach may reflect the actual short-term impact of growth more accurately. Changes in efficiency may mask changes, which result from different levels of renewals in different control periods.

1.20 The approach developed by Railtrack applies the same methodology to derive freight and passenger costs. Booz Allen & Hamilton have suggested that the assumptions made in the model, concerning the line speed and loading of vehicles, mean that this leads to particularly inappropriate cost estimates for freight vehicles. Further refinement of these assumptions may therefore be required on the basis of a better understanding of the actual levels of these variables.

1.21 The Regulator is proposing that the total cost associated with a stand-alone freight network is used as an overall cap on the total revenue that Railtrack may recover from freight customers (at least where the capacity is already in existence).

1.22 The existing charges are levied on the basis of vehicle miles, and do not vary across the network. The Regulator's current view is that this structure should be retained. While different systems are possible, the Regulator has yet to be convinced that changes would improve incentives sufficiently to justify the complications and associated costs.

1.23 Table 1.1 sets out the effect of the different approaches on average passenger and average freight costs. The efficiency adjustment is based on an illustrative assumption that Railtrack is able to reduce its costs by 4% per annum over the next control period. This is included for illustrative purposes only and does not represent the Regulator's view of the potential extent of efficiency savings. This issue will be considered more fully in the December periodic review document.

Table 1.1 Comparison of average passenger and freight usage cost estimates

	Average passenger usage costs Pence per vehicle mile	**Average freight usage costs £ per 1000 gross tonne miles**
Existing	5.65	1.43
Railtrack	15.84	4.40
Railtrack with efficiency adjustment	12.91	3.59
Booz Allen & Hamilton	11.83	2.44
Booz Allen & Hamilton with efficiency adjustment	9.65	1.99

(Source: Railtrack and Booz Allen & Hamilton)

Incentivising efficient maintenance

1.24 Track interacts with the vehicles passing over it. In particular, the level to which each are maintained has an effect on the other. Booz Allen & Hamilton have recommended a performance regime based on the forces, which trains impose on track, and vice versa. Such a regime could be reflected through a system of surcharges and rebates on the usage charge.

1.25 The main benefit with this approach is that it would incentivise both Railtrack and train operators to maintain their assets in a way which avoids unnecessary damage to

other parties' infrastructure and vehicles. This would therefore help to minimise the total cost of the railways. However, the case for further complexity requires consideration, taking into account implementation costs. One option could be to phase in these developments over a period of years.

2. Elements of usage costs

Introduction

2.1 The annual cost of maintaining and renewing infrastructure assets is high. A significant proportion of this figure is considered to vary with the use, which is made of the assets. Usage costs are therefore defined as that element of the total cost of maintenance and renewal, which varies with the amount and nature of traffic carried.

2.2 Not all maintenance and renewal costs depend on usage. The costs of certain types of asset are considered not to vary at all and, even where assets are considered to have usage related costs, the degree and significance of these costs varies by asset type.

2.3 This chapter describes how particular assets degrade with use and explains how, in principle, infrastructure maintenance and renewal activities vary with usage. This description focuses on the asset types whose costs Railtrack considers to vary most with traffic (track, structures carrying the railway, signals and electrification equipment). This work has been reviewed for the Regulator by Booz Allen & Hamilton.

Maintenance and renewal

2.4 Maintenance is a term that is used to describe a wide variety of activities carried out to ensure that the assets continue safely in service with the functionality and performance required of them. Renewals also fulfil this function, but they usually comprise either the replacement of the whole asset or at least of component parts of the asset. Renewals are carried out when continuing maintenance ceases to be an economic option and they therefore generally differ from maintenance work in terms of scale and frequency.

2.5 Assets must be maintained and renewed in order to sustain network serviceability and performance, and usage costs may therefore depend upon how the balance is struck between maintenance and renewal. To some extent, this is an issue of how specific work content is defined, but there is an important trade-off between the two. Assets, which are maintained to a higher standard, require a greater level of maintenance input, but are likely to require less frequent renewal. Conversely, a reduced level of maintenance will generally cause assets to degrade more quickly – both through natural deterioration and usage – leading to a more frequent requirement for renewal.

Elements of cost which vary with usage

2.6 The extent to which these maintenance and renewal costs vary with the type, speed and number of vehicles using the infrastructure depends upon the type of asset considered. Track assets are the most affected group, but Railtrack has also suggested that other asset types incur incremental costs from increased usage. The three further categories suggested are structures (where bridges carry the railway over other services), signals and electrification equipment. If access charges are to allow Railtrack to recover the usage-related incremental costs of traffic, it is important to understand clearly how, and to what extent, these costs vary.

2.7 Usage is not the only determinant of maintenance and renewal costs. Other factors, such as ageing, obsolescence and weather all generate requirements to maintain and renew the assets. The models, which Railtrack and AEA have developed, make provision for these elements of cost, which are therefore not included in usage charges.

Track usage costs

2.8 The costs of maintaining and renewing track assets are considered to be the most significant usage-related costs. Railtrack's analysis of the key cost drivers concentrates on modelling the effects of use on the degradation of three major track components: rail, sleepers and ballast. Before describing them, it is important to note that these costs are also heavily influenced by the complex nature of the interaction between track and train. Poorly maintained vehicles impose greater track forces and hence cause greater track damage and more rapid degradation of the track assets; similarly poorly maintained track imposes greater wear and tear on rail vehicles and hence higher rolling stock maintenance costs.

Rail

2.9 The degradation of rail is a major usage-related factor. Rails do deteriorate through natural processes such as corrosion. In certain environmental conditions (such as heavy pollution, wet tunnels and salt-laden atmospheres) this process can be so accelerated that it becomes the primary driver of maintenance and renewal. Generally however, it is the cumulative effect of traffic, which dictates requirements for maintenance and, ultimately, renewal.

2.10 Usage effects on rail are complex, but may be considered as either mechanical wear or fatigue. Rails are subjected to both lateral and longitudinal loads each time a train passes, and this action causes physical wear to the rail metal. The nature of this wear

depends upon many factors, but is governed by the forces each imposes on the other and is dependent upon characteristics of both the track and the vehicles using it. Wear is therefore influenced by the relative profiles of wheel and rail and the interaction between them, the geometrical design and the curvature of the track. Such wear may eventually reduce the dimensions and profile of the rail towards carefully specified safety limits, at which point it needs to be replaced.

2.11 The life of rail is also determined by fatigue. Rail metal has a finite life, which may be considered to be partly 'consumed' each time it is subjected to the wheel loads of passing trains. As the cumulative traffic carried by a piece of rail increases with its age in service, there will be an increasing likelihood that the rail metal will develop internal defects. Monitoring of rail defects, and the actions necessary to respond to them when they are detected, are both important elements of rail maintenance.

Sleepers

2.12 As with rail, sleepers degrade in various ways. Ignoring 'environmental' factors such as corrosion, splitting or rotting, the costs of sleeper maintenance and renewal are also driven by the effects of use. The repeated impact by passing trains may cause fatigue to occur which leads, for example, to cracking or splitting and the failure of the rail fastening. The loads imposed upon sleepers will vary with the track design, the quality of its maintenance, the quality of vehicle maintenance, and the nature of the underlying track foundation. However, sleepers are also subjected to mechanical wear. An example of this is the abrasion, which occurs between the surfaces of a concrete sleeper and the track ballast.

Ballast

2.13 The purpose of ballast is to support the rail/sleeper combination and distribute the loads applied to it, whilst maintaining the designed track alignment and profile (the track geometry) and providing a natural mechanism for track drainage. Ballast degrades as it becomes clogged with fine particles, which reduce its ability to fulfil these functions. Such material accumulates within the ballast from several sources. In part, it is a product of natural deterioration, but there are significant usage-related effects. Abrasion occurs within the ballast itself and with the sleepers each time the track deflects under axle loads. Additionally, ballast also wears through friction each time it is subjected to track maintenance activities such as tamping. The passage of traffic may introduce other external pollutants such as brake dust and detritus from wagons, which might add to maintenance activity.

2.14 The functionality of ballast is maintained by ensuring that it remains relatively free from pollution by such fine materials. Maintenance and renewal works therefore include replacement and 'cleaning' of track ballast; the latter activity involves removal, screening and return of the stones to the track, and may be carried out manually or mechanically.

Track geometry

2.15 The foregoing discussion has focused upon aspects of degradation of individual track components. However, in combination these components form a structure which is not totally rigid and therefore which itself deteriorates with use. This is most evident in the need to maintain the geometry of the track, which is to maintain its designed horizontal and vertical alignment and the dimensional relationship between the two running rails. Track geometry tolerances are defined to ensure the safety of traffic and the comfort of passengers, and they vary with the speed of traffic; higher speeds allow smaller tolerance to localised geometric faults and hence require higher quality geometry.

2.16 Track geometry maintenance can involve several processes, including manual attention. However, the most common form is mechanical tamping, in which specialist machines consolidate the ballast to support the corrected track geometry. Railtrack is also introducing 'Stoneblower' machines, which achieve the same objective in a different way. The usage cost models consider these activities to be usage related.

Inspection

2.17 One other area of track maintenance activity is considered to be included in the AEA modelling for Railtrack. This is the activity of track inspection, which includes manual inspection, testing for rail defects and the recording of track geometry. Railtrack contends that the frequency of these activities depends upon the level of usage and the costs of inspection should therefore be treated as usage-related cost.

Non track usage costs

Structures usage costs

2.18 The railway network comprises a large number of structures, including bridges, viaducts, tunnels, retaining walls, culverts and earth structures such as embankments and cuttings. Many of these structures do not carry the direct loads imposed by the passage of rail traffic and their maintenance and renewal costs are not considered to

vary with use. Other structures have been considered by Railtrack to be only marginally affected by usage, and the element of usage-related cost is ignored.

2.19 This is not the case with underbridges. Underbridges carry the railway over other services and rights of way, and therefore do carry the direct loads imposed by rail traffic. As with all other structures assets they also deteriorate by ageing, corrosion and other 'environmental' factors, but their deterioration and economic life is also considered by Railtrack to have a significant usage-related element. Railtrack has proposed that the AEA model therefore includes an element of underbridge cost.

2.20 The significance of the usage element of underbridge costs is dependent upon the type of bridge and the material from which it is constructed. Metal bridges are particularly prone to fatigue life limitations, which lead to component replacement or even full-scale reconstruction of the bridge. The nature of the applied loading and the way in which it interacts with the structure will also affect the way in which each structure responds to use. This effect therefore varies with the type of train, its weight, speed and composition.

Signalling usage costs

2.21 The majority of signalling maintenance and renewal costs have not been considered in the past to be related to the amount of traffic carried on the network. In the latest work carried out by Railtrack, this understanding has changed.

2.22 Railtrack has proposed that certain signalling maintenance activities, and hence costs, are partly driven by the level of use of the network. These elements cover the 'rapid-response' maintenance activity of replacing the lamp filaments in colour-light signals, and the usage element of these costs is justified on the basis that more frequent use requires more frequent switching of signal lights and hence a reduced asset life. A similar case is made to justify the inclusion of elements of points maintenance and level crossing maintenance costs.

2.23 Other signalling maintenance costs, such as those related to cabling, control panels, lineside modules, interlockings and power supply are not considered to be usage-related. Signalling renewals costs are also excluded from Railtrack's analysis. The decision to renew signalling assets is regarded as not usage-related.

Electrification usage costs

2.24 Railtrack purchases the electricity used by the rail network, and recovers the costs of traction electricity from operators through a separate access charge. In addition to the

cost of electricity used, Railtrack owns and maintains a range of electrification assets to deliver electricity to trains. In particular this includes the overhead contact wires used in AC systems, and the conductor rail used in "third rail" DC systems.

2.25 Booz Allen & Hamilton have advised the Regulator that usage affects the life of the contact wire and, to a lesser extent, the amount of fatigue of the connections between the contact wire and the catenary. While age and corrosion are important in the speed with which these assets degrade, heavily used systems are more likely to require higher levels of maintenance and renewal. Booz Allen & Hamilton have also advised that the conductor rail will also be worn more through greater usage.

2.26 The Regulator has already consulted on the basis of charges for traction electricity. He considers that any costs associated with the usage of electrification assets should also be reflected in these charges.

2.27 The Regulator invites consultees' views on whether in principle the maintenance and renewals costs described for track, structures, signals and electrification assets do vary with usage. Consultees' views are also invited as to whether there are any other significant cost elements which, in principle, vary with usage.

3. Railtrack's proposals for usage costs and charges

Introduction

3.1 This chapter describes Railtrack's estimated incremental usage costs and its proposed structure of usage charges. Railtrack has based its estimates on total maintenance and renewal costs for relevant assets of £1,980 million per year. It argues that around 20% of its current maintenance and renewal costs are related to current usage (in the range of £380 – £390 million per year).

3.2 Railtrack commissioned AEA Technology to develop a model to replace the use of mini-MARPAS in the charging regime. This has developed revised estimates of the extent to which track costs vary with respect to traffic levels. Railtrack has also provided estimates, on the basis of internal engineering advice, of the extent to which the costs associated with signalling and electrification assets vary with usage. Finally, Railtrack has been working with AEA Technology to provide estimates for the incremental costs associated with structures, in particular underbridges. Each of these elements is described in this chapter.

3.3 Railtrack has also submitted proposals for the form of the usage charge, suggesting that cost reflectivity could be increased by introducing further dimensions to the charge. These proposals only cover the charges levied from franchised passenger operators. Freight operators currently negotiate both their fixed and variable charges. Railtrack has considered that the same estimates of costs inform the negotiation of the freight variable charges.

3.4 The final section of this chapter discusses the actual estimates, which Railtrack has produced through applying their methodology to the LNE zone. A range of these estimates by vehicle type is reproduced in Annex 2.

Railtrack's methodology for estimating track usage costs

3.5 Railtrack has derived its track usage cost estimates through a bottom-up approach adding up the cost attributed to different types of damage caused by a vehicle running over a section of track. AEA Technology have been retained by Railtrack to assist in the development of these estimates, and have updated and reworked the underlying relationships used in the mini-MARPAS model. This has led to the creation of a set

of track damage models, which Railtrack has used to revise estimates of costs for charging purposes[3].

3.6 Damage is defined in these models as being the effect of a single vehicle of a given type passing over a particular section of track. This is made up of:

(a) a renewals cost derived from the proportion of the life of an asset, which is consumed; and

(b) a cost derived from the maintenance activity, which is required (for example, if a maintenance activity is required after 1000 vehicles pass the asset, then the damage attributed to an individual vehicle is 1/1000 of that maintenance activity).

3.7 The track damage models are modular. Components of the overall model estimates, for a particular service:

(a) rail fatigue;

(b) switches and crossings fatigue;

(c) sleeper life;

(d) track geometry deterioration;

(e) ballast life; and

(f) inspection.

3.8 The basic structure of the interactions between the different modules is shown in figure 3.1. Each of these modules calculates an element of damage caused by an individual vehicle running over a particular segment of track, taking into account the type of assets (or "network category") of that particular network section. There are 121 network categories in the model along the following dimensions:

(a) track type (continuous welded rail, jointed or switches and crossings);

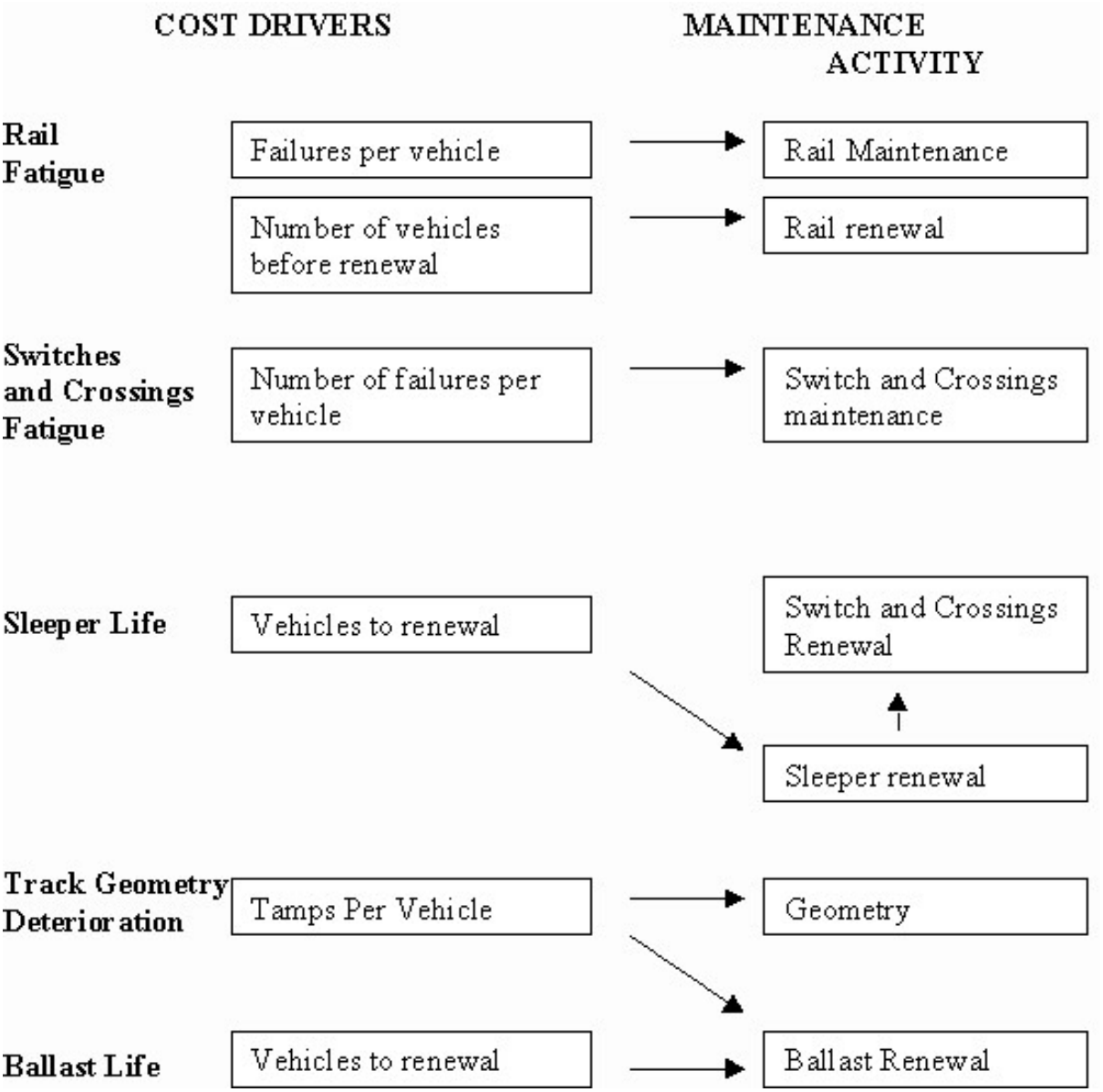
(b) sleeper type (concrete, hardwood, softwood or metal); and

(c) track quality band (from 1 to 11).

[3] The overall logic of the models is shown in figure 1 of the Booz Allen & Hamilton report

3.9 For a particular service the models calculate the extent of damage caused by each vehicle, over each network segment, for each type of damage (module of the model). Each individual damage contribution is then multiplied by the unit cost of the maintenance or renewal activity in order to provide a cost contribution in money terms. The overall cost for the service is the aggregation of these costs. Rates per vehicle mile, or per gross tonne mile, are derived through appropriate division of the overall service cost.

Figure 3.1



(Source: AEA Technology)

3.10 The total level of maintenance and renewal costs on which Railtrack has based its estimates of track-related usage costs is around £600 million per year. Table 3.1 shows the amount of track maintenance and renewals costs, which Railtrack argue vary with usage, and the percentage they represent of Railtrack's total usage cost estimates. These are based on current traffic levels.

Table 3.1: Railtrack's track usage cost estimates

	Overall variable cost per year	Percentage variability	Percentage of estimated total usage cost
Track	£300m	50%	77%

(Source: Railtrack)

3.11 Railtrack has proposed that track usage charges be recovered either through a per vehicle mile charge (as is presently the case), or through a per unit or consist mile charge[4]. It has also suggested that charges could vary by strategic route or service code. Introducing geographical variation to charges would allow charges to be more cost-reflective, i.e. to take more direct account of differences in speed, the density of switches and crossings (which are more expensive to maintain) and the characteristics of the track.

Railtrack's methodology for estimating other usage costs

3.12 Railtrack has recently provided estimates of those non-track maintenance and renewal costs, which it argues, vary with traffic. These elements were not included in the cost estimates made using mini-MARPAS at the time of the 1994/5 determination of charges. The overall variable costs, which Railtrack has attributed to these elements, and the percentage those costs represent of the relevant total maintenance and renewal costs are shown in table 3.2.

Table 3.2: Railtrack's non-track usage cost estimates

Asset Type	Overall variable cost per year	Percentage variability	Percentage of estimated total usage cost
Underbridges	£40m-£50m	20%	13%
Signalling	£15m-£20m	5%	5%
Electrification	£15m-£20m	20%	5%

(Source: Railtrack)

[4] Railtrack has stated that while different vehicles in a multiple-unit currently have individual charges, this does not send a useful price signal these are always run in a fixed formation. It has suggested therefore that a charge related to the fixed unit or consist might be more appropriate

Underbridges

3.13 The figures for underbridges are derived from recent research undertaken by Railtrack. Railtrack has proposed that AEA Technology derive an additional module, consistent with the track damage modules. This work would investigate further the sensitivity of underbridge maintenance and renewal costs to various cost drivers.

3.14 The preliminary analysis conducted by Railtrack suggests that weight, speed and formation of trains are important factors concerning the impact of traffic on these structures. Railtrack has suggested that, subject to further analysis, an additional charge based on vehicle miles would be suitably cost-reflective, but that the charging mechanism would need to reflect geography as well, since bridges are not uniformly distributed across the network.

Electrification assets

3.15 Railtrack has conducted a top-down analysis of the extent to which the costs of electrification assets vary with traffic. Its engineers have estimated the percentage variability of individual renewal activities considered to be affected by usage. An overall variable cost has been derived through adding the resulting costs. Railtrack's present track cost estimates have been increased by a percentage amount to include these costs.

3.16 For electrification assets, Railtrack has stated that, while maintenance costs do not vary with usage, the level of renewals is dependent on the level of electrified train miles. For DC electrification systems (where electricity is drawn from a "third rail"), Railtrack has stated that an additional train affects the conductor rail, substations and high voltage feeder cable networks. Those elements of AC electrification systems (where electricity is drawn from overhead wires) affected are the primary contact wires, other overhead line equipment and the feeder station equipment.

3.17 Railtrack has identified a number of cost drivers leading to the degradation of these assets, but the key ones are the number of pantographs (in the case of AC systems) or the number of conductor shoes (in the case of DC systems) using the Railtrack asset. It has therefore suggested that charges be based either on the consist mile by electrification type, or vehicle miles by electrification type.

Signals

3.18 Railtrack has undertaken a similar top-down analysis for signalling assets. Railtrack analysed the maintenance costs, which are variable, having stated that renewal rates

are not significantly effected by usage. Railtrack considers that the number of trains passing affects the wear and tear of signal lamp filaments (i.e. the more the signals are switched, the more likely it is that the filament will fail and need to be replaced), points mechanisms and level crossing barriers. The vibration caused by trains passing is also said to effect the points mechanisms themselves and the track level signals (shunt signals).

3.19 Railtrack has suggested that these costs could be recovered through a train mile or vehicle mile charge, which effectively would be an adjustment to the estimated track usage costs. It is the number of trains passing the relevant asset, which is the important driver. Therefore this approach would assume that signalling assets are evenly distributed across the network. An alternative charging mechanism, proposed by Railtrack, would therefore be for adjustment to charges to vary geographically, reflecting the distribution of signalling assets.

Railtrack's estimates for total usage costs

3.20 Railtrack has applied the methodology to data collected from the London and North East (LNE) zone to estimate track usage costs. Overall maintenance costs for electrification assets have been analysed, while the signalling usage cost estimates have been based on detailed analysis of data from the Wessex and Kent contract areas. As a result it has estimated sample usage costs for a range of actual vehicle types. These are therefore averages across an individual zone, compared with the national averages derived from mini-MARPAS and used to set current usage charges.

3.21 Earlier this year, the first results of this work were shown to the Users' Group, comprising representatives from the shadow strategic rail authority, PTEs and operators. Railtrack and AEA Technology have since refined and updated the estimates and taken account of the work done on non-track usage costs[5]. Railtrack's current figures also include estimates for the non-track usage costs described above.

3.22 The tables in Annex 2 set out illustrative results for a number of representative vehicle types. The Regulator has proposed that usage charges reflect the level of efficiency, which should be achievable at the end of the control period. In order to provide consultees with an indication of the effect of this proposal, the estimates in Annex 2 are also presented with an illustrative efficiency adjustment.

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[5] The Booz Allen & Hamilton report lists the changes made, which include provisions for manual maintenance, spillage from "dirty wagons" and the elimination of environmental impacts on asset lives

3.23 The Regulator has assumed aggregate efficiency gains of 4% per annum over the course of the next control period to calculate the efficiency-adjusted figures in this document. The Regulator has still to reach a view on the efficiency gains during the next control period, but he believes that there is substantial scope for efficiency gains during the next control period. The Regulator is currently considering these matters, and will be publishing his provisional conclusions in December, concerning whether 4% efficiency gains are in fact achievable, or whether further gains could be required.

3.24 Differences between the mini-MARPAS and Railtrack's current estimates derive from four main sources. There is a relatively small change resulting from AEA Technology's work deriving new track damage models. Significant changes occur through:

(a) the revision of maintenance and renewal unit costs;

(b) a change in the way the effect on usage costs of renewals expenditure is treated (discussed further in chapter 4); and

(c) the inclusion of non-track usage elements in the cost estimates.

3.25 Table 3.3 shows the ratio of Railtrack's estimates to the existing cost estimates. These are based on the figures derived from the LNE zone, and represent the average increase for passenger and freight vehicles. The last column of the table reflects the assumption of 4% efficiency gains per year discussed above. These increases reflect the changes in usage cost estimates. They are not necessarily the applicable multiples for usage charges, especially where those charges are negotiated.

Table 3.3: Ratio of current usage cost estimates to existing cost estimates

	Railtrack's estimates	**Railtrack's Estimates adjusted for efficiency**
Passenger	~1:2.8	~1:2.3
Freight	~1:3.1	~1:2.5

(Source: Railtrack and ORR calculations)

3.26 The Regulator invites consultees to comment on Railtrack's methodology for deriving usage costs, and the implications of their estimates.

4. The estimation of usage costs

Introduction

4.1 This chapter considers the alternative methodologies by which usage costs could be derived. The first section deals with the issues of the overall maintenance and renewal costs being considered and the extent to which they vary with traffic. Following which, the conclusions of Booz Allen & Hamilton concerning Railtrack's approach are discussed. The treatment of renewals expenditure, and the question of whether usage charges should reflect the long-run or short-run effect of incremental trains is discussed. Finally the chapter briefly sets out alternative methodologies, which can be used to estimate usage costs on which to base charges.

4.2 Railtrack contends that existing variable charges are lower than actual incremental costs. The Booz Allen & Hamilton review suggests that the overall variability of costs is higher than was used to set current charges.

4.3 Booz Allen & Hamilton have investigated the approach taken by Railtrack for the Regulator. It has questioned the use of a bottom-up approach on the grounds that:

(a) it is unlikely to be comprehensive, not covering elements, which might be expected to have a significant impact on usage costs;

(b) general assumptions are made, which negate the benefit of detail elsewhere in the model; and

(c) it does not appropriately deal with freight vehicles.

4.4 The treatment of renewals expenditure also has a potentially important impact on the overall level of usage charges. The Regulator considers that either the long-run impact of usage, or the short-run impact (in terms of the renewals expenditure required during the control period in question) could be used to set usage charges. While the former might reduce the extent to which usage charges vary between control periods, the latter would ensure that Railtrack recovered only the additional costs, which it was likely to incur in the short term as a result of increased usage.

4.5 Railtrack's estimate of the track incremental costs adds up the individual components of cost caused by an additional vehicle, based on the engineering models developed by AEA Technology. The analysis is bottom-up. Another approach would be to

estimate the incremental costs of individual vehicles solely through statistical analysis based on historic data. Alternatively a top-down approach could be adopted by which the overall level of variable cost is allocated to individual vehicle types.

Overall level and variability of costs

4.6 A model to allocate variable costs to individual vehicles needs to start from an overall level of unit costs for the relevant maintenance and renewal activities. The AEA track damage models calculate an amount of damage (required maintenance and renewal) caused by an individual vehicle. The output of these models is then applied to the unit costs. The usage charges supplied by Railtrack (sample figures are given in Annex 2) are based on Railtrack's estimates of their unit costs.

4.7 Railtrack has argued that these costs have increased compared with the costs, which were used by the mini-MARPAS model on account of three main factors. In particular Railtrack has included:

(a) engineering haulage, which was previously treated as a fixed cost;

(b) a depreciation charge for plant, which they considered included in the commercial rates negotiated with contractors (plant costs were previously written off at the time of purchase); and

(c) contractor margins.

4.8 The overall level of maintenance and renewal costs, which Railtrack requires for efficient operation during the next control period, is a matter on which the Regulator will publish his provisional conclusions this December. At that time he will set out his views on the level of expenditure, which Railtrack should make. The level of unit costs, which is input into any calculation of usage charges, will be expected to reflect these conclusions.

4.9 Railtrack argue that usage costs are about 20% of total infrastructure maintenance and renewal spend. Previous estimates of usage costs represent around 6-7% of total maintenance and renewals spend. (The current usage charge is 3% of total charges for the franchised operators.)

4.10 Booz Allen & Hamilton, in their review, state that maintenance and renewal costs varying in the range 15-20% is likely to reflect the actual impact of traffic on a railway network. Booz Allen & Hamilton have reviewed studies done for other rail networks concerning the variability of costs, and have found that 30-60% of track

related costs are usually estimated to vary with traffic levels. While international comparisons need to be treated with care, as the relationship between costs and usage will also depend on other factors, this would seem to suggest that the current variable charges are unlikely to be cost-reflective.

Deriving usage costs for vehicle types

4.11 The allocation of the overall level of variable costs between individual vehicles is one of the objectives of the track damage models developed for Railtrack. Its approach leads to an amount of damage being associated with each vehicle, which is then converted to a monetary amount through application to the overall unit costs.

4.12 Booz Allen & Hamilton have identified a number of concerns about Railtrack's approach. The overall detail and apparent accuracy of the models is undermined in their view by the potential variation in parameters and phenomena, which are assumed or not considered.

4.13 The high level assumptions, which have been imposed on the engineering relationships provided by AEA Technology, mean that Booz Allen & Hamilton feel unable to assure the Regulator that the allocation of incremental costs to individual vehicles provided by Railtrack would be robust were the methodology to be rolled out across the network.

4.14 Notwithstanding this Booz Allen & Hamilton have advised the Regulator that the approach broadly provides a suitable result on the basis of the information provided, with exception of the division of costs between freight and passenger vehicles. They have conducted a top-down analysis on the basis of detailed information on the LNE zone supplied by Railtrack, which is described in their report. Other than the treatment of freight, Booz Allen & Hamilton have stated that the cost estimates for individual vehicle types are internally consistent, and conform to its prior expectations, based on engineering concepts.

4.15 The remainder of this section outlines specific concerns, which Booz Allen & Hamilton have highlighted concerning the cost drivers included in the model, the assumptions made, the calibration of the models to Railtrack's actual maintenance activity levels, the treatment of freight vehicles and the data, which is used.

Coverage of the model

4.16 The modules, which have been used to estimate the overall cost of vehicles, have been included on the basis of data availability. Potentially important elements have

therefore been excluded, negating the benefit of a bottom-up approach, which should be comprehensive. Booz Allen & Hamilton have identified a number of potential sources of variable cost, which have not been considered in the models.

4.17 While inclusion of more cost drivers would be unlikely to change the overall level of costs, the allocation to individual vehicles might alter. Those cost drivers that the model has been unable to incorporate, which engineering theory suggest may have an important impact, include:

(a) wheel profiles;

(b) rail profiles;

(c) wheel irregularities;

(d) non-uniform quality distribution; and

(e) the effect of the maintenance strategy on the long term track quality.

4.18 Booz Allen & Hamilton have suggested that this is not a comprehensive list. Certain operators and Booz Allen & Hamilton have argued that the curvature and gradient of the track are also important, on the basis of cost causation work done abroad. In estimating the damage caused to the rails themselves, the models concentrate on internal rail fatigue. Booz Allen & Hamilton consider that surface fatigue and rail wear are also significant sources of damage. They are of the view that these are not sufficiently covered within the models. Railtrack has not considered the sub-structure under the track (that is, the underlying geology on which the track is laid). Certain operators have stated that this could be an important influence on costs.

Modelling assumptions

4.19 The models are also required to make certain broad assumptions. While on the one hand they start from a very high level of detail, the usefulness of this must be questioned when set against the overall assumptions, which have also been required. These include:

(a) the reference annual tonnage;

(b) speed assumptions;

(c) vehicle characteristics; and

(d) technologies, which are assumed.

4.20 While the usage cost models being used by Railtrack essentially derive the costs imposed by a vehicle independent of other traffic on the same network section, an overall "reference annual traffic level" is required for some of the track damage models. This allows the damage of an individual vehicle to be derived at a particular point in the asset life cycle. The assumption that has been made by Railtrack concerning this value is 10 million gross tonnes (MGT) per year.

4.21 It has argued that this is a suitable figure, and that varying this assumption by ±50% only leads to changes in vehicle costs of no more than ±12%. Further it has also stated that varying the assumption would lead to the model changing the relative costs of light and heavy vehicles. Booz Allen & Hamilton have questioned the use of this assumption as it has not been established what would happen at very low (or high) levels of volume. Substantial proportions of Railtrack's network experience very low densities, which are outside the sensitivity tests, which have been conducted, and where the robustness of the track damage models has not been proven.

4.22 There is also an issue concerning the scope of the difference between long-run and short-run costs in relation to this assumption. If short-run costs are considered, the relationship may not be linear, and may be substantially more sensitive to overall traffic levels. The long-run relationship between variable costs and the overall traffic density is likely to be flatter, as renewals with new materials will take account of the increasing overall traffic levels.

4.23 Another assumption used in the model is that vehicle speed is the lower of either line speed or maximum vehicle speed. However, many services are unlikely to travel at the maximum possible speed for a substantial portion, or even any, of the journey. Examples would be freight services and commuter services. The models also use "typical" vehicle characteristics for axle loads, which may in fact vary between individual vehicles. The overall calibration of the models (discussed below) ensures that the total level of variability is not affected by these assumptions. However, that calibration is not able to reflect the fact that for certain groups of vehicles the assumptions may be less true than for others.

4.24 The model is based on essentially historic data (while taking into account some new technologies). Booz Allen & Hamilton have maintained that newer technologies have not been considered sufficiently. Newer types of asset could lead to longer component lives, reducing maintenance and renewal. Examples include the use of

premium steel rails. There are questions concerning the extent to which the historic relationships continue to hold. An example is the modelling of "dirty" wagons (these are vehicles, which drop fine material on the track). While the Regulator accepts that the model uses a parameter based on robust analysis, he is concerned that the relevant analysis was conducted some years ago and may not reflect current practice.

Calibration and need to roll out the model

4.25 Railtrack has calibrated the results derived from the AEA models, such that the predictions of the model are consistent with the assumptions, which Railtrack made for the Asset Management Plan 1998 and the current levels of maintenance activity. These adjustments are required to ensure that the predictions of the model link to Railtrack's actual level of maintenance and renewal activity (influenced by assumed asset lives).[6]

4.26 The fact that the calibration factors are significant suggests that it is important that any further use of the AEA model is based on information from more than an individual zone. The Regulator understands that Railtrack is currently working on applying its methodology to a second zone. Railtrack has also separately submitted to the Regulator its belief that a number of factors may vary on a geographic basis.

4.27 The Regulator therefore currently believes that any use that is made of the bottom-up approach being proposed by Railtrack, or the AEA track damage models, will need to be based on a sufficiently representative sample of zones. If the models are not applied to all zones, the Regulator will expect that those zones chosen will include zones, which might be expected to cover the full range of potential variability of relevant factors. To achieve this the Regulator expects that the model will need to be applied to parts of the network, where usage levels and hence costs may be expected to be significantly different from the LNE zone (for example, in Scotland or regional areas away from the main trunk routes).

Data used

4.28 The main data sources, which have been used by Railtrack in order to derive its usage cost estimates, are the databases NETRAFF and GEOGIS. Booz Allen & Hamilton have reviewed these databases, and have concerns about the overall integrity of the data they supply. GEOGIS data has not been routinely updated since privatisation

[6] Booz Allen & Hamilton's report discusses this process, raising reservations about the assumptions made. For example, they suggest that current maintenance activity levels are not leading to the network being maintained in a steady state, and might not reflect required future levels of activity

when responsibility for maintaining the information was passed to contractors. The information in NETRAFF is still being collected for some zones, and does not contain historic data. The vehicle information used in the track damage models is mainly extracted from former BR Research information, and in many cases pre-dates privatisation.

4.29 For the current periodic review this information represents the best available. The Regulator will be considering whether it is sufficient to support, for example, usage charges being different for different parts of the network. If this information is used to set variable charges the Regulator would expect Railtrack to demonstrate that sufficient data of a suitable quality is available to develop robust usage charges on any particular basis.

Application of methodology to freight traffic

4.30 An important area where Booz Allen & Hamilton have stated that they believe the approach adopted by Railtrack is not appropriate is the treatment of freight vehicles. Existing freight access charges are significantly more variable than passenger charges and are subject to separate negotiation and regulatory approval. Railtrack's current cost estimates suggest that the variable element should be higher still.

4.31 Railtrack's methodology treats freight vehicles in a manner identical to passenger vehicles. It does not distinguish between damage done to assets, which freight vehicles require, or which Railtrack only requires to provide a service to passenger operators. Further, freight traffic may not require assets to be maintained to the standards, which the methodology assumed, which are based on the requirements of passenger vehicles. For example, if only freight were to run on a line, then track might be maintained differently as a result of the lower operating speeds of freight trains.

4.32 The assumptions concerning line speed discussed above have a significant impact on the level of freight costs estimated. Further the models also currently assume that freight vehicles are either fully laden or empty. Potentially these assumptions could be refined in updating Railtrack's estimates. Booz Allen & Hamilton (as set out in Annex 2) make more realistic assumptions concerning the speed of freight trains and the extent to which they are laden. This accounts for the lower estimates they have made for freight vehicles as set out in Annex 2. Where better estimates for the loading and speed of vehicles is available, the Regulator believes that the effect of these on usage cost estimates needs to be considered.

4.33 Although total freight charges are not a matter for this paper, the Regulator is considering the principles set out by the then Regulator in the February 1995 policy statement on the approval of access charges for freight services. This stated that:

(a) Railtrack should be able to recover at least its total freight specific costs, thereby avoiding cross subsidy between passenger and freight services;

(b) Cross subsidies between individual freight users should be removed;

(c) Railtrack's avoidable costs should be assessed with greater accuracy than at present;

(d) Charges should be subject to a regulatory ceiling, based on stand alone costs and verified on a case by case basis where negotiated charges are more than 50% of Railtrack's initial estimate of stand alone cost;

(e) Freight users should share in the cost savings, which Railtrack is expected to make; and

(f) Charges should not lead to a significant distortion of competition between freight operators or between freight users competing in the same final market.

4.34 It has been suggested that freight variable charges be derived from a notional efficient freight only network. This would likely distort the price signals faced by passenger and freight operators. However, the total cost associated with a stand alone freight network could be used as an overall cap on the total costs, which Railtrack may recover from freight customers. This would expand the principles described above for charges for individual freight flows to total freight access charges. It would also ensure that freight services are not priced off the network as a result of the way in which common costs are allocated between operators.

4.35 **The Regulator invites consultees' views on Booz Allen & Hamilton's conclusions on Railtrack's usage cost estimates. Consultees' are invited to comment on the assumptions made, and the extent to which they may or may not distort the resulting cost estimates. Consultees' are also invited to provide evidence that the model does or does not include elements, which have a significant impact on usage costs. Consultees' are invited to comment on what geographic areas cost estimates could be based, and the sufficiency of available data. Lastly, consultees' are invited to comment on the application to freight costs, and the principles, which could be used in approving freight charges**.

The treatment of renewals expenditure

4.36 One important reason why Railtrack is proposing increased usage charges concerns the method of including renewals expenditure in estimating incremental costs. This section describes alternative treatments of renewals expenditure, and considers the advantages and disadvantages of each.

4.37 There are two basic approaches, whereby either the long-run or short-run renewals costs are taken into account in the usage costs. The use made of the mini-MARPAS model and Railtrack's current approach are based on recouping the long-run effect of usage on renewals spend. Railtrack's current approach increases incremental costs, compared to the existing approach, through assuming that asset ages are evenly distributed. If the long-run approach were adopted, usage costs could be relatively more stable between control periods.

4.38 An alternative option would be to base usage charges on the short term maintenance and renewals expenditure (during the control period in question), linking charges to Railtrack's overall revenue requirement. However, this approach could mean that usage costs vary between control periods. The extent to which usage costs vary between control periods would also be influenced by efficiency adjustment, which might more than counterbalance the effect of different levels of renewals activity.

Long-run usage costs

4.39 Wear and tear of assets will, at some stage, result in the costs of replacement being lower than the costs of maintenance. Incremental train services will increase wear and tear and will bring forward the stage at which replacement occurs. The reduction in the life of the asset through increased use reduces the period over which capital costs can be recovered. In the long-run, therefore, incremental traffic will lead to higher renewal costs, as assets are replaced more often.

4.40 The mini-MARPAS model includes an annuity charge for renewals. This is a fixed annual amount the present value of which, over the life of the asset, is equal to the initial cost of the asset. The way, which the model was used to set existing usage charges, assumed that all assets were at the beginning of their lives. An increase in usage leads to earlier renewal. The same renewal cost thus needs to be recovered over a shorter period of time, leading to a higher annual charge or annuity. The costs of an additional train were estimated as the difference between the annuity with and without that train being run.

4.41 Railtrack has argued that this is not a realistic description of renewal spend and has proposed a different approach. They have assumed that the age of network components is evenly distributed, such that the same proportion of the stock of assets needs to be renewed each year. There is therefore a steady state level of renewals expenditure each year. An increase in traffic leads to asset lives shortening, and renewals expenditure being brought forward. The shorter asset lives therefore lead to an increase in the annual renewals expenditure.

4.42 An equivalent way of thinking of the even distribution of asset ages is that the same amount is spent on each asset during each year of its life. Shortening the life of the asset, through increased usage, leads to the same renewal cost of the asset being recovered in a shorter time frame increasing the imputed annual amount spent on the asset.

4.43 The AEA track damage models calculate the proportion of the life of each asset "consumed" by an individual vehicle. Railtrack's usage cost estimates include this proportion of the overall capital cost of renewal.

4.44 Incremental traffic will not immediately lead to more assets requiring replacement. Railtrack has also assumed that the lags from renewals created through the structure of their agreements with contractors impact evenly on the reduction of life of assets caused by incremental usage. Increased traffic leads to renewals being brought forward. If lags impact evenly on every renewal the modelled costs are not materially changed.

4.45 The timing of renewals could be assumed to be less affected by lags the further into the future those renewals were. A current increase in traffic, through the effect of lags, will not lead to an immediate increase in renewals. However, if renewals are due a number of years into the future, there will be no lag on costs being incurred sooner. If this is the situation, then ignoring lags could lead to unexpected increases in traffic providing windfall profits for Railtrack. Their revenues would increase, but the effect on their cost would be delayed.

4.46 Railtrack's current approach leads to significantly higher estimates than the original use of mini-MARPAS. The Railtrack approach has the merit of simplicity, while improving on the assumptions made previously. However, neither of these approaches properly reflects what actually happens to renewals. For example, both of these methods assume like-for-like renewals with identical costs. In fact, track assets tend to be replaced by longer life assets, which more than offset the reduction in lives

through increased wear and tear. Examples of this would be replacement with harder rails or longer rails between welds. The interaction between the type of renewals and the level of maintenance required over time could in principle be considered.

Short-run usage costs

4.47 If a short-run approach were adopted (such as that recommended by Booz Allen & Hamilton), the need for a consideration of the age profile of assets would be reduced. It may also provide an imperfect proxy for the effects of lags. The renewal component of usage charges would be based on the expected expenditure for the control period, and the overall proportion of renewals expenditure considered to vary with traffic levels. This expenditure, reflecting the efficiency, which Railtrack should be able to achieve during the next control period, would be allocated to the incremental costs of individual types of train. Only renewals expenditure, which was expected to be incurred during the control period, would then be included within the usage costs.

4.48 This would have the advantage of linking the renewals expenditure elements of usage costs directly to the level of expenditure, which determines the overall level of access charges, and thereby ensure consistent application between the costs included in the fixed charge and the usage charge. It would also mean that the usage cost was linked to the expenditure, which Railtrack was actually expected to incur during the relevant control period.

4.49 A potential disadvantage of this approach being applied across different control periods would be that usage costs could vary between control periods. Actual renewals costs will depend on the age profile of assets at any point in time, and so are likely to vary between control periods and may be subject to peaks.

4.50 The long-run costs would have to be calculated on the basis of current understanding and practice. Renewals polices may change between control periods. For these reasons it may therefore be more appropriate for Railtrack to recover the renewals costs incurred in the relevant control period, rather than over the long-run. It may be necessary to take account of improving technology over time (for example, if this leads to increasing asset lives).

4.51 The Regulator will need to consider the extent to which any changes to the current usage charges interact with the rest of the incentives framework. If a volume incentive were introduced for Railtrack this would provide financial incentives to enhance the network, which would have an effect on the rate of renewals required.

The suitable level for the volume incentive would therefore depend on whether the usage charge already provides some incentive to increase volume. This might be the case if the usage charge is based on the long-run effect of traffic on the network. The short-run impact on costs would depend on the age distribution of assets and whether there are significant lags in the system.

4.52 The Regulator invites consultees' views on the most appropriate assumptions, which should be made concerning the renewals costs element included in the usage costs. In particular, consultees are asked whether they believe that usage costs should reflect the long-run or short-run renewals spend, and if the long-run effect of usage is taken into account, how changes in technology and the actual distribution of asset lives could be taken into account. Consultees are also invited to provide views on the interaction with other potential changes to the incentives framework.

Alternative methodologies

4.53 A number of different approaches is available by which usage costs could be estimated. Other engineering-based bottom-up modelling of asset degradation has been undertaken in Europe and the United States. Models have also been developed in the United States, which attribute costs using historical experience, and engineering and economic principles. Econometric models can also be derived using past behaviour of costs to model the dependencies between traffic and levels of maintenance. Lastly, a top-down approach could be used, whereby an overall level of variable cost is allocated to individual vehicle types.

4.54 The Regulator believes that solely statistical or econometric approaches are not appropriate. They are based on past experience, and it is unlikely that there is sufficient data since privatisation from which robust estimates can be derived. Charges based on such models would therefore be unlikely to incentivise Railtrack or operators appropriately to use and develop the network. Further, the United States rail systems are sufficiently different that the use of a model designed for their purposes is unlikely to be directly applicable to the UK experience.

4.55 The engineering based models derived by Railtrack and AEA Technology have been developed specifically with the UK rail network in mind. It is likely that they provide the best available bottom-up analysis, which is currently possible. However, a top-down approach could also feasibly be used to set usage charges in the current periodic review. This approach would be explicitly linked to the expenditure in the overall

revenue requirement for Railtrack and would avoid some of the difficulties of the Railtrack approach, though it could be informed by that work. Booz Allen & Hamilton have recommended such an approach to the Regulator, and the detail of their proposal is set out in chapter 5.

4.56 The Regulator invites consultees' views on the different approaches to estimating incremental costs described, in particular in terms of their feasibility and appropriateness for setting usage charges.

5. *Proposals for developing usage charges*

Introduction

5.1 This chapter considers the options available for developing usage charges from incremental costs. Booz Allen & Hamilton have recommended an alternative to Railtrack's approach for the next control period, which applies a top-down methodology to all categories of costs. This methodology is described. The available options for developing charges are then set out.

5.2 The form of the charge developed from usage costs is important. While there may be some benefits from changing the basis on which usage is charged, these appear to be outweighed by the costs of so doing. The Regulator is therefore proposing to retain the current system of passenger charging by vehicle mile by vehicle type. While further developments may be considered in the future (for example, a charge varying geographically) the Regulator is not presently proposing to introduce further changes to the base usage charge. It is for consideration whether there should be a provision to allow the structure of charges to be revised before the next periodic review.

5.3 The Regulator is seeking views on the introduction of a performance regime to incentivise better maintenance of track and vehicles, based on measuring the forces exerted by track on trains and vice versa. The Regulator is also proposing that charges reflect the levels of efficiency achievable by the end of the control period. This will require an adjustment to the fixed charge to preserve Railtrack's overall revenue requirement.

5.4 In considering the proposals in this chapter the Regulator will need to assess the relative significance of changes. The extent to which any individual changes will affect charges, and hence incentives, will be considered.

An alternative top-down approach

5.5 An alternative to Railtrack's approach of adding up the individual elements of cost caused by a particular vehicle type, would be to allocate an overall variable amount between vehicles. Booz Allen & Hamilton have recommended an approach based on this concept to the Regulator. The starting point is then the total maintenance and renewals expenditure, which Railtrack requires (which is also an input into the financial model calculating the overall revenue requirement of Railtrack for the next

control period). The element of this total spend which is considered to be variable is then allocated between different vehicle types.

5.6 This approach would provide a readily understandable mechanism, by which charges were calculated, and inform operators and funders in the planning of new services. Under this approach the Regulator would undertake the actual allocation procedure, on the basis of information supplied to him by Railtrack and the operators. To the extent that considerations of commercial confidentiality allowed the Regulator would share this with those parties.

5.7 The top-down approach could use the AEA track damage models directly to allocate variable costs to individual vehicle types. While the Regulator believes that the allocation methodology used should be informed by the work, which Railtrack and AEA have done, the direct use of the track damage models would increase the difficulty for operators of seeing how their behaviour would affect their charges. A more easily understood methodology (which could be recreated as part of operators' investment planning process) would better enable operators to respond to price signals given by usage charges.

5.8 Booz Allen & Hamilton have therefore recommended that the damage mechanisms derived through the AEA models could be used to inform the creation of a transparent and open allocation formula, which the Regulator could create and share with industry participants.[7] A decision on the overall level of variability of maintenance and renewal costs would also likely be informed through the work, which Railtrack has submitted to the Regulator.

5.9 The other data, which would be required to allocate variable costs to individual vehicle types would be national gross tonne miles (GTMs) and vehicle miles by individual vehicle type. Booz Allen & Hamilton have already collected some of this data from Railtrack and freight operators. If this approach is pursued, the estimates for this information may need to be further refined. The Regulator expects that both operators and Railtrack would have the opportunity to assist the Regulator in collecting this data, should this approach be used.

5.10 Booz Allen & Hamilton have made various assumptions concerning these figures (as described in their report) and produced preliminary estimates of the type of charges,

[7] Booz Allen & Hamilton have also recommended that the results from the models be adjusted to take actual operating speeds, actual axle loads and current vehicle characteristics into account in constructing such a formula

which might be produced by the top-down approach they have recommended. These are shown in table 5.1 and by vehicle type in Annex 2.

5.11 Booz Allen & Hamilton also recommend that charges in the next control period are based on the costs, which are expected to be incurred in that control period. An alternative would be for the long-run effects of traffic to be taken into account, such that the overall level of variable cost, which was allocated between vehicles, would reflect the whole life cycle cost of the assets involved. The former approach links the revenue, which Railtrack raises from usage charges, directly to the revenue requirement from the financial framework. It would also not need assumptions concerning future developments in technology and maintenance and renewal policies. However, it may mean greater variability of usage charges between control periods.

5.12 Booz Allen & Hamilton have recommended that the allocation formula does not provide charges for too many vehicle types, but rather groups together similar types of vehicles. Railtrack's cost estimates tend to cluster around particular vehicle types, and this work could inform the groupings, on which charges were based. This would, it is proposed, simplify the regime and thereby increase transparency of pricing signals, while not unduly reducing the cost reflectivity of charges.

5.13 Another possibility would be for a number of explicit adjustments to usage charges to be available, in terms of discounts or surcharges on the basic rates. These could be flat percentage rates above or below the base charge, which would be available to operators. For example, "dirty" vehicles would attract a surcharge (that could be differentiated on the basis of whether the hopper had a hood attached), while low track force bogies would lead to a discount.

5.14 The Booz Allen & Hamilton approach also leads to an increase in variability, but overall the estimated usage costs are lower than Railtrack's estimates. The preliminary estimates, which Booz Allen & Hamilton have provided to the Regulator result in a 64% increase in passenger usage costs and a 61% increase in freight usage costs.

Options for implementation of usage charges

5.15 The Regulator therefore considers that there are two basic options by which usage charges could be set for the next control period. These are to use the predominantly bottom-up approach proposed by Railtrack, or a completely top-down approach such as that described by Booz Allen & Hamilton. A third option may also exist whereby the two approaches were "reconciled", such that the charge was an average of the two.

This latter approach would retain many of the problems of both approaches, and the basis on which the two cost estimates are combined would essentially be arbitrary.

5.16 Use of the Railtrack approach would require further work, which is potentially substantial, to be undertaken, rolling the model out across more zones, and refining estimates further, in light of the comments of Booz Allen & Hamilton and other new information. The approach does not lend itself to rapid reaction to new information or new technologies. Calculation of the charges in this way also does not give operators a clear signal concerning their behaviour, and so may reduce the benefit of cost-reflective charges. Further, improvements to the models in terms of adjusting the assumptions would lead to them becoming even more complex, and make them less transparent. The approach may also be sensitive to the collection of new information as Railtrack improves its information sources.

5.17 The top-down approach would ensure that charges were linked to the actual revenue Railtrack is expected to spend. This could ensure that:

(a) Railtrack would not be disincentivised to accommodate new traffic; and

(b) Railtrack did not over recover their maintenance costs through the effects of growth being unexpected.

5.18 The increased transparency of the top-down approach would also lead to operators being better incentivised, by being able to plan in advance on the basis of well understood charges. The average passenger and freight vehicle costs under the different proposals are shown in table 5.1. Railtrack's numbers and the Booz Allen & Hamilton estimates are shown with an efficiency adjustment. For this document achievable efficiency gains of 4% per annum have been assumed. Further details concerning these figures are provided in Annex 2.

Table 5.1 Comparison of average passenger and freight usage cost estimates

	Average passenger usage costs Pence per vehicle mile	**Average freight usage costs £ per 1000 gross tonne miles**
Existing	5.65	1.43
Railtrack	15.84	4.40
Railtrack with efficiency adjustment	12.91	3.60
Booz Allen & Hamilton	11.83	2.44
Booz Allen & Hamilton with efficiency adjustment	9.65	1.99

(Source: Railtrack and Booz Allen & Hamilton)

5.19 The Regulator invites consultees to comment on the options for deriving usage charges in particular stating which they believe would best improve incentives for Railtrack and operators. Consultees are asked to give their views on the appropriate form of an allocation formula were a top-down approach to be used. Consultees are invited to suggest which significant variables should be taken into account.

The form and coverage of usage charges

5.20 A wholly cost-reflective charge would be levied on the basis of the main cost drivers. Presently passenger charges are levied solely on the basis of vehicle type. There is a trade off between the complexity of the charge and the extent to which it fully reflects costs. A number of different alternative metrics could be introduced to improve the extent to which charges are linked to actual costs, and so that operators more closely face price signals, which reflect the extent to which their behaviour leads to changes in actual maintenance and renewal costs.

5.21 An overly complex charge, while being more cost-reflective, would not necessarily improve incentives and it would be harder for operators to understand all the implications of changing their behaviour and the charge would become more opaque.

5.22 Railtrack has suggested a number of other possible charging metrics, which might be introduced. One option would be charges by tonne miles or train miles (in the passenger context), but Railtrack argue this would not adequately reflect most asset usage costs. Railtrack has submitted to the Regulator that charges per vehicle mile by vehicle type (the present system) would adequately reflect track and electrification costs. While Railtrack argues that train miles would be the best metric for its estimates of signalling costs they argue that the added complexity this would produce is not appropriate given the small proportion of usage costs, which they estimate incremental signalling renewal to be.

5.23 Railtrack has submitted to the Regulator that charges per consist mile by consist type would be the most cost-reflective charge across the different types of relevant asset types for passenger services. Booz Allen & Hamilton have recommended that the Regulator retain the use of charges per vehicle mile, as it has been demonstrated to be workable, and would also make the methodology more comprehensible.

5.24 In principle, the Regulator believes that the introduction of a change to the current system of metrics, especially where it would increase the complexity of the charging regime, would need to be balanced by a demonstrable improvement in incentives.

Usage charges should be set such that the effects of changing services can be clearly seen by both operators and Railtrack.

5.25 Similarly, there is a consideration concerning whether usage charges should vary between areas of the network. Railtrack has suggested that the introduction of a route specific dimension to charges would improve cost reflectivity. Booz Allen & Hamilton also recognise that charges could be varied geographically, but has reservations that appropriate data currently exists to ensure that this could be done in a way, which would provide sufficient transparency for operators. The Regulator proposes that for this reason geographical variation should not be introduced at this stage, before it can be clearly demonstrated that it would improve incentives and that it could be done on the basis of robust data.

5.26 The Regulator presently believes that the usage charge should be determined using the track, structures and signalling maintenance and renewals costs, which can be demonstrated to vary with the number of trains. To the extent that the maintenance of electrification assets can be demonstrated to vary with the number of trains run, these costs could either be recovered through the usage charge or through an adjustment to the access charge for electric current. This would provide that all costs related specifically to electric trains were recovered through a single system of charges. This would be administratively simpler, and provide clear price signals to operators. However, it would be important to identify separately the different elements of charges for electric traction particularly if operators were given the opportunity to procure from alternative suppliers.

5.27 The Regulator invites consultees' comments on whether charges should remain linked to national vehicle miles, or whether another dimension or dimensions should be used for charges. Views are invited as to whether the benefits of increased cost reflectivity through geographically based charges would be off-set by the increased complexity involved. Consultees are invited to indicate the significance of different possibilities on charges, and whether they agree with the costs, which the Regulator suggests the charge reflect.

Future developments

5.28 Whichever of the approaches set out above are used to set charges for the next control period there are, in principle, a range of further developments, which could be introduced at a later date. These might arise through new technologies, or improved data collection. More generally, further refinements to the methodology chosen might

be available. For example, were the Railtrack approach to be used, it might be possible to develop further modules for the track damage models, to take into account those elements currently ignored. Introducing changes to reflect such developments would have the effect of increasing uncertainty for operators, however, and a number of administrative issues would arise. Another option might be to use a top-down approach for the next control period, but ensure that the bottom-up modelling could be maintained as an option at future reviews.

5.29 If charges continue to be set on the basis of a national average, there would also be the possibility of introducing a geographic element to the charges at a later date. Before undertaking such a move the Regulator would want to assess the costs and benefits. For example, there would be significant increases in complexity for operators who ran services over a number of routes, making it harder for them to plan investments. However, greater cost-reflectivity might improve the incentives on operators.

5.30 In principle, provision could be made for altering usage charges during the control period to introduce geographic variability or to take account of new technologies. Difficulties in introducing such changes to non-franchised operators would need to be considered. The Regulator does not believe that the improvements, which might be gained in terms of improved incentives for part of the control period would likely be outweighed by the costs and increased complexity of so doing. His current view is that to the extent that such changes are considered appropriate, they be introduced at a later periodic review.

5.31 The Regulator invites consultees' views on potential improvements to the methodology adopted, and concerning when any changes to the base cost estimates should be reflected in charges during the next control period.

Charges reflecting the costs imposed on other industry participants

5.32 The Regulator is seeking views on the introduction of a mechanism by which the usage charge can be varied to reflect the actual levels to which track and vehicles are maintained. Track and vehicles interact with each other such that the quantity of maintenance required for one, depends to a certain extent on the quality of the other.

5.33 Poorly maintained track can lead to damage of vehicles, and a decrease in passenger comfort. Similarly, if vehicles are poorly maintained, they can have a substantially greater effect on the track, over which they pass. These interactions could also impact on other operators using the same section of track. This feedback mechanism will mean that the extent to which one operator maintains its vehicles will have an effect

on another operator's trains through track which they both use. Similarly, the effect of Railtrack maintaining a section of track poorly could affect operators on other sections of track. A static usage charge will not be able to incentivise operators and Railtrack to improve quality of track and vehicles.

5.34 For Railtrack the important variables are the forces, which the vehicles exert on its network. Operators are concerned with the quality of the track and the consequent affect on their vehicles. In principle these can be measured. Booz Allen & Hamilton have proposed a regime based on such measurements, which would provide incentives for operators and Railtrack to maintain their assets to a high standard. This could be considered as refining cost reflectivity to take account of the effect of an individual party's behaviour on other participants in the network. In economic terms this is an externality. A measurement-based system would lead to industry participants facing direct economic incentives, such that this externality was internalised.

5.35 In practice, Booz Allen & Hamilton believe that the current track measuring equipment would be suitable for the purposes of assessing the forces exerted by track on vehicles. They have identified potential equipment, which could be used to measure the effect of vehicles on track. This would not require equipment to be installed on trains themselves. Instead data could be collected periodically at different points on the network. This would provide a representative sample for track in different geographical areas, for each train operator.

5.36 The average forces could then be measured, and a performance regime instituted such that where these forces fell into certain bands the usage charge would be adjusted by a relevant percentage. Where the forces exerted by the vehicle on the track were above a specified level by a certain amount (i.e. the vehicle was maintained to a lower standard), the usage charge would increase. Where the effect of the track on the vehicles exceeded the allowed amount, usage charges would be discounted by a percentage amount. As standards improved, and with the introduction of new technology, the bands could be moved over time.

5.37 In considering whether to implement such a scheme the Regulator will want to assess the issues concerned with the implementation of such a scheme. Booz Allen & Hamilton have outlined the physical equipment, which would need to be installed. This will include the appropriate cost and time required to install the requisite systems, and the data, which would need to be collected to provide a suitable

statistical sample on which to base the initial bands. This system would not be dependent on the way in which the base level of usage charges is derived.

5.38 The Regulator invites consultees to comment on the principle of a performance regime for the level to which track and vehicles are maintained. He also invites comments on the issues surrounding the implementation of such a system, including the relevant timeframes and costs involved.

Interim review

5.39 One option for introducing further changes to the structure of charges would be to make provision for an interim review, prior to the next periodic review. The coverage of this review would be limited, and would not allow changes to the overall level of Railtrack's charges. An interim review might cover:

(a) whether the usage charge should vary geographically;

(b) adjustments to the usage charge to incentivise improved maintenance;

(c) the recovery of congestion costs through a "capacity reservation fee";

(d) allowing operators to purchase electricity for traction directly from generators.

5.40 The Regulator has already consulted on proposals for operators to purchase electricity directly from the generators. The Regulator expects to make clear whether or not a "capacity reservation fee" will be introduced during the next control period in his provisional conclusions on the incentive framework in spring 2000. The interim review could provide conclusions on the exact form of the charge.

5.41 The scope for any interim review would need to be clearly defined, and would not affect the level of charges, which Railtrack could raise. This would be to ensure that regulatory uncertainty was minimised. If any changes were made to variable charges, this would therefore need to be taken into account through an adjustment to the fixed charges.

5.42 The Regulator invites consultees' views on whether provision should be made for an interim review on the structure of charges, and, if so, what specific issues they believe such a review could cover.

Annex 1: Questions for consultation

1. This annex collects together the consultation questions asked in this document.

2. The Regulator invites:

   (a) consultees' views on whether in principle the maintenance and renewals costs described for track, structures, signals and electrification assets do vary with usage. Consultees' views are also invited as to whether there are any other significant cost elements which, in principle, vary with usage.

   (b) consultees to comment on Railtrack's methodology for deriving usage costs, and the implications of their estimates.

   (c) consultees' views on Booz Allen & Hamilton's conclusions on Railtrack's usage cost estimates. Consultees' are invited to comment on the assumptions made, and the extent to which they may or may not distort the resulting cost estimates. Consultees' are also invited to provide evidence that the model does or does not include elements, which have a significant impact on usage costs. Consultees' are invited to comment on what geographic areas cost estimates could be based, and the sufficiency of available data. Lastly, consultees' are invited to comment on the application to freight costs, and the principles, which could be used in approving freight charges.

   (d) consultees' views on the most appropriate assumptions, which should be made concerning the renewals costs element included in the usage costs. In particular, consultees are asked whether they believe that usage costs should reflect the long-run or short-run renewals spend, and if the long-run effect of usage is taken into account, how changes in technology and the actual distribution of asset lives could be taken into account. Consultees are also invited to provide views on the interaction with other potential changes to the incentives framework.

   (e) consultees' views on the different approaches to estimating incremental costs described, in particular in terms of their feasibility and appropriateness for setting usage charges.

(f) consultees to comment on the options for deriving usage charges in particular stating which they believe would best improve incentives for Railtrack and operators. Consultees are asked to give their views on the appropriate form of an allocation formula were a top-down approach to be used. Consultees are invited to suggest which significant variables should be taken into account.

(g) consultees' comments on whether charges should remain linked to national vehicle miles, or whether another dimension or dimensions should be used for charges. Views are invited as to whether the benefits of increased cost reflectivity through geographically based charges would be off-set by the increased complexity involved. Consultees are invited to indicate the significance of different possibilities on charges, and whether they agree with the costs, which the Regulator suggests the charge reflect.

(h) consultees' views on potential improvements to the methodology adopted, and concerning when any changes to the base cost estimates should be reflected in charges during the next control period.

(i) consultees to comment on the principle of a performance regime for the level to which track and vehicles are maintained. He also invites comments on the issues surrounding the implementation of such a system, including the relevant timeframes and costs involved.

(j) consultees' views on whether provision should be made for an interim review on the structure of charges, and, if so, what specific issues they believe such a review could cover.

Annex 2: Usage Cost Estimates

1. This annex contains figures illustrating the different approaches described in this document. Table 5.1 compares the average cost estimates for passenger and freight vehicles using the existing, Railtrack's and Booz Allen & Hamilton's methodologies. Tables A2.1 and A2.2 illustrate the Railtrack estimates for a range of different individual passenger and freight vehicles based on the analysis of the LNE zone done by Railtrack. Tables A2.3 and A2.4 show the costs derived from the methodology recommended by Booz Allen & Hamilton. Table A2.5 shows the difference between Railtrack's current estimates of track usage costs, compared with the mini-MARPAS estimates. Finally, the principle reasons for the difference in the estimates is explained.

2. Railtrack's current estimates would be subject to further refinement, in particular concerning the method in which non-track usage costs are attributed to individual vehicle types.

3. Average costs across passenger and freight vehicle types are shown in table 5.1 in chapter 5. Booz Allen & Hamilton's estimates are on the basis of end of control period costs, where the assumption has been made that efficiency gains of 4% per annum are achievable over the course of the next control period. Railtrack's current estimates are shown with and without this same efficiency adjustment. Existing estimates and Booz Allen & Hamilton's estimates are on a national basis, while Railtrack's figures are based on averages for the LNE zone. The existing estimates are based solely on track usage costs, while Railtrack's and Booz Allen & Hamilton's include non-track items (structures, signals and electrification assets). Table A2.5 shows Railtrack's track only estimates for the purposes of comparison.

4. Tables A2.1 to A2.4 show Railtrack's current, and Booz Allen & Hamilton's usage cost estimates for a range of illustrative vehicle types. These are compared with the existing estimates for those vehicles. The tables also show the effect on these costs of the Regulator's proposal that usage charges be set on the basis of achievable efficiencies by the end of the control period. The assumption that has been made is an improvement of 4% per annum (as discussed in Chapter 3). Further detail of Booz Allen & Hamilton's estimates can be found in their report.

Table A2.1 Railtrack and existing usage cost estimates for sample passenger consists (Costs expressed in pence per vehicle mile)

Sample Consist	Vehicles	Existing cost estimate	Railtrack estimate	Railtrack estimate with efficiency adjustment
IC 225 (Class 91 + 9 Mk 4 + DVT)	11	7.51	20.69	16.87
HST (2 Class 43 + 8 Mk3)	10	5.66	16.99	13.86
Class 142 (2-car unit)	2	3.41	8.63	7.03
Class 144 (2-car unit)	2	3.41	8.41	6.86
Class 150 (2-car unit)	2	2.63	9.68	7.89
Class 156 (2-car unit)	2	2.93	10.60	8.64
Class 158 (2-car unit)	2	3.51	10.61	8.65
Class 308 (4-car unit)	4	3.23	8.99	7.33
Class 313 (3-car unit)	3	2.70	12.41	10.12
Class 315 (4-car unit)	4	2.93	16.73	13.64
Class 317 (4-car unit)	4	3.11	12.98	10.59
Class 321 (4-car unit)	4	4.78	13.15	10.73

(Source: Railtrack and ORR calculations)

Table A2.2 Railtrack and Existing usage cost estimates for sample freight vehicles (Costs expressed in pounds per 1000 GTM)

Sample Freight Vehicles	Existing Cost	Railtrack estimate	Railtrack estimate with efficiency adjustment
Steel Bogie, empty	0.23	1.75	1.43
Steel Bogie, laden	1.6	3.63	2.96
Class 47 Diesel Locomotive	2.76	5.32	4.34
Class 60 Diesel Locomotive	1.62	3.42	2.79
Bogie Open Hopper, empty	0.25	4.41	3.60
Bogie Open Hopper, laden	2.08	6.58	5.37
Tank Bogie, empty	0.25	1.84	1.50
Tank Bogie, laden	1.79	3.67	2.99
Freightliner Flat Bogie	0.86	3.01	2.45
2 axle coal hopper, empty	0.25	4.10	3.34
2 axle coal hopper, laden	1.35	6.01	4.90

(Source: Railtrack and ORR calculations)

Table A2.3 Booz Allen & Hamilton usage cost estimates for sample passenger consists (Costs expressed in pence per vehicle mile)

Sample Consist	Vehicles	Existing cost estimate	Booz Allen & Hamilton estimate	Booz Allen & Hamilton estimate with efficiency adjustment
IC 225 (Class 91 + 9 Mk 4 + DVT)	11	7.51	17.5	14.3
HST (2 Class 43 + 8 Mk3)	10	5.66	15.2	12.4
Class 142 (2-car unit)	2	3.41	5.1	4.2
Class 144 (2-car unit)	2	3.41	5.0	4.1
Class 150 (2-car unit)	2	2.63	8.7	7.1
Class 156 (2-car unit)	2	2.93	9.6	7.9
Class 158 (2-car unit)	2	3.51	9.6	7.9
Class 308 (4-car unit)	4	3.23	10.2	8.4
Class 313 (3-car unit)	3	2.70	7.9	6.4
Class 315 (4-car unit)	4	2.93	7.2	5.9
Class 317 (4-car unit)	4	3.11	9.2	7.5
Class 321 (4-car unit)	4	4.78	9.6	7.8

(Source Booz Allen & Hamilton)

Table A2.4 Booz Allen & Hamilton usage cost estimates for sample freight vehicles (Costs expressed in pounds per 1000 GTM)

Sample Freight Vehicles	**Existing Cost**	**Booz Allen & Hamilton estimate**	**Booz Allen & Hamilton estimate with efficiency adjustment**
Steel Bogie, empty	0.23	1.42	1.16
Steel Bogie, laden	1.6	2.16	1.76
Class 47 Diesel Locomotive	2.76	2.92	2.38
Class 60 Diesel Locomotive	1.62	2.75	2.24
Bogie Open Hopper, empty	0.25	1.50	1.22
Bogie Open Hopper, laden	2.08	2.62	2.14
Tank Bogie, empty	0.25	1.59	1.30
Tank Bogie, laden	1.79	2.85	2.32
Freightliner Flat Bogie	0.86	2.49	2.03
2 axle coal hopper, empty	0.25	1.74	1.42
2 axle coal hopper, laden	1.35	2.81	2.29

(Source: Booz Allen & Hamilton)

Table A2.5 Comparison of Existing cost estimates and Railtrack's track only usage cost estimates

	Existing usage cost estimates	Railtrack track only usage cost estimates
Passenger average (pence / vehicle mile)	5.65	12.23
Freight average(£/1000 GTM)	1.43	3.50

(Source: Railtrack)

5. Table A2.5 compares the existing usage cost estimates (which only include track usage costs) with Railtrack's current track only usage costs. Railtrack estimates that these comprise around 77% of total usage costs. These figures are to show the effect of the work undertaken by Railtrack and AEA Technology to revise the underlying models, the changes to unit costs, and the different treatment of renewals (as discussed in Chapter 5). They therefore allow a like-for-like comparison.

6. Booz Allen & Hamilton's estimates differ from those of Railtrack for a number of reasons. Table A2.6 compares the levels that costs for different types of assets are considered to vary with usage under each approach.

Table A2.6: Percentage variability of maintenance and renewal costs

	Railtrack's estimates	**Booz Allen & Hamilton estimates**
Track	50%	38%
Structures	20%	10%
Signals	5%	2%
Electrification	15%	24%

(Source: Booz Allen & Hamilton)

7. The Booz Allen & Hamilton estimates also use actual levels of renewal activity, rather than assuming that the age of all assets are evenly distributed as discussed in chapter 4. Further the Booz Allen & Hamilton estimates are based on expenditure for 2000/01, while Railtrack's estimates are based on figures for 1997/98. Booz Allen & Hamilton have stated this year was not typical in terms of the amount of maintenance and renewal activity, which was undertaken. Railtrack's estimates are currently also based on data from a single zone, while Booz Allen & Hamilton have used national information.