THE TUBE: MOVING ON
FINAL REPORT

A Report for The Tube Future Priorities Investigative Committee

Prepared by NERA

July 2002
London

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I Introduction

1. This document reports the results of the Assembly of the Greater London Authority's Scrutiny project: *The Tube: Moving On*. The overall aims of this Scrutiny were to:

- define what service levels Londoners should be able to expect from the Underground, by referring to "world-class" standards achieved in other countries, and bearing in mind the characteristics of the London system ;
- assess if, where and how London Underground currently falls short of these levels;
- set benchmarks for service levels against which the London Underground should be measured in the future, ensuring that these benchmarks are challenging, but also realistic;
- identify priority areas for investment and comment on the likely implications in terms of investment levels.

2. The Investigative Committee contacted a wide range of organisations and individuals and invited them to provide written evidence. The Committee also held an important series of hearings at which witnesses were questioned. Further information, including a large amount provided by London Underground, was obtained and analysed by NERA using desk-based research.

The London Underground

3. The London Underground is the oldest underground railway system in the world. It is also one of the largest and most complex. The age of the system is a major constraint to improving it. In addition, demand has been growing strongly in recent years, and is set to continue to grow. This will increase the pressures on the system.

Use of Overseas Comparators

4. One of the approaches used in this Scrutiny was that of making overseas comparisons. To do this it is necessary to compare like with like, so that results are not distorted by differences in the external environment in which the metros operate, or by differences in the characteristics of the systems themselves, or by differences in the way data are measured. We selected the following metro systems to act as comparators to London Underground: New York; Paris; Berlin; Stockholm; Madrid; and Barcelona.

II Levels of Service Scrutiny

Safety and Security

5. It is important to distinguish between "safety" and "security". Safety and security are key priorities for all those involved with the Underground – government, operators and passengers. Risks to individual passengers of being involved in an accident or a crime on the Underground are low, but nevertheless seven people were killed on the Underground in accidents in 2000/01. Deaths involved in boarding and alighting from trains represent the biggest single risk. Safety is the highest priority of all, and is not currently seen as a problem area. Londoners should be able to reasonably expect a high level of safety and security, and the current record is good.

Reliability

6. Reliability is the second most important feature of service quality as far as passengers are concerned, and London Underground reliability has been falling in a number of important respects in recent years. There are a number of different causes of unreliability (signal failure, rolling stock failure/unavailability, staff absences and other problems, track failures, passenger action and infrastructure failures) and all contribute to the problems experienced by London Underground passengers. Comparison between lines (internal benchmarking) is a useful technique for understanding and reducing causes of unreliability. In addition, London performs badly in comparison with other metro systems, and Londoners can reasonably expect an improvement in the reliability of their system.

Waiting and Journey Times

7. Increasing train frequencies reduces waiting time and hence total journey time, and is also the most effective way to increase capacity on the system. Passengers place a high cost value on time spent waiting for trains, while time spent in ticket queues is also particularly annoying. Most metro systems have standards for minimum frequencies at different times of the day, and London does not always compare favourably with what is provided in other cities. There is some scope to increase frequencies on some Underground lines, and Londoners can reasonably expect improvements to world standard peak frequencies by means of improvements to signalling systems on existing lines. Better train regulation can also contribute to improved operational frequencies.

Crowding and Capacity

8. London Underground currently suffers excessive levels of crowding both on trains and in stations on a fairly regular basis, predominantly in peak hours. Levels of overcrowding have been increasing. Crowded conditions contribute to discomfort and in some cases illness on tube trains, particularly in very warm weather, when

conditions on crowded tubes can become very unpleasant. International comparisons are difficult to make because London average capacity utilisation figures are distorted by the suburban nature of many routes. In the short run overcrowding can be reduced by provision of a more reliable service, and in the medium run by enhanced frequencies. In the longer term it requires construction of new lines, though in some parts of the system extra capacity will attract extra passengers. However, it is particularly worrying to note that on current projected traffic growth trends, overcrowding on the Underground will get worse over the next ten years.

Provision of Information

9. Currently passenger satisfaction levels in regard to provision of information on the Underground are high, especially in regard to static information on stations and trains. However, there is less satisfaction with real-time information, and a need for better performance, especially in conveying information to passengers about delays. Management action in the short term to improve staff performance has an important role to play in achieving this.

Accessibility

10. Access to the Underground for those with disabilities is often difficult. Much of the system was designed and built long ago, and only a small proportion of stations can be classified as "step free". However, the Scrutiny has identified a number of initiatives that could improve access for the disabled, including better training for staff, improvement of disabled access at a few key central London stations, better tactile markings for the visually impaired, better audible announcements, and better consultation with groups representing the disabled. Comparison with approaches in other countries indicates that they differ: in New York all buses are fully accessible and so provide a good alternative to the subway. Londoners can reasonably expect improvements in disabled access, but they cannot expect a fully accessible system to be achieved in the next 15 years.

Integration across Transport Modes

11. Integration includes physical integration (the ease with which passengers can move from one mode to another), information integration (provision of comprehensive information on all modes), and ticketing integration (the extent to which tickets can be used across different modes). London's physical integration is mixed, with better integration between mainline rail and the Underground than between bus and Underground. However, the quality of information on connecting bus services at Underground stations has been improved in recent years. Travelcards have been a great success in encouraging multi-modal travel, but cash fares are still non-transferable. London falls short of world best practice in both physical integration and ticketing integration.

Comfort, Cleanliness and Customer Care

12. Cleanliness of trains and stations is a source of dissatisfaction for customers. Although London Underground have undertaken a number of initiatives to improve cleanliness, evidence of extensive monitoring of litter, graffiti and vandalism on the New York subway suggest that more could be done to monitor LUL progress in these areas. Londoners can reasonably expect improved performance, especially as major capital expenditure is not required.

Fares

13. Underground fares have been rising in real terms in recent years, and are already high in relation to those on comparable systems in other world cities. However, fare levels are to a large extent the result of political decisions as to the proportion that farebox revenue should contribute to overall costs. We therefore do not believe it is appropriate to set fare targets in this Scrutiny, though we expect that the Assembly will find it useful to monitor overall trends in fare levels.

Part III: The Future

Priorities for Investment

14. In regard to investment needs, Londoners place high priority on investments that will **maintain** existing safety levels, that will **yield improvements** in frequency and reliability and which will **reduce** overcrowding. These priorities are shared by London Underground and by the Mayor.

Setting Targets

15. Current targets for the Underground are set by London Underground itself, through its Customer Service Delivery Standards, and by Transport *for* London. The Assembly needs to bear these targets in mind when drawing up its own. Our report sets out detailed targets which we suggest that the Assembly adopt. These targets are designed to monitor London Underground performance in each of the key areas discussed in Part II of this report. We distinguish between headline indicators and secondary ones.

Implications for Investment

16. London's Underground system has benefited from considerable investment over the past 15 years, including completion of the Jubilee Line Extension, route modernisation of the Central Line, complete replacement of rolling stock on the Central, Northern, Jubilee and Waterloo & City lines, heavy refurbishment of other rolling stock, and station refurbishments. However, substantial additional

investment is needed, especially as demand growth is expected to outstrip capacity growth.

17. Current planned PPP projects include installation of new signal and control systems, capacity increases on the Jubilee, Victoria, Metropolitan and Circle lines, major rolling stock replacement, and modernisation of the major central London Underground stations. Other investments to increase capacity must consist of new lines. The East London extension will not increase capacity in central London, where it is most needed. The major central London capacity expansions will come from the Hackney-South West line, which is a traditional tube line, and from the two mainline rail routes, Thameslink 2000 (North-South) and Crossrail (East-West). It is the last two that would relieve pressure on the existing network by providing London with an alternative rail system penetrating the centre and providing the city with the equivalent of Paris' RER system. In addition, there are other major investments that will improve passenger comfort and safety, in particular, fitting of platform edge doors to stations and air conditioning to trains.

PART I: AN INTRODUCTION

1. BACKGROUND TO THE SCRUTINY

This document reports the results of the Assembly of the Greater London Authority's Scrutiny project: "The Tube: Moving On". The overall aims of this Scrutiny were to:

- define what service levels Londoners should be able to expect from the Underground, by referring to "world-class" standards achieved in other countries, and bearing in mind the characteristics of the London system;
- assess if, where and how London Underground currently falls short of these levels;
- set benchmarks for service levels against which the London Underground should be measured in the future, which are both challenging and realistic; and
- identify priority areas for investment and comment on the likely implications in terms of investment levels.[1]

The Tube Future Priorities Scrutiny Investigative Committee contacted a wide range of organisations and individuals, inviting them to provide written evidence (a list of respondents providing written evidence is given in Appendix B). The Committee has also held a series of hearings, which the following organisations have attended:

- Capital Transport Campaign;
- Crime Concern;
- Greater London Action on Disability;
- London Underground Limited (LUL); and
- London Transport Users' Committee.

Further information on this study was obtained via desk-based research conducted by NERA, including a large amount of information provided by London Underground. The Committee also asked London Underground users to submit their views on Underground Services via e-mail.

[1] Note that *modes* of funding, including the PPP are outside the scope of this study.

2. REPORT STRUCTURE AND SCOPE

The remainder of this report is structured as follows.

Chapter 3 provides a brief introduction to the London Underground (LUL) system, including a discussion of some of its key characteristics and of the different lines that make up the system. Chapter 4 describes the approach we have adopted in using metro systems as benchmarks against which to compare London Underground.

Part II of the report on Level of Service Scrutiny then reviews each of the main aspects of service quality provided by London Underground. Each chapter considers a different dimension of service quality. In each chapter we describe the aspect of service provision and its importance to customers, we consider current LUL performance and how this compares with performance overseas, and we set out what we believe that Londoners can reasonably expect in terms of performance in this area in the future.

The chapters in Part II are as follows:

- safety and security (Chapter 5);
- reliability (Chapter 6);
- waiting and journey times (Chapter 7);
- crowding and capacity (Chapter 8);
- provision of information (Chapter 9);
- accessibility (Chapter 10);
- integration across transport modes (Chapter 11);
- comfort, cleanliness and customer care (Chapter 12); and
- fares (Chapter 13).

Part III of the report considers the future. Chapter 14 looks at the lessons this Scrutiny has drawn on what the key priorities for investment are on the London Underground. Chapter 15 suggests benchmarks against which LUL's performance might be measured in the future. Chapter 16 considers implications for investment.

3. AN INTRODUCTION TO THE LONDON UNDERGROUND

3.1. The System

London's Underground system is the oldest in the world, with the first line built in 1863.[2] It is also one of the largest and most complex systems in the world, with the following key characteristics:

- **Kilometres of line**: 414 km, of which some 28 kms are owned by Railtrack, and around 45 per cent of which is underground.[3] London Underground lines are a combination of deep tunnels (35 per cent), "cut and cover" (ie, sub-surface) tunnels (10 per cent), and overground rail (55 per cent). The only other system in the world with similar length of route is New York. Other systems are smaller. For example, Moscow has around 250kms of line, and Paris, the fourth largest just over 200 kms of line.
- **Passengers**: London Underground carried 970 million passengers in 2000/01. While a number of systems carry more (such as New York, with around 1,100 million and Tokyo with over 2,000 million, and Moscow with over 3,000 million a year) this figure still makes London Underground one of the busiest systems worldwide.
- **Lines**: There are 12 lines on the London Underground, larger than the number typically observed on other metros (the largest is New York with 25, followed by Paris with 14). The London Underground network is also more complex than many systems in terms of eg intersections.
- **Stations**: There are currently 275 stations on the network. Again, this number is large by international standards, and is only exceeded by New York and Paris.
- **Number of carriages/cars:** almost 4,000 cars.

The age of the system is a major constraint to improving London's Underground. The geographical layout was not designed with modern city/commuter populations in mind and suffered from piecemeal development. A major problem afflicting the tube network is the restricted tunnel diameter, which limits the train cross section thereby constraining capacity and leading to on-train overcrowding.[4] Despite much work over the years, in many cases station design limits space for concourse areas, ticketing facilities, lifts, escalators and platform size, with little room to expand in built-up areas.[5] Some lines, especially the sub-surface District, Metropolitan and Circle lines, have flat junctions that cause conflicting

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2 The line from Paddington to Farringdon was opened in 1863.

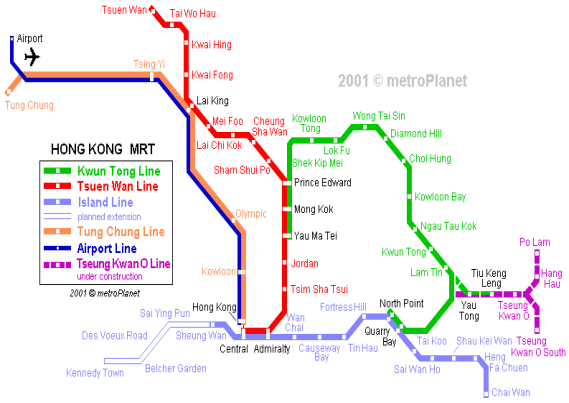
3 Calculated from published sources.

4 Typically a London tube car is 2.7 m wide x 2.9 m high, in comparison to 2.95 x 3.7m for the largest sub-surface stock in London and 2.8 x 4.0m for main line railway stock.

5 Many older Underground stations are also listed buildings.

movements between trains that can contribute to delays. Other difficulties arise surrounding network complexity (number of lines, where/how they intersect, etc). Comparing a map of the London System with a map of the Hong Kong system illustrates this point.

Figure 3.1
Hong Kong MTR Map



Source: MetroPlanet

Figure 3.2
London Underground Map (Central)

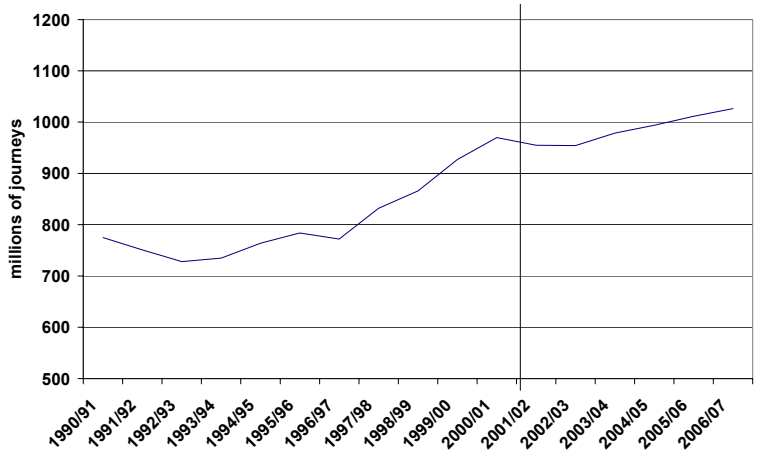
Source: MetroPlanet

3.2. Trends in Demand

Figure 3.3 shows the number of journeys and Figure 3.4 shows the number of passenger-kms (note that division of passenger-kms by journeys gives average journey length). As the figures show, the number of passengers travelling on the Underground has grown strongly in recent years, and is forecast to continue to grow, exacerbating current capacity constraint problems if no investment is undertaken.

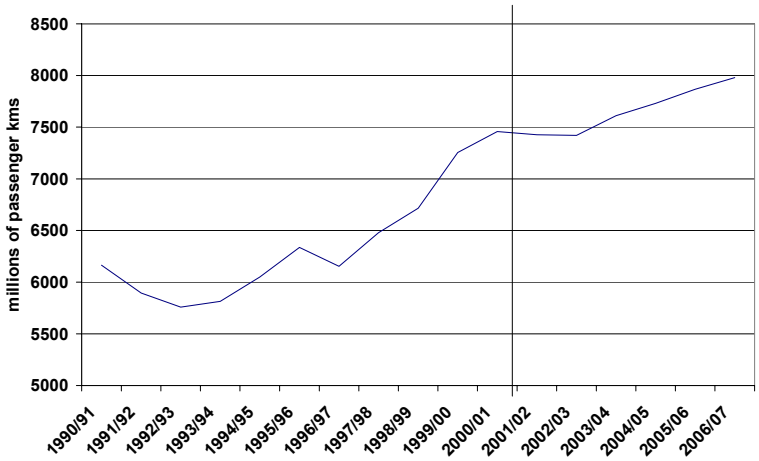
Figure 3.5 shows trains-kms operated. If passenger kilometres (Figure 3.4) are divided by train kilometres (Figure 3.5), average train loading figures can be derived (ie, average number of passengers per train). These are shown in Figure 3.6. From this, it can be seen that while average train loadings fell in the early to mid 1990s, much of the growth in passenger journeys and passenger train kilometres since 1996/97 has been accommodated by increases in average train loadings (from 104 in 1996/97 to 117 in 2000/01).

Figure 3.3
LUL Passenger Journeys *per annum*



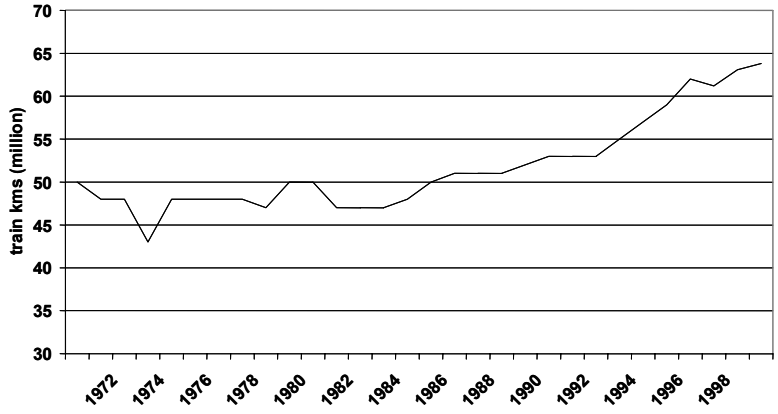
Source: Historical figures TfL, forecasts LUL.

Figure 3.4
LUL Passenger Kilometres *per annum*



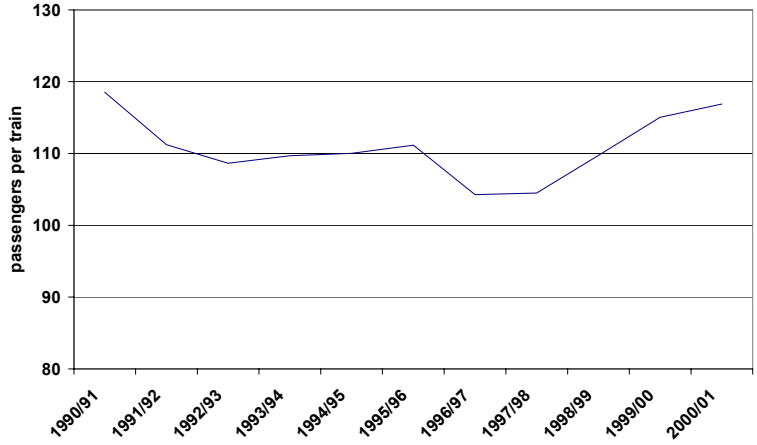
Source: Historical figures TfL, forecasts LUL.

Figure 3.5
LUL Total Train Kilometres



Source: Transport Statistics Great Britain, 2001

Figure 3.6
LUL Average Train Loadings



3.3. The Different Parts of the System

London Underground divide their network into eleven groups of service for analysis. The principal characteristics of each of these are shown in Table 3.1.

Table 3.1
Line Characteristics

	Annual train km	Route length (km)	Annual trains per km of route	Stations	
				Total (no.)	U'ground (no.)
Bakerloo	2,965,142	23.55	125,908	25	15
Central	8,852,029	73.17	120,979	49	19
District	8,927,030	62.35	143,176	59	n/a
Jubilee	6,652,487	37.19	178,878	27	13
East London	658,873	7.22	91,257	9	5
Northern	10,378,582	57.53	180,403	49	36
Piccadilly	10,914,223	69.61	156,791	52	24
Victoria	4,868,066	21.28	228,763	16	16
Metropolitan	6,041,656	62.59	96,527	34	n/a
Circle & Hammersmith	3,311,841	38.69	85,599	46	n/a
Waterloo & City	238,234	2.37	100,521	2	2
Total/LUL average	**63,808,163**	**n/a**	**137,164**	**n/a**	**n/a**

(NB not all totals sum)

The Victoria Line has the most intensive level of operation, which is to be expected as it primarily serves Central London with a single line route, in contrast to the Central Line for example, which has an extensive network of branches serving suburban areas at either end of its route. Other sections of the network with particularly intensive level of operation include the Circle line (which is used both by Circle, and District or Metropolitan line trains), and the Northern line. The East London Line and the country end of the Metropolitan Line are the least intensively operated parts of the system.

The most modern line is the Jubilee Line Extension from Green Park to Stratford, which was opened in four stages in 1999. The only other sections opened since the 1940s are:

- the Victoria line, which was opened in stages between 1967 and 1971;
- the central section of the Jubilee line, between Baker Street and Charing Cross, opened in 1979; and
- the extension of the Piccadilly line to Heathrow Airport, opened in 1977, and extended to Terminal 4 in 1986.

LUL has embarked on an extensive programme of route modernisation to replace life expired equipment and upgrade lines to what it considers to be acceptable modern standards, as an alternative to piecemeal replacement. Funding issues have meant that this programme has had a somewhat chequered history; nevertheless the Central Line route modernisation has been completed and serves as a benchmark for the effectiveness of this programme. Less extensive work was undertaken to the Waterloo and City Line, prior to its

handover by the former British Rail, and on the East London Line. The Northern Line route modernisation is incomplete and that for the Victoria Line scheduled, which should serve as benchmarks for the pre-upgraded performance.

Procurement methods for London Underground rolling stock have changed radically over the past decade. Traditionally trains were purchased by LUL against a detailed engineering specification produced by themselves. The last trains acquired in this manner were the "1992" stock for the Central Line. Subsequent stock has been provided by procurement against a performance contract under which the manufacturer has the responsibility for providing the stock for a defined number of diagrams on a day-to-day basis and is thus responsible for maintenance, being penalised for shortcomings in reliability and maintainability. The profile of LUL's rolling stock by line is shown in Table 3.2.

Table 3.2
Profile of Rolling Stock

	Trainsets (no.)	Annual km operated per set	Cars (no.)	Built	Av. Age (years)	Refurbished	Years since const/ ref
Bakerloo	35½	83,525	250	1972-1977	29	1991-1995	9
Central	85	104,142	680	1992-1995	9	n/a	9
District	75	119,027	450	1979-1983	21	n/a	21
Jubilee	59	112,754	354	1996-1998	4	n/a	4
East London	6	109,812	24	1960-1963	40	1992-1997	6
Northern	106	97,911	530	1996-1999	3	n/a	3
Piccadilly	87	125,451	522	1975-1978	26	1994-2000	5
Victoria	43	113,211	344	1967-1973	34	1990-1995	9
Metropolitan	53½	112,928	428	1960-1963	40	1992-1997	6
Circle & Hammersmith	46	71,997	276	1970-77	31	1990-1994	10
Waterloo & City	5	47,647	20	1993	9	n/a	9
Total/LUL Average	**601**	**106,170**	**3,878**	**1981**	**20**		**8**

(NB not all totals sum)

The above data have mainly been derived from published sources. The fleet has a considerable degree of homogeneity, all bar the "1992" stock used on the Central and Waterloo & City Lines, and the "A"-Stock for the Metropolitan and East London Lines, having been delivered from the same manufacturer. Only the Victoria and Bakerloo Lines have any mixture of design in the fleet used on the line and in both cases the two designs of vehicle used are closely related.

4. COMPARISONS WITH OTHER METRO SYSTEMS

4.1. The Comparator Cities

In this Chapter, we introduce the comparator systems that we have studied as part of the study. The cities are:

- New York;
- Paris;
- Berlin;
- Stockholm;
- Madrid; and
- Barcelona.

Although comparators with other systems can produce valuable insights, they always need to be interpreted with a degree of caution due to the inherent differences between systems. In Section 4.2 we set out some of the difficulties.

An initiative that seeks to address some of these difficulties is the CoMET database, described in Section 4.3. Although we will occasionally refer to this database, the usefulness of it for this study has been constrained by the limited number of customer-oriented indicators in the database and the confidentiality of the data in it.

In Section 4.4, we set out the process by which we have selected our comparator cities. Brief introductions to these cities are contained in Section 4.5.

4.2. The Limitations of Cross-System Comparisons

When undertaking a comparison between different systems, the results usually need to be interpreted with a degree of caution. In the context of benchmarking underground systems, there are at least three main factors that can make comparisons difficult:

- different systems operate in different external environments;
- different systems have different characteristics; and
- data on different systems may not be expressed on a consistent basis.

Differences in the **external environment** in which systems operate include the social conditions in the city for example. Thus a crime indicator that is lower in London than in New York is not necessarily an indicator of better London Underground performance if the

metro in New York operates in an urban environment with significantly higher levels of crime. In such a case, the level of security that Londoners can reasonably expect cannot therefore be directly informed by the level of crime in New York. Other examples include differing average income levels, which can impact on fares levels and policies, and differing cultural attitudes to issues such as acceptable levels of crowding and seat availability.

The geographic characteristics of a city also play an important part in determining what constraints to top-level performance a particular metro system faces. Examples include the size and population density of a city, tunnelling conditions, and the extent to which the city is built-up or has free space.

Different **characteristics** of various systems can also influence the reliability of comparisons and the possibility of inferring reasonable standards from experience abroad. For example, the metro system in Paris is of a very urban nature (no metro line extends beyond what would be Zone 2 in the London tariff system). As a result, there is less need for the operator in Paris to offer seating capacity than there is in London, where underground lines extend to suburban areas and thus passengers on long journeys require a seat for at least part of their trip. Other examples include tunnel size, which acts as a constraint on the size of trains and platforms. London deep-level tunnels, bored through the London clay, have a small profile in comparison with the tunnels of most metro systems, thus putting constraints on the ability to handle large volumes of passengers. Other historic factors, such as the location of stations which cause accessibility difficulties for the mobility impaired, and the way that the system has been extended over time resulting in a non-optimal network configuration for present-day travel demands, add further constraints.

Finally, differences in **data definitions** can also make comparisons difficult. Examples include different ways of measuring overcrowding, delays and accidents. Although the CoMET database discussed in the next Section tries to address this problem by collecting data in a consistent format, its usefulness for the present study is limited.

When drawing our conclusions about the relative performance of London Underground and the scope for improvement, we have borne these limitations in mind. It is important to note that international comparisons form only one analysis tool used in this study, with others including internal comparisons within LUL, an examination of recent trends in performance, and written and oral evidence.

4.3. The CoMET Database

As indicated above, benchmarking metro systems is difficult. Each metro system has its own culture, its own definition of terms, physical characteristics etc.

To overcome these problems, in 1994 London Underground and four other metro systems formed a group to share performance data with each other. In 1996, these systems and three

more formed themselves into the CoMET group, which by 1998 consisted of nine large metro systems.

The objectives of CoMET, which is administered by the Railway Technology Strategy Centre at Imperial College, are to:

- build a system of measures to identify best practice which can be accepted and used by mass transit railways;
- use the system of measures for internal management;
- help prioritise areas for improvement; and
- provide comparative information.

To meet these objectives, a system of 32 key performance indicators has been developed, including measures both of a "hard" operational nature and of a "soft" customer focused orientation. The focus is on the operational indicators.

To ensure the collaboration of all CoMET members, a confidentiality agreement has been signed whereby they can share all the data amongst themselves but cannot publish the data externally with metro names attached. Metros are able to identify their own position relative to other members of the group, but are not able to identify the positions of other group members (other than in the form of, for example, "European Metro A, Asian Metro B" etc).

The confidentiality agreement and the limited number of customer-oriented measures limits the usefulness of the CoMET database for the purposes of the present study. London Underground have made available a selection of the information that they have in a form that is permitted. Where appropriate, we report on these indicators and (if available) the ranking of London Underground on these indicators. However, in our work, we principally have had to rely on data directly supplied by the relevant operators, or on information from other published sources including the Internet.

4.4. Selecting Appropriate Comparator Systems

In selecting our comparators, we have applied the following criteria:

- **A focus on systems with similar characteristics to London**. As described above, the characteristics of a system, including factors such as its age, size, number of passengers and network complexity all affect the levels of service that can reasonably be attained by a system. For this reason, we have tried to select metro systems that form the most realistic comparators for London, while still informing on the scope for making improvements. For example, systems such as Rotterdam, Munich and Hamburg have not been considered as they are smaller, less complex networks.

Similarly, we have avoided placing undue weight on comparisons with modern systems such as Singapore and Hong Kong which do not face the historical constraints of the London system.

- **A focus on European comparators**. In addition to the physical characteristics described above, we have tended to focus on European comparators due to similar culture, and income and GDP levels. Although New York is obviously a very important comparator, other non-European cities were considered less valuable as a result of cultural and other differences.
- **Expected data availability**. Although Tokyo was initially considered as a comparator (despite the cultural differences), lack of a response from the operators and the very limited data available from other published sources prevented us from studying the Tokyo underground system in detail.

After applying these criteria, the following cities have been selected:

- New York;
- Paris;
- Berlin;
- Stockholm;
- Madrid; and
- Barcelona.

In the next Section, we briefly introduce the metro systems in each of these cities. In some cases, we have also outlined further "case study" examples of best practice from other cities around the world where we think these provide useful lessons for London Underground.

4.5. Introducing the Comparators

4.5.1. New York

The city of New York itself has a population of around 8 million, though the number of people living in the entire New York City region exceeds 21 million. The population density of the city is high with more than 10,000 people per square kilometre (London: around 4,500).

New York has the largest metro system in the world in terms of route length, number of lines and number of stations. The system mainly covers Manhattan and Brooklyn; there are some services into New Jersey but these are operated by a different authority. Total route length is 398km, slightly less than the length of the London network. There are 468 stations on the system, with an average distance between stations of some 850 metres (London: 1600

metres). Importantly, the average journey length on the New York system is markedly shorter than on the London Underground.

Due to inadequate maintenance, the New York subway system was in a run-down condition by the late 1970s, with unreliable services and outmoded practices and equipment. Following a declaration of a "transport emergency" by the New York State Legislature in 1981, massive funds were devoted to the modernisation and rehabilitation of the system. Although this did not involve the construction of new lines, a number of network expansion projects are planned for the next decades. Almost 20 per cent of the funds in the 2000-04 capital program of the Metropolitan Transit Authority are devoted to expansion projects.

Over 40 per cent of line-km in New York have quadruple tracks and another 25 per cent are triple-track lines. This allows express trains to operate on many lines, as well as other skip-stopping services, eg night services. In London, by contrast, almost all lines have twin tracks, although there are a few cases where two different lines run parallel to each other for several kilometres (e.g. Piccadilly and District between South Kensington and Acton Town; Jubilee and Metropolitan between Baker Street and Wembley Park).

Further operational flexibility is provided on many of New York's lines by provision of bi-directional signalling (so tracks can be operated in either direction), unlike many other metro systems. The headway between trains is approximately 2 to 5 minutes during peak times, 10 to 15 minutes during the daytime off-peak, and 20 minutes after midnight. This applies to individual lines; since many lines run parallel on trunk sections, frequencies on some key sections of the network are in fact higher. These headways are broadly compatible to those in London.

4.5.2. Paris

The Paris metro network provides a closely-knit in-town network with exceptionally closely spaced stations. Consequently, a substantial proportion of metro passengers are making short journeys, which might be taken by bus in London. The network extends to the inner suburbs of the city but, unlike in London, not beyond that. For example, in the 8-zonal tariff system in the Greater Paris area, no metro line extends beyond the distance that defines zone 2 on the London Underground.

A number of outer suburbs have now been linked to the central area by the Regional Express System (RER), which uses existing surface suburban lines in the outer areas. Some of the five RER lines are jointly or solely operated by French National Railways. The proposed Crossrail scheme in London would be similar in nature to the RER lines in Paris.

The conventional network (excluding RER) has 14 lines and a total network length of just over 210km. Although no new lines were built in the 1980s, the network was slowly expanded through extensions of existing lines. In the 1990s, however, it was decided to build a completely new line (Line 14 "Météor) from the south to the north-west of the city. The first 7km stretch opened in October 1998; work on a further section is currently under

way. It has taken ten years from the first presentation of the ideas for the new line to the Government to the opening of its first stretch, with the actual construction taking six years.

About one third of the network is operated by rubber tyred trains. The 297 stations imply an average distance between stations of 700 metres (London: 1600 metres). On an average weekday, the system is used by about 4.35 million passengers.

Peak service intervals in Paris are generally between 1.5 and 2 minutes. During the middle of the day, headways are around 3.5 minutes, whereas trains run every 7 or 8 minutes during late evenings. A somewhat reduced service operates in the summer months. Thus the average operational intensity is somewhat higher than is the case in London.

4.5.3. Berlin

Berlin is the capital of the unified Germany and has a population in its metropolitan area of around 3.5 million. The city has a population density of around 4,000 people per square kilometre (London: around 4,500).

The Berlin "U-Bahn" network consists of nine lines with a total length of 144km. There are 170 stations, implying an average distance between stations of almost 900 metres (London: 1600 metres). In recent years, the network has been expanded somewhat, although this mainly reflects the impacts of the re-unification of the city.

The U-Bahn complements the S-Bahn system in Berlin, a fully separated heavy rail system, largely elevated. Although some S-Bahn lines extend somewhat beyond the Berlin metropolitan area (unlike the U-Bahn), it is mainly an urban means of transport. In practice there is a substantial degree of exchangeability between U and S-Bahn services.

The first U-Bahn line opened in 1902 (S-Bahn 1882). Whilst a substantial proportion of the system dates from the early 20th Century, considerable reconstruction took place after 1945. The U-Bahn system in the former West Berlin was expanded substantially after the construction of the Berlin Wall in 1961 to alleviate overcrowding arising from customer resistance to use of the East German controlled S-Bahn system. Further new line construction and extensive modernisation has followed the re-unification of the city.

On workdays, the U-Bahn operates between 04:00h and 01:00h, with trains generally running every 3 to 4 minutes during peak hours and every 5 to 10 minutes during the off-peak. Thus service frequencies are broadly compatible to those in London.

4.5.4. Stockholm

Stockholm, a city with 1.7 million inhabitants in its metropolitan area, has a "Tunnelbana" system with 3 lines, 11 branches and a network length of 110km (64km of which are in tunnel). There are 100 stations, thus giving an average distance between stations of

1100 metres (London 1600 metres). The first line of the network did not open until 1950, with the network being completed in its present form in 1975.

The network covers the entire city and is operated by Connex Tunnelbanan on behalf of the transport authority SL. SL owns 40 per cent of Connex Tunnelbanan's shares.

The Tunnelbana is notable among metros for having pioneered innovations such as cab-signalling, integrated metro/new town planning.

4.5.5. Madrid

Madrid is the capital of Spain with a population in the Madrid metropolitan area of around 3 million people and a population density of some 5,000 people per square kilometre (London: 4,500)

Madrid's metro network has been growing rapidly over recent decades and now consists of an 11 line system with 158 stations, covering virtually the entire metropolitan area. The current length of the network is just over 171km, implying an average distance between stations of almost 1100 metres (London: 1600 metres). Of the network, 50km has been constructed during the last 10 years. A 12th line, 40km long, is under construction. When this is completed, the total length of the tunnel sections in Madrid will be some 188km. Presently, some 85 per cent of the network is in tunnel, a considerably higher proportion than London.

The system operates from 06:00h until 01:30h. On most lines, trains run every 2-3 minutes in peak hours and every 4-6 minutes during the day. On one line, the peak headway is only 90 seconds, implying 40 trains per hour. This is somewhat greater than on any line in London, whilst those on the other lines are broadly compatible to London.

4.5.6. Barcelona

Barcelona, a city with a metropolitan area in which over 2.5 million people live, has a metro network consisting of five lines and 112 stations. The length of the network, operated by the main operator TMB, is about 81km, giving an average inter-station spacing of 720 metres. Another two lines with a total length of 44km are operated by a different operator FGC. Virtually the whole network is in tunnel. One of the TMB lines (Line 2) did not open until the 1990s.

On weekdays, the system operates from 05:00h until 23:00h. On Fridays and Saturdays, the service is extended until 02:00h. During peak hours, trains run every 3 to 4.5 minutes. Off-peak intervals are between 4 and 6 minutes, with trains running every 6 to 9 minutes during evenings and Sundays. Peak service frequencies are thus rather less than London's 2 to 4 minutes.

PART II: LEVELS OF SERVICE SCRUTINY

5. SAFETY AND SECURITY

5.1. Introduction

When considering safety and security issues, it is important to make a clear distinction between risks arising due to operational issues and those arising due to criminal activity. In this report, we follow convention and use the term "safety" to refer to issues of operational safety, such as incidents and accidents involving trains, and those at stations, eg involving escalators. We use the term "security" to refer to issues concerning exposure to criminal activity, ranging from graffiti, to theft, to serious incidents involving violence.

In the evidence received in relation to this Scrutiny study, both verbal and written, safety and security emerged as key priorities for all those involved, including government, operators and customers. All stakeholders were in agreement that safety should have priority over other aspects of service.[6]

LUL provided the Committee with a note setting out the current approach to safety management on the Underground. Risks are controlled by the widely used ALARP principle – controlling risks to a level that is as low as reasonably practicable, as required by the Health and Safety at Work Act of 1974.[7]

5.2. London Performance

5.2.1. Operational safety

Figure 5.1 and Figure 5.2 below show LUL's recent safety performance. The solid lines show major injuries, while the dotted lines show fatalities. At first sight, safety performance appears to have had a mixed record in recent years in terms of safety trends. While there has been a significant fall in the number of employees and contractors sustaining major injuries, major injuries to customers have increased quite significantly from just over 50 cases *per annum* in 1995/96 to around 140 cases by 2000/01. However, evidence provided by LUL has explained that a change in the definition of a "major injury" in 1995 accounts for this increase.[8] If this factor is taken into account, although there are fluctuations for year to year, the trend is much flatter and shows no real increase over the last three years.

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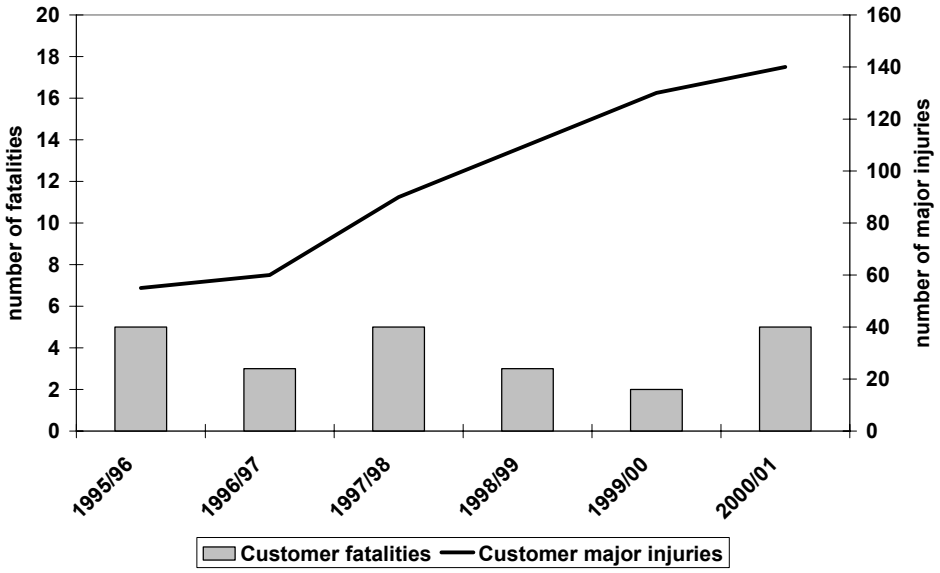
6 Note that to say this is not to imply that customers or operators are in any way dissatisfied with current levels of safety. More details of LUL's record on safety and security are provided in the next section.

7 *Safety Management in London Underground*, LUL.

8 Dislocations and unconsciousness were added to the definition.

The number of fatalities has remained low and relatively stable for both customers and employees/contractors. Seven people were killed in accidents on the Underground in 2000/01.[9]

Figure 5.1
Customer Fatalities and Major Injuries *per annum*



Source: approximate figures from LUL graph

[9] ie, excluding suicides.

Figure 5.2
Employee/Contractor Fatalities and Major Injuries *per annum*

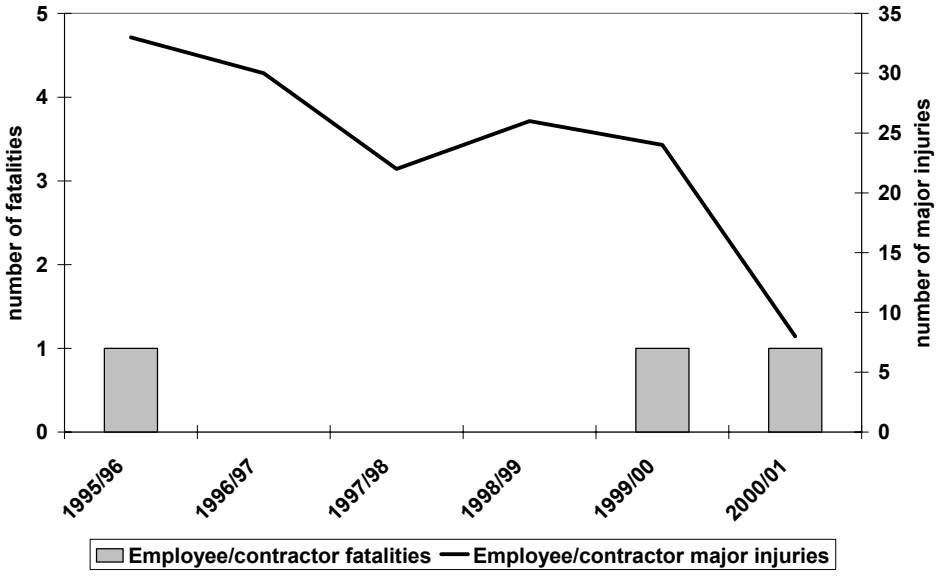


Table 5.1 shows LUL's safety record in more detail for 2000/01. The very low probability of a serious injury or fatality occurring can be illustrated by the fact that based on these figures, a passenger making ten Underground trips a week, every week of the year for forty years would have a 0.015 per cent chance of being killed by an operational accident, and a 0.3 per cent chance of suffering a serious injury.

Table 5.1
LUL Safety Incidents 2000/01

Accident/Incident	Number
Passenger accidental fatalities	7
Employee/contractor fatalities	0
Passenger major injuries	135
Employee/contractor major injuries	7
Signals passed at danger	863
Person-train incidents	1168
Incorrect Door Openings	36

Source: LUL

The highest number of safety incidents were for person-train incidents and signals passed at danger (SPAD). Person-train incidents include any reported contact between a person and a train, varying from customers struck by a moving train whilst they are on the platform to a person under a train. It includes contact arising due to trespass or suicides. LUL reported that around 53 per cent of such incidents involve no injury, around 43 per cent a minor injury, two per cent a major injury and two per cent a fatality.

Unlike mainline rail, all London Underground lines are provided with mechanical trainstops that automatically apply an emergency brake if a train passes a signal at danger. If the train protection system is activated, an automatic speed control system is also activated. The Victoria and Central lines have Automatic Train Protection (ATP) systems which in addition to the train-stop facility also protect against overspeed. The provision of these systems means that the risk to passenger safety associated with a SPAD is low.

It should also be noted that although incorrect door openings are included in the safety statistics (ie, doors opening when a train is not at rest at a platform) there have been no fatalities and only one injury per year arising as a result of this over the past three years.

However, according to Paul Godier, London Underground's Managing Director, the biggest single risk on the Underground is that arising from fatalities boarding and alighting from trains, the cause of a number of fatalities in a typical year.[10] One action taken has been to fit inter-car barriers to prevent passengers from falling or stepping into the gap between cars when a train is at rest. Another is to paint yellow lines on platforms, and advise passengers to stand behind them when a train is approaching. There is concern that overcrowding on platforms could increase the risk of passengers falling onto the line, although Mr Godier indicated that he was not aware of any crowding incident where people have been crushed or fallen onto the track as a result.[11] London Underground are also looking into the possibility of extending use of platform edge doors, as fitted on the Jubilee Line Extension, but there are technical difficulties (see section 5.4.2 below).

Overcrowding on trains may also raise safety concerns in regard to passenger health. There are no restrictions on the number of passengers trying to board a train other than physical capacity, and passengers on a crowded train, especially on hot days, and when trains are delayed in tunnels, may start to suffer ill-effects. London Underground have pointed out that they will try to avoid trains becoming trapped in a tunnel, but, if they are, will take action to detrain passengers by walking them out once the train has been trapped for more than 15 minutes.[12]

Evidence provided by LTUC suggests that customers generally feel both safe and secure when travelling on the London Underground. This is mirrored in London Underground's own Customer Satisfaction Survey, where customers awarded personal safety on trains one of the highest levels of satisfaction out of all the elements surveyed.

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[10] Hearing, May 16th. Subsequently, LUL provided the Committee with a paper setting out the principles on which risks are assessed, and proving a chart showing assessed risks in terms of expected fatalities per year from different causes.

[11] Hearing, May 16th.

[12] Hearing, May 16th.

5.2.2. Security

LUL and British Transport Police (BTP) report that there were 14,370 crimes on the Underground in 2000/01. This figure represents a 21 per cent drop on crime levels in the previous year, which compares to a drop of just 3 per cent in BTP's crime figures for England and Wales as a whole. The 2000/01 crime figures were however slightly higher than those reported in 1998/99 (13,035).

The low risk of being a victim of crime on the Underground is illustrated by the fact that a passenger using the Underground ten times a week, every week of the year for forty years, has roughly a one in four chance of being a victim of crime once in that period, with over half of that probability being the chance of a theft of personal property.

Table 5.2 shows that theft of passenger property accounted for almost 60 per cent of the crimes on London Underground over 2000/01, with more serious crimes at much lower proportions.

Table 5.2
Proportion of Crimes by Type on London Underground (2000/01)

Crime	Proportion of total crimes
Violent crime	10%
Sexual offences	3%
Criminal damage	5%
Line of route offences	0.3%
Theft of passenger property	59%
Motor vehicle/cycle theft	8%
Robbery	4%
Property theft/burglary	3%
Public order	3%
Fraud and forgery	1%
Drug offences	1%
Other crimes	3%

London Underground consumer surveys show that passengers attach a very high priority to improvements to security measures. LUL willingness to pay surveys reveal improved security as the aspect that consumers would be willing to pay most to improve.[13] Customers express a particularly high willingness to pay for surveillance cameras on trains, a staff presence on platforms and the provision of help points in walkways.

[13] Note that this survey only covered improvements that did not involve "time" factors, such as improved frequency, reliability and reduced queues, which other surveys have also shown to have high consumer priority.

As mentioned above, written evidence received by the GLA from consumer groups suggests that consumers generally feel safe and secure. However, consumer groups also note that perceived risk of crime amongst passengers is higher than actual risk. Customer surveys also report a divergence between men and women polled on this issue, with women generally feeling less secure and attaching a higher priority to improved security measures.

5.2.3. Initiatives taken by LUL to improve security

LUL has taken a number of initiatives to try and further improve security on trains and in stations in recent years. Key examples include the installation of CCTV in stations, covering ticket halls and walkways as well as platforms. LUL is currently in the process of introducing CCTV cameras to its trains, and aims to equip all its new trains with CCTV. Although it is difficult to judge the impact of CCTV on crime levels and perceived crime levels, some anecdotal evidence is available. For example, London Underground report that following the introduction of a new control room at Ladbroke Grove, linked to CCTV cameras, there was a 60 per cent reduction in total crimes.

Help Points are available at London Underground stations, providing a direct link to a member of staff, plus a fire alarm. A number of bodies providing written evidence have drawn attention to the fact that a relatively large proportion of Help Points are non-operational and are not easily accessible for eg, those in wheelchairs, or those with impaired hearing or vision. Some of those giving evidence have also suggested that passenger awareness of the availability of alarms on platforms is quite limited, and have suggested that visibility be increased.

London Underground have stated their intention to upgrade older Help Points over the next year, and that all stations that currently do not have Help Points will receive them as and when they are refurbished.

5.2.4. Secure stations scheme

Crime Concern and BTP operate a Secure Stations Scheme (established by DTLR in 1998), under which individual stations can receive accreditation[14] if they meet certain security standards and have satisfactory results from a customer security survey. The accreditation lasts for two years after which, re-accreditation must be sought.

In order to qualify for accreditation, stations must reach specific standards covering the following areas:

- general design features;
- features of the waiting environment;

[14] Crime Concern acts as the accrediting agency.

- information provision;
- calling for help; and
- staff deployment and competence.

Accreditation is based on attaining a certain number of points, so that stations that fall down in a particular area (such as poor station design which may be, for example, due to historic factors) can still gain accreditation be making up for this with particularly good performance in another area (such as management action). The pass-mark is not made public, so as to encourage station managers to achieve the best score possible, rather than just the pass mark.

Eleven LUL stations had received accreditation, equivalent to 4.5 per cent of LUL stations. The proportion of mainline railway stations accredited is currently also around 4.5 per cent. LUL have stated that they hope to extend the scheme to more stations, but note the significant cost involved, including the cost of conducting customer surveys every two years to maintain accreditation.

Public awareness of the Secure Stations Scheme currently appears to be very low. For example, LUL reports that "virtually all" customers surveyed at Marylebone Station in its re-accreditation survey were not aware of the scheme, although the "vast majority" of respondents said that they felt safe on the station. They have since taken some steps to increase awareness of the scheme.

Attaining Secure Stations Scheme accreditation is not without its difficulties. In addition to the costs involved (eg in modifying the station in order to pass accreditation), the time taken to reach accreditation, and the practical difficulties of surveying ten per cent of passengers at each station every two years have been highlighted. Ina follow-up written response to the Committee, LUL advanced proposals to reduce the survey costs and time significantly by replacing surveys of specific stations by a network-wide survey supplemented by local research where appropriate.

LUL have also proposed increasing the period before re-accreditation from 2 years to 5 or even 7 years, with crime statistics used as the prime means to ensure that stations are not falling below required standards.

Finally, LUL have also pointed out that if a station is accredited it does not mean that the streets outside the station, or walking links with non-LUL stations, are necessarily secure. They have taken some steps to implement measures that could have some benefit in the area immediately around the station entrance (such as improved lighting or CCTV coverage), but accept that complementary measures are needed from local councils, property owners and (where appropriate) operators of stations on the national rail network in areas where street crime is a known problem.

The Secure Stations scheme is not currently extended to cover trains themselves, but at the evidential hearing, Crime Concern could see no practical barriers to a similar scheme being set up to cover trains.

At these hearings with Crime Concern, it was also suggested that incorporating Secure Stations Scheme accreditation into the benchmarks against which LUL is measured would be desirable. LUL have suggested that the Assembly might wish to contribute to any review of the scheme that might be conducted by the Department for Transport.

5.3. Comparisons with Overseas

5.3.1. CoMET

In the CoMET database, the following safety indicators are included (top-level in **bold**):

- **total fatalities/total passenger journeys;**
- suicides/total passenger journeys;
- medical conditions/total passenger journeys;
- illegal activity/total passenger journeys; and
- accidents/total passenger journeys.

Although the CoMET data are confidential, we have been provided with the ranking of London Underground on the top-level indicator (total fatalities/total passenger journeys). In 2000, London ranked 6th out of 9 on this indicator, slightly below the median score. While at first sight this might suggest a roughly "average" performance on "safety" compared to other CoMET members, it is important to note that this particular measure shows only one, extreme, measure of safety performance, and that it does not distinguish between suicides and accidental fatalities. Interviews with operators of the CoMET database have also highlighted the difficulties in making comparisons between metros in the area of safety and secturity, pointing to, for example, the significant differences in how different metros define a major injury.

5.3.2. New York

New York City Transit principally monitors personal **safety** using two indicators:

- customer accidents per million passengers carried; and
- customer injuries per million passengers carried.

The "accidents" indicator measures the number of accidents involving one or more claimed injuries to a customer on the subway system. The "injuries" indicator measures the number

of injuries as a result of these accidents. Due to the way these indicators have been defined, the value of the "injuries" indicator will always be equal or above the "accidents" indicator. The measures do not include assaults and suicides.

The performance on these measures since 1997 is shown in Table 5.3. The number of accidents has fallen each year, with the likely 2001 outturn about 15 per cent below the 1997 figure. The development of the number of injuries as a result of accidents has shown a similar trend. However, the 2001 target of 2.83 customer injuries per million passengers carried is unlikely to have been met.

Table 5.3
New York Customer Accidents and Injuries per Million Passengers Carried, 1997-2001

Year	Accidents	Injuries
1997	3.45	3.61
1998	3.32	3.37
1999	3.29	3.37
2000	3.11	3.17
2001[15]	2.91	3.01
2001 target	n/a	2.83
2005 target	n/a	2.31

Sources: NYC Transit Committee Agenda, September 2001; New York City Transit Strategic Business Plan 2001-2005

General initiatives to improve customer safety include:

- modernisation of signal systems;
- safety awareness marketing initiatives to inform customers how to avoid unsafe actions; and
- replacing mercury vapour lighting in subway tunnels with fluorescent lighting to increase the visibility of the trackway and emergency exists.

The level of personal **security** on the New York subway system is monitored on the basis of absolute numbers for such crimes as robbery and assaults. Reporting the absolute outturn numbers would not be very informative, also because these numbers are highly specific to the particular social environment in which the New York subway operates. However, the following observations are worth making:

- All stations are staffed at all times.

[15] 12 month rolling average through September 2001

- Virtually all trains carry conductors at all times.
- Between 1995 and 2000, the total number of crimes on the New York subway system fell by about 30 per cent, with both robberies and assaults down 50 per cent. Over the last 10-years period, major felonies were down 75 per cent, robberies 85 per cent, and assaults 73.5 per cent.
- In December 2000, New York City Transit had CCTV cameras installed at 146 stations (around 30 per cent of stations). According to the then plans, CCTV was to be installed at a further 98 stations by 2003, bringing the total to around 50 per cent.
- However, following the September 11 attacks, New York City Transit is reassessing its security system. Further information apart from the general observations made above is now confidential.

Although we do not have insight into exactly what initiatives exactly have contributed to the decline in crime on the New York subway in the last 10 years, we note that the subway is under the jurisdiction of the New York City Police Department Transit Bureau. We suppose that the general "zero-tolerance" policy of the New York police will have been one of the contributing factors.

5.3.3. Other cities

The **Paris** metro operator RATP uses the following indicators for passenger safety and security:

- customer and third party accidents per million passengers carried;
- violent acts per million passengers carried; and
- number of physical attacks against staff per million passengers carried.

The 1999 and 2000 outturn levels for these measures are contained in Table 5.4.

Table 5.4
Paris Safety and Security Indicators, 1999-2000 (Metro and RER)

	1999	2000
Customer and third party accidents per million passengers carried	5.17	5.03
Violence acts per million passengers carried	1.75	1.63
Number of physical attacks against staff per million passengers carried	0.38	0.34

Source: RATP

Currently, around 30 per cent of underground stations in Paris are equipped with CCTV, with an extension project ongoing. All stations are staffed, and also equipped with alarm

systems for passengers. Alarm systems are also available in all trains. Only 2 per cent of trains have been fitted with CCTV, although Paris is ahead of London in this regard.

Currently, 50 per cent of the **Barcelona metro** stations are equipped with CCTV, although the objective is to equip all stations with CCTV by 2002. The trains are not fitted with CCTV.

All Barcelona metro stations are equipped with intercoms in the platforms and booking halls. All stations are staffed and security staff subcontracted from private companies are present in 28 per cent of the stations.

Barcelona metro managers are currently collecting information to develop a set of proposals to improve personal security in the Barcelona Metro system. The sources of data being used are:

- surveys of metro users; and
- studies that compare the perceived criminality level in the metro and the actual level of criminality in and outside the metro.

Due to the different ways in which the safety and security indicators have been defined, the data from the overseas comparators are not readily comparable with the London data. However, the improvements in both safety and security on the New York subway in recent years are noteworthy.

5.4. What Can Londoners Reasonably Expect?

Given that other metro systems measure safety and security in different ways to London, it is difficult to draw direct lessons from other cities as to what Londoners can reasonably expect in this area. However clear points emerging from this study are that:

- Safety is the highest priority of LUL itself, and is also afforded very high priority by passengers.
- Safety is not seen as a "problem" area. Current safety levels are generally regarded as good. The risk of serious injury or fatality is very low.
- Crime levels on the Underground are relatively low, and most crime that does take place involves the theft of personal property rather than more serious crimes.
- People generally feel secure, but this perception varies with gender, location and time of day. Customers do report feeling vulnerable, particularly late at night and at quieter stations. Perceptions of crime levels appear to be higher than actual crime levels.

We conclude that Londoners should be able to reasonably expect a high level of safety and security and that the current record is generally good. However, some initiatives have been identified that LUL could take to further improve standards to what might be considered "world-class" levels. It is important to remember however that London, fortunately, has not had to experience a major underground train fire. Such an incident has the potential for considerable loss of life, the performance in such an incident remains an open question.

5.4.1. Staff availability and visibility

A very large proportion of the written and oral evidence provided to the Committee on the issue of personal security suggested that passengers would feel a lot safer if there were more station staff visible and available, particularly in the late evenings, and at outer stations as well as central London stations. Respondents suggested that there should be an increase in staff stationed on platforms, rather than, as one respondent put it, "clustered around the ticket machines". The DTLR's *Personal Security on Public Transport Guidelines for Operators* also note the importance that any staff on duty are both visible and available to passengers.

However, when considering whether Londoners should reasonably expect an increased staff presence, it is important to note that London Underground currently employs more staff per station than is typical for mainline stations and for many metro stations elsewhere in the world. Anecdotal evidence from other metro systems around the world also suggests relatively low levels of "visible and available staff", particularly on platforms, compared to London. The physical impossibility of having staff available on every platform and every walkway, at all hours of the day has also been highlighted.

On balance, it would appear that London Underground does not fall behind what might reasonably be expected from a world-class system in terms of staffing *levels*. However, London Underground might be able to give some consideration to how perceptions of staff availability and visibility might be increased, for example:

- considering their location within the station and between stations (particularly inner *vs* outer London);
- the increased use of glazing in station design so that staff are more visible;
- staff training that maximises their confidence in dealing with situations of potential conflict or aggression, so as to increase their own confidence in being "visible and available" in quieter stations, particularly late at night.

5.4.2. Platform edge doors

The majority of deaths resulting from passengers under trains are the result of suicides, though the numbers also include the inebriated and accidental and criminal acts. Quite apart from the issue of loss of life involved, such incidents can have a severe traumatising effect on staff, the emergency services and other passengers involved. Reduction in the ease

with which passengers in station areas can gain access to track areas will undoubtedly reduce the frequency of such incidents. This can be accomplished by installation of platform edge doors, such as those on the Jubilee Line Extension. These will have the further benefit of permitting the number of passengers waiting on platforms to be safely increased as the number of tube users increases. However, although London Underground are currently looking at the possibility of extending platform edge doors, they have indicated that there are no currently available designed platform edge doors that will work on a curved platform.[16] Nevertheless, we recommend that a detailed cost-benefit analysis is undertaken as a matter of priority (and which properly includes the impact of increasing tube ridership) to determine the most cost effective scale of provision where fitting of platform edge doors at busy stations would be practically feasible.

5.4.3. CCTV

The evidence provided suggests that while more visible, available and better-located staff would be desirable as a "first best" solution to customers' security fears, the increased use of CCTV, particularly if it is seen to be actively monitored by staff (including links to the PA system) is an initiative that passengers have expressed a high willingness to pay for. At present 96 per cent of stations have CCTV systems installed, but their value depends in part on the age of the system – older systems are less effective in recording details that can be used as evidence in court.[17]

Some respondents have pointed to some limitations with current CCTV systems, such as failure to cover the full length of a platform or walkway.

There would appear to be scope for further initiatives in this area, including the rolling-out of CCTV on trains. This is consistent with LUL's own aims, as set out in its Customer Service Delivery Standards (CSDS).

5.4.4. Graffiti and vandalism

Crime Concern provided some details of schemes aimed at tackling graffiti and vandalism on other metro systems. For example, New York generally adopts a policy of "rapid removal" aimed at showing "zero tolerance" for such crimes, and at removing the "reward" or motivation for the crime. In Sweden, schemes include working with offenders to provide them with alternatives to graffiti and vandalism, although the success of such schemes were reported to be ambiguous. Crime Concern consider that a combination of these measures is likely to yield the most effective results.

DTLR Guidelines on Personal Security on Public Transport note (drawing on the 1997 DTLR report on the fear of crime on public transport) that "graffiti, damage, litter and other signs

[16] Hearing, May 16th.

[17] Hearing, May 16th.

of neglect signal to passengers a lack of control of the environment, and contribute to feelings of fear".

Graffiti, vandalism and litter are considered in more detail in Section 12 on Cleanliness and Comfort.

5.4.5. Help points

As set out above, LUL has plans to repair and refurbish help points as stations are refurbished, and to extend them to stations that currently do not have them. However, concerns have been expressed about Help Points that are not working, their relatively poor accessibility for the disabled, and low levels of public awareness.

5.4.6. Policing

Crime Concern at the hearing suggested that there is some confusion over the boundaries between areas served by British Transport Police, and by the Metropolitan Police, including who is responsible for what. They also pointed to the inability of BTP to make a "rapid response" to crimes in most cases, due to the small number of officers available.

Unfortunately the British Transport Police were unable to attend the hearings, but London Underground stressed the value of a police force that understands how the system works (eg the risks involved in pursuing suspects through tunnels) "We are very impressed and pleased with the performance of the British Transport Police in relation to the Underground."[18] However, one concern is response times, especially away from Central London, though in these areas the BTP will often call upon officers from the Met or from county forces.

[18] Paul Godier, Managing Director, LUL, Hearings, May 16th.

6. RELIABILITY

6.1. Introduction

Reliability is a matter of key concern to passengers, to London Underground, and to Transport *for* London.

In their background evidence to the Scrutiny Committee London Underground presented survey results that showed that improved reliability is the greatest priority for consumers after safety.

A survey conducted in 2000 asked customers to state the improvements they would like to see on LU. Reliability was most frequently cited for improvement. When respondents were asked to state the single most important aspect of the service to be improved, 4 of the top 5 most frequently given answers included aspects of reliability, the other being safety. The four were:more trains/more frequent trains;

- reduced overcrowding;
- reduced delays; and
- cleaner stations.

Improved reliability would improve performance in each of these areas.

In this Section we first (in Section 6.2) provide some figures on overall trends in reliability, considering train reliability (in terms of delays over 15 minutes, percentage of peak trains cancelled, and percentage of scheduled train kms not operated), and escalator and lift reliability. We next (Section 6.3) compare unreliability between lines, and the causes of relative differences between lines, drawing on the summary statistics provided in Section 3.3 and on reliability statistics provided by London Underground. Such internal benchmarking can be used as a diagnostic tool to identify best performance within the system and to identify reasons why parts of the system fall below best practice. Section 6.4 reviews reliability and the assessment of reliability performance and desirable standards in overseas metro systems. Section 6.5 provides our assessment of what Londoners can reasonably expect in terms of reliability.

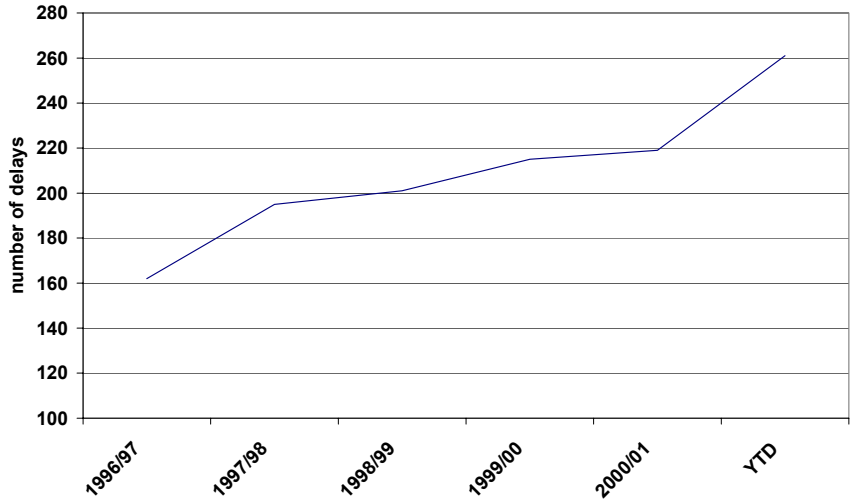
6.2. London Performance

6.2.1. Train reliability

Figure 6.1 shows the average number of train delays of fifteen minutes or more, while Figure 6.2 shows the average percentage of peak trains cancelled. Figure 6.3 shows the percentage of scheduled kilometres not operated. All three graphs show upward trends, equating to a

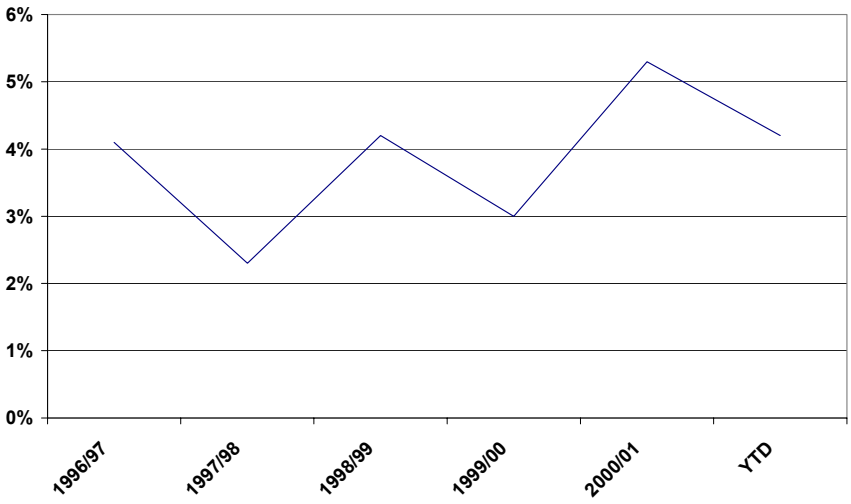
significant fall in reliability levels in recent years, with the number of delays steadily increasing.

Figure 6.1
Average Number of Train Delays Over 15 Minutes



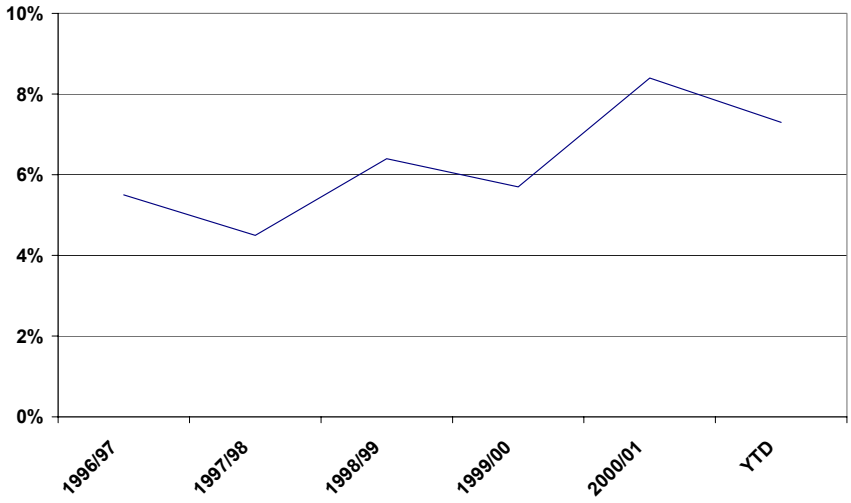
Source: LUL Performance Report to the Rail Transport Advisory Panel

Figure 6.2
Percentage of Peak Trains Cancelled (Attributable Only)



Source: LUL Performance Report to the Rail Transport Advisory Panel

Figure 6.3
Percentage of Scheduled Kilometres Not Operated



Source: LUL Performance Report to the Rail Transport Advisory Panel

Table 6.1 shows the proportion of delays accounted for by different causes for the period ended 15th September 2001. 72 per cent of delays are attributable to London Underground, the remainder being due to events largely outside their control such as passenger action, and security alerts. Of attributable delays, staffing problems, rolling stock problems and signalling problems are the three biggest causes, together accounting for 55 per cent of attributable delays. It is, however, worth noting that the number of train delays caused by staff problems has fallen in the past six months (from 16 in March 2001).

Table 6.1
Reasons for Delays on London Underground

Cause of Delay	**%**
Staff	13%
Rolling Stock	19%
Signals	23%
Infrastructure	2%
Track	11%
Other	5%
Total attributable	**72%**
Total non-attributable	**28%**

Source: LUL Performance Report to the Rail Transport Advisory Panel

6.2.2. Reliability of escalators and lifts

London Underground's escalator stock is varied and includes machines from a variety of manufacturers and periods. Many of the escalators date back to the 1920's and 1930's. Although modernised, the Northern Line in particular is notable for the age of its stock, the first modern escalators installed in 1924 at Clapham Common are still in service. The Jubilee Line Extension stations are notable for provision of escalators on an unprecedented scale.

Table 6.2 provides an indication of the relative differences in escalator provision between the various lines but is indicative only: the total number of escalators at each station has been divided by the number of deep tube lines using it and sub-surface lines have been ignored because of the relatively small number of escalators provided on the sub-surface system.

Table 6.2
Indicative Escalator Numbers

	Stations with escalators	Total no.	Av. no. per Underground station
Bakerloo	12	38	2.5
Central	15	58	3.0
Jubilee	16	102	7.9
Northern	27	87	2.4
Piccadilly	15	53	2.2
Victoria	14	42	2.6
Waterloo & City	2	4	2.0
Total	**79**	**394**	**3.1**

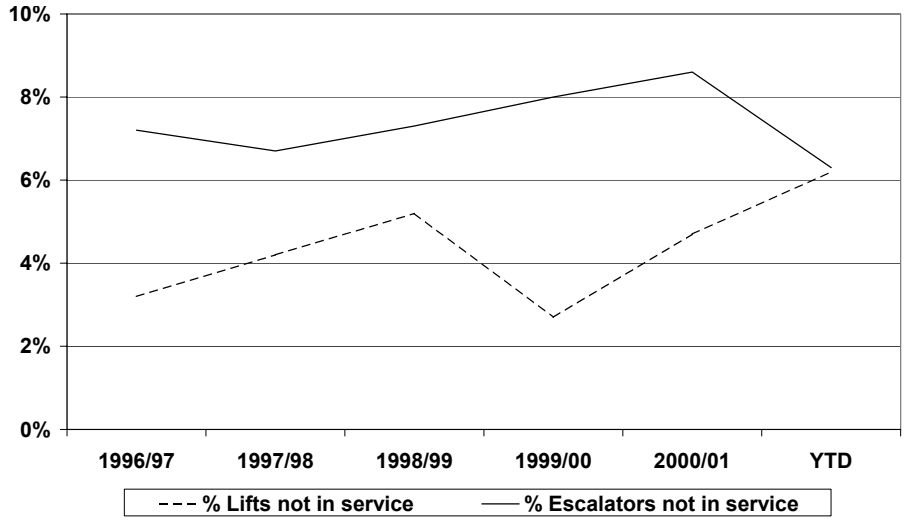
As with escalators LUL's stock of lifts is also somewhat varied, consisting of both traditional, pre-escalator lifts and modern lifts installed for the mobility impaired. Table 6.2 provides an indication of the relative differences in lift provision between the various lines. As with Table 6.2, it is indicative only for the same statistical reasons, nevertheless the difference in accessibility for the mobility impaired and those encumbered by young children, shopping, etc, is clear, for example the difference between the modern standards as represented by the Jubilee Line Extension and the Victoria Line is stark.

Table 6.3
Indicative Lift Numbers

	Stations with lifts	Total no.	Av. no. per Underground station
Bakerloo	5	9	0.6
Central	5	8	0.4
Jubilee	12	26	2.0
Northern	12	27	0.8
Piccadilly	10	21	0.9
Victoria	2	2	0.1
Waterloo & City	1	1	0.1
Total	**79**	**101**	**3.1**

Figure 6.4 shows recent trends in escalator and lift reliability. The chart shows that while lift reliability levels have historically been better than those for escalators (as one would expect), the average percentage of lifts out of order has risen in recent years. The proportion of escalators out of service has risen slightly to 2000/01, but the year to date has shown a material improvement. (When assessing escalator and lift reliability statistics, it is important to note that at any one time, there will always be *some* escalators and lifts out of service for routine maintenance). The improvement over the past year can be interpreted as due to the Jubilee Line Extension, which (as can be seen from Table 6.2) has greatly increased the number of escalators on the system and whose escalators (procured under new contractural arrangements placing more responsibility on the suppliers) have much higher reliability rates than is found elsewhere on LUL (See Section 6.3). There is no evidence therefore of a genuine underlying improvement in escalator reliability.

Figure 6.4
Escalator and Lift Reliability



6.2.3. Station closures

London Underground statistics on the number of station closures lasting for fifteen minutes or over show an overall upward trend since 1998/99 (89 closures of fifteen minutes or more in 1998/99 compared to 126 in 2000/01) .

6.3. A Comparison of Reliability Across London Underground

6.3.1. Cross system benchmarking

In this Section we consider different factors determining delays over 15 minutes caused by different factors on different parts of the system in 2000/01 and 2001/02 (data for 2001/02 relate to the first nine months of the year only). To allow for differences in the relative scale of operations on different lines, we express all results in terms of train kms operated per 15 minute delay, which is the only partially disaggregated delay data supplied by LUL. This means that the greater the train kms operated per delay, the better the performance of the line. For delays caused by signalling, track and infrastructure, results are also expressed in terms of delays per route km. Delays over 15 minutes are only one type of delay. Since it is known that LUL collects data for a number of other time bands we had also requested data on delays over 2 minutes, but have not yet received them, other than aggregate annual totals of events by line causing delays of more than 2 minutes.

This lack of data for 2 minute delays has two important implications; firstly in terms of the proportion of total delays incurred and secondly in relation to the pattern of delays.

A 15 minute delay is quite a severe event on a metro-type system. Delays of 2 minutes or more are over fifteen times more frequent than 15 minute delays, the total figures for LUL for 2000/01 being:

- 2 minute delays 44,568 events
- 15 minute delays 2,860 events

Whilst the analysis we provide is on the basis of the 15 minute delays, it is important to acknowledge that the pattern of delays exhibited will not be repeated for the shorter delay periods. Serious infrastructure faults can be expected to be more heavily represented in the 15 minute period, whereas, for example, delays of 2 to 5 minutes will include a higher proportion of operational events, such as passenger action and a different pattern of equipment faults, with events such as faulty vehicle doors predominating to a greater extent.

The most significant causes of 15 minute delay, in terms of the size of the overall contribution of each factor to the overall figure on the system as a whole in 2000/01 are:

- signal failure;
- rolling stock;
- staff;
- track;
- other attributable causes; and
- infrastructure.

We analyse the first four of these in detail in the next subsections.

6.3.2. Delays due to signalling

Signalling systems provided throughout the London Underground are similar, being lineside colour light signals, though they differ in the technology employed, varying from traditional relay interlockings to modern solid state interlockings.

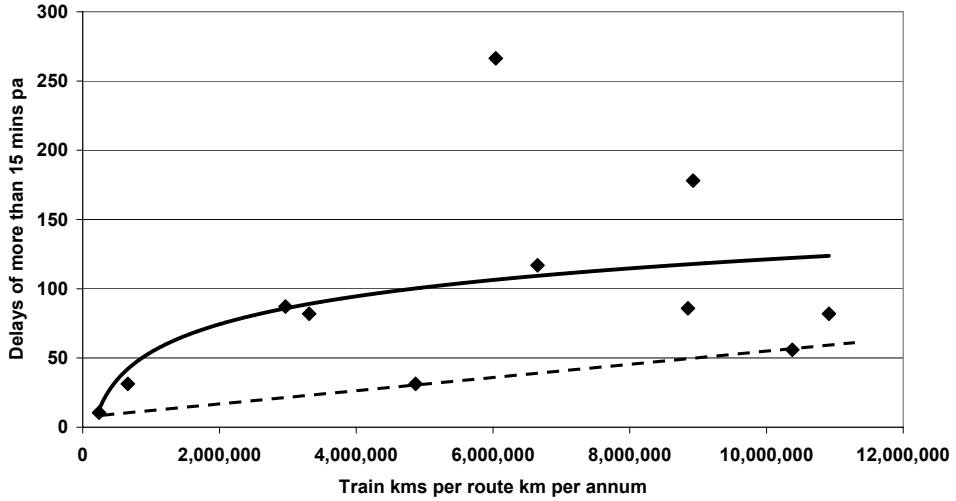
Table 6.4 shows the incidence of delays caused by problems with signalling. The most interesting finding is that the lines with the newest signalling systems (Jubilee and Central Lines) are not noticeably better in performance than the other lines, although signalling reliability statistics normally include items such as point machine and track circuit failures. In contrast the Northern Line, which is one of the two lines scheduled for the next resignalling schemes by LUL has consistently the best performance on LUL, although the need for resignalling can be dictated by safety related equipment condition: for example, there have been occasions on other systems where reliability rates have actually improved when the condition of cabling has become so frail that signalling technicians have been prohibited from working on it.

Table 6.4
15 min Delays Caused by Signalling

Line	Train km per delay		Delays per route km	
	2000/01	2001/02	2000/01	2001/02
Bakerloo	55,946	34,043	2.251	3.699
Central	126,458	103,171	0.957	1.173
District	81,899	50,124	1.748	2.856
Jubilee	84,209	56,859	2.124	3.146
East London	32,944	21,118	2.770	4.321
Northern	230,635	185,663	0.782	0.972
Piccadilly	218,284	133,263	0.718	1.177
Victoria	167,864	156,028	1.363	1.466
Metropolitan	46,120	22,670	2.093	4.258
Circle & Hammersmith	46,646	40,438	1.835	2.117
Waterloo & City	29,779	22,907	3.376	4.388
LUL Average	**95,952**	**62,131**	**1.820**	**2.688**

The relationship between train kilometres operated and signalling delays can also be represented graphically, as shown in Figure 6.5, which uses 2001/02 data. In this graph each point on the solid line represents LUL's current mean performance and the dotted line the LUL benchmark, as achieved by the Waterloo & City, Victoria and Northern Lines.

Figure 6.5
Relationship Between Train kms & Signalling Delays



In conclusion the average London Undergound signalling system on each route kilometre of the network causes a delay of at least 15 minutes about once every six months.

6.3.3. Delays due to rolling stock

Table 3.2 showed the difference between ages of rolling stock on different lines. Table 6.5 shows differences between lines in the incidence of delays caused by rolling stock.

Table 6.5
15 min Delays Caused by Rolling Stock (train km per delay)

Line	2000/01	2001/02
Bakerloo	68,957	73,577
Central	40,420	34,390
District	202,887	221,514
Jubilee	214,596	138,305
East London	43,925	50,683
Northern	415,143	469,619
Piccadilly	303,173	220,936
Victoria	270,448	138,691
Metropolitan	67,130	103,276
Circle & Hammersmith	78,853	74,929
Waterloo & City	13,235	91,628
LUL Average	**109,825**	**104,432**

There are some interesting comparisons to be drawn from this Table. It is apparent that the most consistently reliable trains are the "1995" stock on the Northern Line, which have been procured under the new form of contract, indicating the potential of the incentives. However, the "1996" stock for the Jubilee Line is practically identical, was constructed simultaneously by the same builder and is procured in a similar manner and yet causes almost twice as many delays per train km, being broadly the same as that achieved on most other deep tubes. A more detailed breakdown of the figures would be required to understand the reasons behind this.

The Central Line and Waterloo & City Lines also share identical rolling stock, but it is harder to draw conclusions since the small size of the Waterloo & City fleet leads to considerable fluctuations in the reliability figure. Nevertheless although these comprise the third newest stock on the Underground, they appear to be the least reliable by a substantial margin. This is particularly disappointing given that even the "1992" trains have been in service for almost seven years and initial reliability problems that are frequently associated with new rolling stock should have been resolved long ago. Apparent reliability rates more than ten times worse than the equivalent Northern Line stock need to be explained.

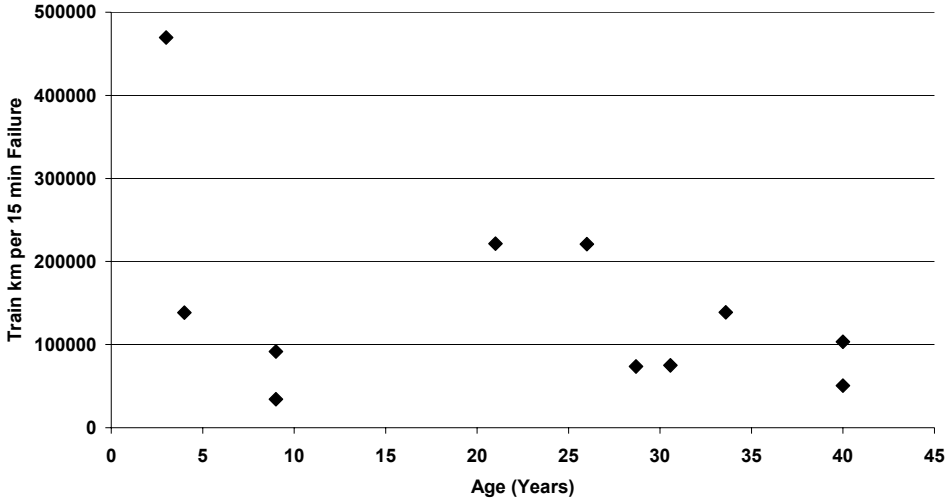
The reliability of the un-modernised deep tube lines is also interesting given the close family relationship between the trains; the superior performance of the Piccadilly Line stock may be explained by its more recent construction and refurbishment, but the Victoria Line's performance is substantially better than that of the Bakerloo Line, although the stock used

on each line are very closely related and that on the Bakerloo Line of more recent construction.

In the case of the sub-surface stock, one can again partially explain the relative superiority of the District Line stock by its relative youth, although the final build of Circle and Hammersmith & City Line stock is little older and has had the added advantage of having been refurbished. However, the disparity also partly reflects the generous provision of spare trainsets for the District Line. The performance of all other sub-surface rolling stock all of which has received heavy refurbishment in recent years is poor. The "A"-stock is used by both the Metropolitan and East London Lines and so the relatively poor performance of the East London Line stock is notable, particularly since East London Line trains are normally formed of four cars, whereas most Metropolitan Line trains are formed of eight coaches. It is likely that the remote location of the heavy maintenance base for this stock at Neasden has an effect in the case of the East London Line.

The influence of age rolling stock age on delays of more than 15 minutes is shown in Figure 6.6 (using 2001-02 data), where each point represents an Underground line.

Figure 6.6
Relationships between Rolling Stock Age and Reliability



The scatter is so random that it is not appropriate to attempt to draw a trend line through it; it is apparent that the prime driving factor behind reliability is not age.

In conclusion the typical London Underground train is a tube train built in 1981 and refurbished within the past ten years, which covers an average of 106,170 km per annum and causes a delay of at least 15 minutes once a year. (Note there are no trains that exactly match this average profile although the Victoria Line trains are perhaps the closest.)

6.3.4. Delays due to staff

Table 6.6 shows delays due to staff. Underlying figures for all lines show considerable variations throughout the course of a year. It appears that the incidence of delays is less in the summer months than in the winter months and early spring. The reason for this are not clear, but may be related to staff sickness patterns. The figures deteriorate over the two years provided.

Table 6.6
15 min Delays Caused by Staff (train km per delay)

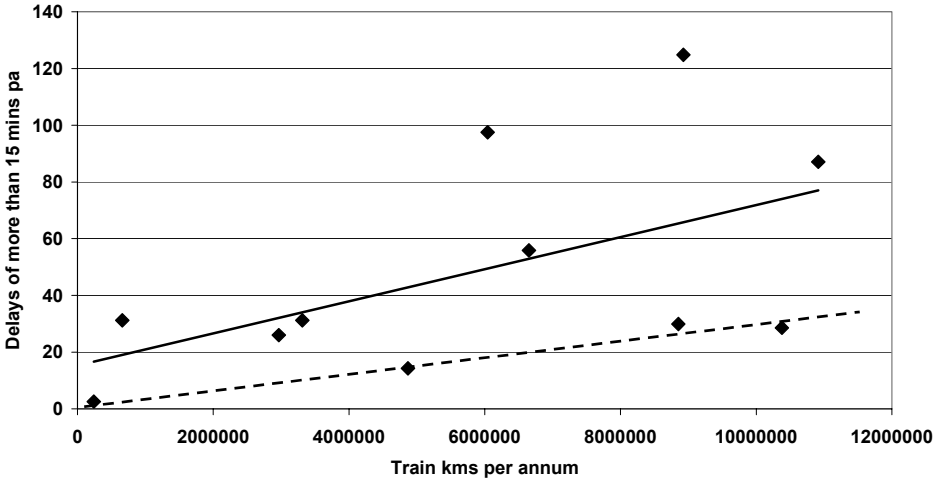
Line	2000/01	2001/02
Bakerloo	60,513	114,044
Central	188,341	296,054
District	156,615	71,531
Jubilee	179,797	119,007
East London	13,177	21,118
Northern	370,664	362,887
Piccadilly	209,889	125,307
Victoria	608,508	340,424
Metropolitan	87,560	61,966
Circle & Hammersmith	63,689	106,149
Waterloo & City	59,559	91,628
LUL Average	**140,857**	**120,598**

There is a considerable difference between lines, the difference being up to twenty-fold in magnitude. It is to be expected that the short distance lines such as the Waterloo & City and East London Lines would perform poorly under this measure as the high proportion of terminal dwell times inherent in relatively short distance shuttle operations, such as these, restricts the average distance operated per staff hour. Nevertheless the performance of the East London Line is still exceptionally poor and would appear to warrant close management attention. Other poorly performing lines include the Bakerloo, Metropolitan and District Lines, although the former has shown some improvement over the period.

As one would anticipate the Victoria Line exhibits by far the best performance. This line traditionally has had a less militant workforce than many other lines, the provision of what is virtually ATO (Automatic Train Operation) theoretically enabling drivers to be dispensed with, subject to minor modifications, may also play a rôle.

Figure 6.7 indicates the inconsistency between lines (using 2001/02 data), with the points representing the performance of individual lines, the solid line the LUL average trend and the dotted line the internal benchmark performance:

Figure 6.7
Relationship between Train kms and Staff Delays



If staff were deployed consistently between lines and achieved consistent outputs, all points should lie on the trend line. Only the Waterloo & City, Victoria, Central and Northern Lines achieve the LUL benchmark performance. All other LUL lines fail to achieve this performance by a factor of at least two.

The large variation between lines suggests that effective staff resourcing and deployment is an issue that requires urgent attention.

6.3.5. Delays due to track faults

There are two main track systems in use on London Underground; ballasted track, mainly employed on surface lines and the sub-surface network, and the system employed in tube tunnels, which traditionally involves sleeper stubs cast in the concrete of tunnel floors, although the Jubilee Line Extension uses a more modern trackslab form. There are a numerous sub-types and individual variations.

The delays caused by track problems have been analysed in the same manner as signalling incidents: by train kilometres operated and by route kilometres. As is normal for track faults, which tend to be less frequent than operational incidents, rolling stock and signalling faults, there is a very considerable variation for each line over time. Furthermore for the same reason there are also significant variations in the number of delays caused from year to year for each line. However, there is a clear pattern, which can be seen in Table 6.7.

As with the measures discussed above there has been a clear deterioration in the past year, with the number of 15 minute delays caused by track faults having increased by nearly 50 per cent.

Table 6.7
15 min Delays Caused by Track

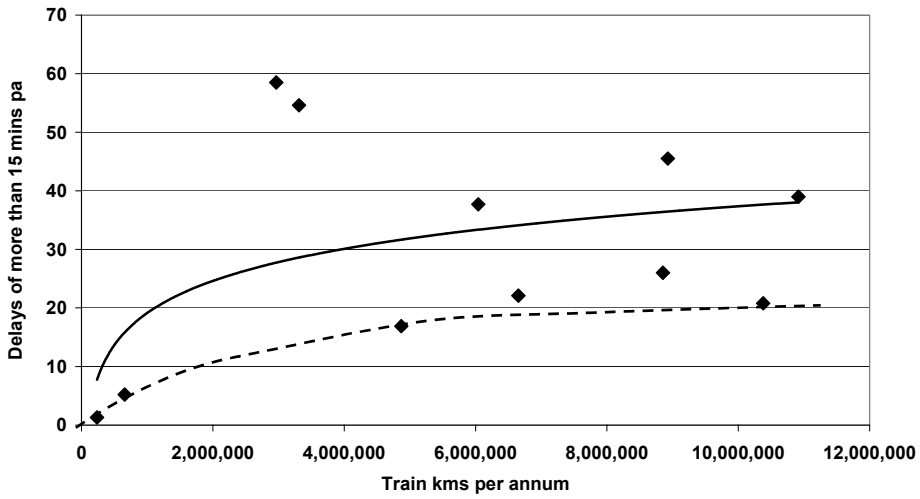
Line	Train km per Delay		Delays per Route km	
	2000/01	2001/02	2000/01	2001/02
Bakerloo	89,853	50,686	1.401	2.484
Central	553,252	340,463	0.219	0.355
District	194,066	196,198	0.738	0.730
Jubilee	739,165	301,018	0.242	0.594
East London	219,624	126,706	0.416	0.720
Northern	384,392	498,970	0.469	0.362
Piccadilly	341,069	279,852	0.460	0.560
Victoria	811,344	288,051	0.282	0.794
Metropolitan	208,333	160,256	0.463	0.602
Circle & Hammersmith	97,407	60,656	0.879	1.411
Waterloo & City	119,117	183,257	0.844	0.549
LUL Average	**269,223**	**194,775**	**0.583**	**0.883**

Once again the relatively good performance of the Northern Line is immediately apparent, this indicates the effectiveness of the "patching up" operations that LUL have undertaken pending the proposed route modernisation. The effectiveness of the extensive track reconstruction in the central tunnelled sections as a part of the Central Line route modernisation programme is also clear, although the figure is possibly being dragged down by elderly track on the extensive surface sections.

The consistently poor performance of the Bakerloo and Circle & Hammersmith Lines is equally apparent, being twice as poor as the next worse line by any relevant measure and is a reflection on the "tired" infrastructure on these lines. Once again the relatively poor performance of the sub-surface lines is apparent, with all lines tending to lie in the second half of the "league table"

The relationship between train kilometres operated and track delays can also be represented graphically, as shown in Figure 6.8, which again uses 2001/02 data. In this graph each point on the solid line represents LUL's current mean performance and the dotted line the LUL benchmark as represented by the Waterloo & City, East London, Victoria and Northern Lines.

Figure 6.8
Relationship between Train kms and Track Delays



Once again, the poor performance of the Circle & Hammersmith and Bakerloo Line is apparent (being the two points well above the trend line).

Thus in conclusion each route kilometre of London's Underground network suffers a failure causing a delay of at least 15 minutes about every eighteen months. However, track defects can also cause other problems, most notably **speed restrictions** that impose some delays on services, and deterioration in **ride quality** and hence in passenger comfort.[19]

6.3.6. Escalator and lift reliability

Table 6.8 shows information supplied by LUL on the average percentage of escalators out of service on each deep tube line at any one time.

Table 6.8
Escalators Out of Service

Line	1996/97	1997/98	1998/99	1999/00	2000/01
Bakerloo	7.4	2.3	2.6	5.6	5.9
Central	10.1	12.9	7.8	11.0	15.0
Jubilee	4.2	17.3	20.9	3.4	1.9
Northern	5.9	5.4	9.9	12.3	11.5
Piccadilly	5.1	6.2	6.8	8.4	9.2
Victoria	7.9	3.5	7.2	10.6	15.3
LUL Average	**7.2**	**6.7**	**7.3**	**8.0**	**8.6**

[19] Hearings, May 16th.

There are significant differences between the deep tube lines. The reliability rates of the new escalators on the Jubilee Line Extension are noteworthy, although the performance of the relatively modern escalators on the original Jubilee Line (see data for the first three years in the Table) is particularly poor.

Table 6.9 shows information supplied by LUL on the average percentage of lifts out of service on each deep tube line at any one time.

Table 6.9
Lifts Out of Service

Line	1996/97	1997/98	1998/99	1999/00	2000/01
Bakerloo	2.6	3.5	3.5	3.0	4.9
Central	1.8	3.2	14.5	2.6	1.8
Jubilee	0.0	0.0	0.0	3.8	9.6
Northern	2.7	6.6	3.0	2.3	1.8
Piccadilly	4.1	3.0	4.1	1.6	1.4
Victoria	0.0	0.0	0.0	1.3	0.2
Total	**3.2**	**4.2**	**5.2**	**2.7**	**4.7**

Contrary to the position with escalators, the large number of new lifts on the Jubilee Line Extension exhibit disappointing reliability figures. We hope that this is either due to "teething troubles" or the inclusion in the figures of a number of lifts on the JLE which were commissioned after the line opened. More detailed information would be required to examine either of these hypotheses. The poor lift performance of the Bakerloo, Northern, Central and Piccadilly lines is also apparent, being a reflection of the age profile of the lift stock on these lines, nevertheless these figures are still considered to be unacceptable.

6.4. Comparisons with Overseas

6.4.1. CoMET

The CoMET database includes the following indicators for reliability/service quality (top-level in **bold**):

- **revenue operating car km between incidents;**
- **car hours between incidents;**
- **car hours/hour train delay;**
- passenger hours delay/passenger journeys;
- passenger journeys on time/total passenger journeys; and
- trains on time/total trains.

In 2000, London Underground scored 8th out of 9 on the car km between incidents measure. On the proportion of trains on time, LUL score was 8th out of 8.

This suggests that London performs relatively poorly in terms of reliability, a position confirmed by LUL at their Hearing with the Committee on 18th December 2001 and May 16th 2002.

6.4.2. New York

In New York**,** reliability measures have recently been changed to better reflect the reliability experienced by the customers.

The key reliability measure is now **Wait Assessment**, defined (for metros) as the percentage of service intervals that are no more than two minutes (06:00 to 09:00h; 16:00h to 19:00h) or four minutes (09:00h to 16:00h; 19:00h to 21:00h) over the scheduled interval.[20]

At night (21:00h to 06:00h), when services are less frequent and customers are more likely to rely on schedules, a different measure is used called **Enroute On-Time Performance**. This is defined as the percentage of trips departing from all scheduled time points between –1 and 5 minutes (previously 0 to 5 minutes) after their scheduled departing time.[21]

The outturn levels for these indicators since they were introduced are contained in Table 6.10. No formal targets for these indicators have been set.

[20] The previous indicator Service Regularity was defined as the percentage of intervals between trips departing from all scheduled timepoints, not including terminals within plus or minus 50 per cent of the scheduled, where the interval scheduled interval was less than 10 minutes, or within plus or minus five minutes where the scheduled intervals was 10 minutes or more. Apart from the problem of easily comprehending this measure, it was also thought not to reflect customers' travel experience, and to be accompanied by unreasonable standards.

[21] The revised definition was introduced to allow operational strategies to minimise customer waiting time without penalty, and also to better reflect daily variations in the operating environment that can result in faster than scheduled running times.

Table 6.10
New York Key Reliability Indicators

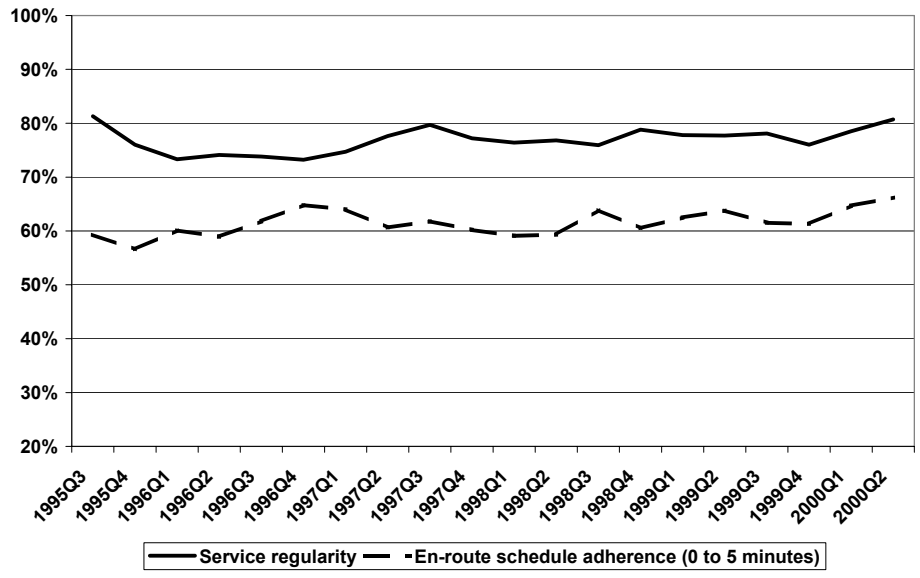
	Wait assessment	En-route schedule adherence
2000Q1	n/a	78.8%
2000Q2	n/a	80.8%
2000Q3	87.9%	78.4%
2000Q4	86.9%	80.5%
2001Q1	87.5%	79.7%
2001Q2	87.9%	80.4%
2001Q3	85.8%	77.5%

Source: New York City Transit

Although these measures are different to the ones employed by LUL, and so do not allow direct comparisons, they can provide useful insights into potential measures for benchmarking LUL performance in the future.

The scores on the old measures from 1995 until their discontinuation are shown in Figure 6.9. Service regularity was measured during daytime; en-route schedule adherence (between 0 and 5 minutes) at night. The latter measure has been slowly improving, whereas on balance, service regularity has been more or less stable.

Figure 6.9
New York Former Reliability Measures, 1995-2000



Source: New York City Transit

In addition, New York City Transit continues to measure a number of other aspects of service reliability, including

- Mean distance between failures. Although it could be argued that this is not a key indicator from the perspective of the customer, this indicator is widely used by operators because it represents a reliable and responsive indicator of system reliability. In 2000, a mean distance between failures of 110,180 miles was achieved.
- Subway 24-hour terminal on-time performance. This measure is defined as the number of trains arriving at their terminal within five minutes of scheduled arrival time as a percentage of the total number of trains scheduled during the 24-hour period. The score on this indicator has increased from 90.0 per cent in 1995 to 95.1 per cent in 2000. Fifteen years ago, terminal on-time performance was only 80.7 per cent.
- Subway throughput; the percentage of scheduled trains actually running. In 2001, a score for both rush hours of around 98 per cent was achieved, up from around 95 per cent in 1995.

6.4.3. Other cities

In Paris, reliability is regulated by means of targets for the numbers of passengers having waited less than *x* minutes. Since these targets refer to waiting time, we discuss these in the Section (7.3.3) that deals with waiting times. We have not received specific reliability figures for Paris, nor for Berlin.

Reliability figures for the Stockholm metro system are available by line, both in terms of punctuality and cancellations. On the oldest line (opened around 1950), around 80 per cent of trains are punctual, with the punctuality level being around 95 per cent on the two newer lines.[22] The proportion of cancellations on the oldest line fell from 3 per cent in 1998 to around 0.5 per cent in 2000, which is also the level of cancellations seen on the newer lines.

The Transport Consortium, which is the **Madrid** local government institution in charge of supervising and controlling the city's public transport system, establishes the minimum number of train hours that have to be run at different periods of day for the different metro lines. Table 6.11 shows data on how Madrid metro achieved these standards from 1999 to 2000.

[22] Percentage of contracted departures not exceeding three minutes after of one minute before timetable.

Table 6.11
Madrid Reliability Figures, 1999-2000

	1999	2000
Average day	99.75%	99.85%
Peak	99.34%	99.49%

Reliability in the **Barcelona metro** is measured in terms of:

- average number of car kms between breakdowns; and
- lost revenue earning car time due to incidents.

Reliability figures in Barcelona are available, in terms of both indicators. Data from 2000 to 2001 are contained in Table 6.12.

Table 6.12
Barcelona Reliability Figures, 2000-2001

	2000	2001
Average number of car km between breakdowns	30,901	31,327
Lost revenue earning car time due to incidents (minutes)	1,522	1,353

The **Barcelona metro** managers also calculate a monthly index to measure the reliability of each line for different types of day (i.e. public holidays, Saturdays, week days) at different periods of the day (i.e. 7:00-9:00, 17:00-18:30 and 19:00-21:00). The calculation of the index is rather complex and its interpretation is related to the number of trains that fulfill the established schedule. Nevertheless it is not exactly a percentage but a number that is increased in relation to the number of trains that are punctual. The Barcelona metro lines managers have the commitment of improving it each year. The index is currently being revised and it is likely that its definition will change by next summer season.

Compared to the other cities examined as part of the present study, London Underground performs relatively poorly in terms of reliability.

6.5. What Can Londoners Reasonably Expect?

Londoners can reasonably expect to have a more reliable system. Reliability has been declining despite the investment of recent years.[23] London Underground performs particularly badly in the CoMET comparisons of unreliability, as measured by car kms between incidents and proportion of trains on time, and London's poor performance was confirmed by LUL at their Hearings in December and May. Analysis of London's reliability statistics shows the wide range of factors contributing to poor performance. All of these factors need to be addressed.

A number of current initiatives should improve reliability, including those involving signalling and route modernisation.[24] However, we believe that Londoners can also expect short-term improvements in reliability through better management of the existing system.[25] This can be achieved through arrangements to incentivise good performance, better use of diagnostic analysis of statistics on causes of poor unreliability to target remedial actions, and better train regulation. Good examples of this are actions to improve staff attendance (London Underground gave an example of this at their Hearing on May 16th, where they explained how they had set up teams to visit each train crew depot, monitor performance, and transfer best practice in managing problems arising from drivers not turning up for work). Short term improvements in reliability would provide the best means to improve the service that Londoners currently get from their Underground – and short-term management action may be the most cost-effective way to achieve this.

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[23] However, at the May 16th Hearing LUL noted that their reliability statistics for the first four-week period of the 2002/03 Financial Year are the best for over two years.

[24] In addition, LUL have indicated that improved management information systems that have been introduced on the Central, Northern and Jubilee lines can improve train running - and are particularly valuable when there are disruptions to services so that trains need to be reversed – under the alternative manual system staff had considerable difficulty in keeping track of the location of particular trainsets and crews. LUL have proposals for extending these management information systems.

[25] LUL have indicated that they expect significant improvements in reliability on both the Circle and Piccadilly lines from September 2002 through introduction of new timetables on the Piccadilly, Metropolitan, District, Hammersmith & City and Circle lines. These timetables are intended to provide service patterns that are more realistic to achieve in practice than are the present ones.

7. WAITING AND JOURNEY TIMES

7.1. Introduction

Reducing waiting and journey times, particularly by increasing the frequency of trains and reducing the number of delays is an area to which customers attach a very high priority. For example, the Londoners Survey Report conducted in 2000 on behalf of LUL identified increased train frequency as the number one priority for passengers, followed by less overcrowding and fewer delays. Reducing delays was dealt with in Section 6 on Reliability. Here we concentrate on other aspects of waiting and journey times.

Firstly, we turn our attention to train frequency. A key point to note is that increasing train frequency is not only desirable in the eyes of customers in that it helps to reduce waiting and journey times for customers, but also because reducing the time between trains (the "headway") is the most significant way of increasing the capacity of the system, and therefore helping to reduce overcrowding which is another key customer priority.

We then go on to consider ticket queues and total journey times.

7.2. London Performance

7.2.1. Train frequency

Train frequency levels vary by line and by time of day, from 29 trains per hour on the Central line in the peak, to six on parts of the Metropolitan Line in the off-peak. The table below illustrates the variation for a selection of lines.

Table 7.1
Train Frequencies

Line	Peak frequency (trains per hour)	Off-peak frequency (trains per hour)
Central	29	18
Victoria	28	18
Jubilee	24	16
Piccadilly	27	21
District	22.5	17.5
Metropolitan (Baker St – Aldgate)	15	6
Circle	7.5	7.5

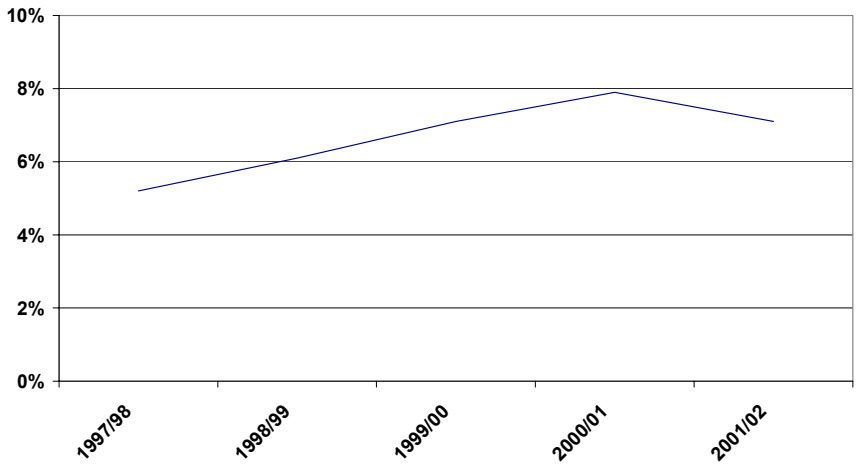
LUL's statistics report that the average chance of waiting for a train for less than five minutes is currently 80 per cent (compared to 81 per cent a year ago, and an average of 82 per cent in 1999). The chance of waiting for a train over 10 minutes is 5 per cent, and over 15

minutes 1.5 per cent. (However, note that these figures exclude extended periods of suspended service – eg due to adverse weather or industrial action).

7.2.2. Ticket queues

Figure 7.1 shows that the proportion of customers waiting in a ticket queue for over three minutes has risen since 1997/98 from 5.2 per cent to 7.9 per cent in 2000/01, falling to 7.1 per cent in the past year. The percentage chances of waiting more than three minutes vary from line to line, with the highest figures recorded on the Victoria line, where the figure was 13.6 per cent for 2000/01. The lowest figure in 2000/01 was 1.8 per cent on the East London Line, but the lowest figure on what might be considered the more "generally representative" lines was around six per cent (Central and Bakerloo lines).

Figure 7.1
Percentage of Customers in Ticket Queues for More Than Three Minutes



Waiting as a result of service delays, and escalator/lifts out of service was considered in Section 6 on Reliability.

7.2.3. Journey times

When measuring journey times, London Underground employ a "journey time metric" which weights the different parts of a typical customer's journey according to the relative importance customers attach to that part of the journey. For example, customers dislike spending time walking up stairs and queuing for tickets more than they mind spending time walking to the platform or travelling on the train, so the former get a higher weighting than the latter. This means that journey times shown are weighted times, rather than actual times.

London Underground's September 2001 Performance Report to the Rail Transport Advisory Panel reports that excess (ie, over scheduled) journey times have shown successive improvements over the last 18 months.[26]

Table 7.2 shows London Underground weighted average journey time statistics from 1999/00 to the year to date. It shows that while weighted journey times increased from 1999/00 to 2000/01 due to a rise in excess journey time, in the year to date, weighted excess journey time has fallen overall compared to the previous year. The table also shows that weighted excess journey time due to trains makes up the single biggest component.

Table 7.2
Average Journey Times (minutes per journey)

	1999/00	2000/01	2001/02 (to date)
Scheduled journey time	35.4	35.4	35.4
Excess journey time	6.8	7.5	7.2
Stations excess	2.2	2.4	2.4
Trains excess	4.1	4.5	4.4
Closures excess	0.5	0.5	0.4
Total journey time	**42.2**	**42.8**	**42.6**

London Transport Market Planning report that on District Line surveys, on average, 48 per cent of journey time is spent on the train, 29 per cent on access, egress and interchange, and 20 per cent on platform waiting, with ten per cent of time taken up by closures, and two per cent by ticket purchase.

7.3. Comparisons with Overseas

7.3.1. CoMET

The CoMET database does not include specific indicators for waiting and journey times.

7.3.2. New York

In New York, there is a basic policy to provide maximum intervals of 10 minutes during weekday peak hours, middays and Saturdays; 12 minutes for evenings and Sundays; and 20 minutes for nighttime services. On the New York system, most services are more frequent in practice, partly because sticking to the basic policy guidelines would fail to meet the loading standards to be described in Section 8.3.2. Since New York also has many lines running in parallel (of which some may provide a stopping service and others may not),

[26] The Rail Transport Advisory Panel is a Transport for London body.

overall frequencies from key stations will also be much higher than the individual line frequencies suggest.

London Underground's planned train frequencies imply a service at least every five minutes in the central area, increased to at least one every three minutes in the peak (LUL's target is to provide a service at least once every ten minutes on the network as a whole[27], and once every five minutes on the "core network"). Although we have not undertaken a detailed analysis, our impression is that average scheduled waiting times on key New York stations will be similar to those seen at key stations in London. Service levels at smaller stations in New York are probably below those seen in London due to the widespread occurrence of fast services. On many flows, fast services will however reduce journey times.

We note that fast and skip-stopping services in New York are feasible because of the widespread availability of quadruple-track underground railways in the city, unlike in London. New York therefore has an inherently more effective structure for meeting demand between key origins and destinations, albeit at the expense of less popular destinations and the consequent need to change for some single line trips.

7.3.3. Other cities

Peak service intervals in **Paris** are generally between 1.5 and 2 minutes. During the middle of the day, headways are around 3.5 minutes, whereas trains run every 7 or 8 minutes during late evenings. A somewhat reduced service operates in the summer months.

Metro services in Paris since January 1st, 2000 have been regulated by means of a contract between the regional transport authority STIF and the operator, RATP. Among other things, this contract includes waiting time targets. For the metro, these refer to:

- during peak hours; the percentage of travellers waiting less than 3 minutes;
- during off-peak hours: the percentage of travellers waiting less than 6 minutes; and
- during night-time: the percentage of travellers waiting less than 10 minutes.

These can therefore be regarded as the service standards that Parisians can expect as far as waiting time is concerned. They can also be regarded as a target for reliability.

Trains in **Berlin** generally run every 3 to 4 minutes during peak hours and every 5 to 10 minutes during the off-peak.

The standard for average waiting time on any of the **Madrid Metro** lines is that no passenger should wait more than six minutes for the 6:00 to 22:00 period. On most lines,

[27] Limited to once ever 15 minutes on a few, specific routes.

trains run every 2-3 minutes in peak hours and every 4-6 minutes during the day. On one line, the peak headway is only 90 seconds (1.5 minutes), implying 40 trains per hour.

In **Barcelona**, trains run every 3 to 4.5 minutes during peak hours. Off-peak intervals are between 4 and 6 minutes, with trains running every 6 to 9 minutes during evenings and Sundays.

Peak frequency levels in Paris and on the best line in Madrid are slightly better than those typically seen on the best lines in central areas of London *in the peak*, where the highest frequencies are just below 30 trains per hour (ie just over one every two minutes on average). Typical off-peak frequencies in Paris and Madrid are broadly in line with the averages for London. In New York, frequency levels are probably similar to those seen in London, though the comparison is complicated by the widespread occurrence of fast services there. In Berlin and Barcelona, frequency levels are somewhat lower than in London, both during peak and off-peak hours.

7.4. What Can Londoners Reasonably Expect?

7.4.1. Train frequency

A comparison of current London train frequency statistics with those seen in other "comparable" metro systems suggests that London is not far off achieving world-class train frequency levels on key lines. However, there would appear to be scope for improvement in two key areas:

- firstly, increasing *peak* service train frequencies on *all* London Underground lines, where demand (ie congestion) warrants it (likely to be in Central London areas), to the peak frequencies that LUL has already demonstrated that it can achieve on some lines (eg 29 per hour on the Central line, 28 per hour on the Victoria line); and
- secondly, increasing peak service, Central London train frequencies (particularly on the most congested parts of the network).

LUL already has plans to increase frequency on a number of lines. Key examples include plans to upgrade signalling on the Northern, Piccadilly and Victoria lines over the next 15 years (in some cases as part of a wider refurbishment). LUL intend to further increase frequency to 33 trains per hour on the Central line, and to 24 trains per hour on the Jubilee line. London Transport's Managing Director indicated at their second hearing and in

subsequent written evidence that he believed that there is at present not the technology in a deep tube environment that is capable of operating more than 33 trains an hour.[28]

Comparisons with systems overseas and engineering estimates suggest that LUL could make some improvements to train frequency over those planned, but that on some lines in particular, these would be relatively small and would not on their own "solve" current or forecast capacity problems. For example, it is estimated that with "state of the art" lineside signalling technology, LUL might be able to increase train frequencies to around 36 trains per hour per direction (tph). The introduction of cab and moving block signalling could increase this to an absolute maximum of around 42 tph further into the future (the final figure will be driven by the detailed constraints on each line and the degree of timetable robustness sought but we expect it to lie in the 40 to 45 tph range for each line). But improvements much beyond these levels are unlikely to be feasible in the foreseeable future and indeed such figures are very close to the ultimate physical constraints imposed by station dwell times and rates of train acceleration and deceleration that are commensurate with passenger comfort.

To give an example of the extra capacity that such initiatives would create, we will consider the Victoria Line. Assuming that all trains were loaded at LUL's capacity planning levels of one person standing to one sitting, the capacities would be as follows:

- current capacity (28 tph) 17,204 pax/hr pd
- as LUL benchmark (29 tph) 17,632 pax/hr pd(+3.5 per cent)
- 33 tph 20,064 pax/hr pd(+16.6 per cent)
- 36 tph 21,188 pax/hr pd(+27.2 per cent)
- 42 tph 25,536 pax/hr pd(+48.4 per cent)

Note that the above relate to LUL's capacity planning levels. In practice the achievable capacities are somewhat greater, particularly at "crush" loadings (standees generally taken as 6 pax/m^2 for design purposes in the UK).

There are two important points that should be borne in mind when considering the above. Firstly, frequency increases involve considerable investments in signalling and rolling stock and have lead times of several years, indicating the vital necessity of formulating a long-term vision for the system and having a coherent mechanism for implementing it. Secondly, these are "one-off" benefits, which once achieved take one close to ultimate line capacity, although some less significant capacity increases are also available through innovative rolling stock design. Beyond these levels, further capacity increases would have to come in the form of new lines.

[28] Hearing, May 16th.

It is also important to note that increases in capacity must be considered in a holistic way. For example, increasing capacity by increasing train frequency also requires adequate capacity at key stations to cope with the greater flow of passengers. On some lines (eg the Piccadilly and Victoria lines with relatively narrow platforms) careful assessment would be needed as to whether station design poses any further constraints to capacity expansion. It should be noted however that not only would the installation of platform edge doors generally improve passenger safety, but they can also be expected to enable additional passengers to be accommodated on platforms.

In sum, Londoners should be able to reasonably expect greater train frequencies in the peak than those that they currently receive, on some lines in particular and especially in the centre of London, if London Underground is to be classed as a "world class" system. LUL's current plans to upgrade signalling systems on a number of lines should make significant improvements to current frequency levels, but, were it to have the appropriate levels of funds, LUL could arguably do more. Quite apart from service quality issues, improvement in train frequency is the key method available to increase system capacity, since civil engineering constraints generally preclude train length increase as a practicable option (the Jubilee Line being an exception) and the benefits available from innovative rolling stock design are smaller.

7.4.2. Ticket queues

The statistics presented above point to a trend increase in the proportion of people waiting more than three minutes to buy a ticket. The underlying data also points to a significant variation in performance between lines. While particular characteristics such as the number of people using a station and the size of the ticket hall can impose constraints on the best performance particular stations might achieve, and while increase in demand also makes it "tougher" to achieve any particular standard as time goes on, it would seem reasonable but challenging for Londoners to expect ticket queue performance levels similar to those currently achieved on some of the better performing lines, ie around a six per cent chance of waiting more than three minutes to buy a ticket. This would equate to a level of performance that LUL has *already achieved* across the system in general in 1998/99, and which it managed to exceed in 1997/98. LUL's current and planned initiatives, including the introduction of the Prestige ticketing system and the recently rolled-out new ticketing machines, should help it to achieve better performance, but careful monitoring is likely to be desirable. Extension and effective promotion of initiatives that enable tickets to be purchased outside station areas and to reduce the numbers of tickets purchased (eg multi-use tickets and smart cards) will be key to achieving this strategy in the context of the greater number of passengers using the system and to achieving the higher pedestrian flow through stations required. As with much else on London's Underground system, minimisation of ticket queuing is part of a "virtuous circle" enabling the system to perform better and improving the experience for customers.

7.4.3. Better train regulation

The primary causes of lack of journey time predictability on metro type systems is irregular train headways, which generally becomes a vicious circle as late running trains become more and more overcrowded as station dwell times become more and more protracted as they lag further and further behind the preceding train. This has a number of effects, on journey time predictability and wait times, on safety, on capacity (the late running train delays following trains, thus losing peak train mileage), on reliability and on overcrowding. LUL's line control and signalling centres have the job of regulating trains. It is clear to even casual users that this process is imperfect. Much of the problem arises from variability in train driving style and on drivers' tolerance to passengers attempting to board trains that are already full or to open doors for late arrivals. The problem is then that the drivers who are least able to recover from delays end up driving the late running trains. The enforcement of a consistent driving style and better regulation of late running trains (possibly even involving skipping less busy stops, after a suitable prior on-board announcement) is a management issue. It is considered that this should be a priority area, since it is a way of improving the customer experience, safety, capacity and reliability that is achievable both without major investment and is rapidly implementable. London Underground have indicated that they are addressing this issue by training their drivers to drive in a similar way.[29] One further solution is Automatic Train Operation (ATO), recently introduced on the Central Line.

[29] Hearing, May 16th.

8. CROWDING AND CAPACITY

8.1. Introduction

Reducing overcrowding features consistently as one of the highest priorities for improvement identified in customer surveys on the London Underground. As Section 8.2 illustrates, London Underground currently suffers excessive levels of crowding both on trains and in stations on a fairly regular basis, predominantly in peak hours.

8.2. London Performance

London Underground measure crowding using three key measures: the percentage chance of being on a train with (i) all seats full; (ii) one person standing for every person sitting; and (iii) two persons standing for every person sitting. LUL differ in this respect from other metros such as Paris and New York, where crowding statistics look at the amount of standing space (in m^2) that each person has. However, it would appear that there are logical reasons for this difference. As mentioned earlier, the average journey length on the London Underground is significantly longer than that on many other metro systems, so that the availability of seats is a more important aspect to performance in London than might be the case on some other systems (eg Paris in particular). LUL's current measure aims to take this factor into account. It is however arguable that separate standards should be applied to the Central Zone that are more akin to those used in other cities, for example a passenger travelling from Oxford Circus to Victoria has entirely different needs to one travelling from Amersham to Baker Street, particularly in respect of the availability of seating and the average amount of personal space that he/she has.[30]

Trend data on crowding measures covering several years have not been made available from London Underground, but comparisons of figures for the first half of 2001 with those for 2000 and 1999 are possible, shown here for the peak in Table 8.1.

Table 8.1
Peak-time Crowding Statistics

	First half 2001	2000	1999
% chance of all seats full	61	60	60
% chance of 1 standing to every 1 sitting	n/a	19	15
% chance of 2 standing to every 1 sitting	n/a	2	1

Source LUL

[30] At their May 16th Hearing, LUL indicated that they are able to produce figures to show how crowding varies by section of line.

Crowding levels vary from line to line as well as between peak and off peak. For example the percentage chance of being in a peak-time carriage with all the seats full on the Piccadilly line was 77 per cent in 2000/01, but only 27 per cent on the Bakerloo line. As might be expected, off-peak data shows much lower crowding probabilities, with the average probability of being in a carriage with all the seats full around 16 per cent.

Evidence provided to the Committee has also raised the issue of the safety implications of overcrowding. Tube trains are designed to carry more weight than would be reached even in an extremely crowded carriage, and so there are no *direct* safety implications in terms of operational issues (eg breaking speeds/distances). However, crowded conditions undoubtedly contribute to discomfort and in some cases illness on tube trains, particularly in warm weather. Evidence received also pointed to safety implications in stations, for example the recent upward trend in injuries sustained on escalators, to which overcrowding has been a significant contributory factor.

Crowding on platforms can also create problems and safety concerns.[31] Some of the busiest stations, in particular Victoria, are sometimes closed because of crowding on platforms. Each station on the network has an emergency and congestion plan which covers all issues relating to emergency planning and control of congestion. Each plan details the pinch points on the station, and defines the measures by which each station would be classified as congested. These plans have all been validated by LUL's Safety Quality and Environmental department.

Congestion within the station is generally dealt with by staff monitoring conditions on platforms and introducing crowd control measures once free movement along the backs of platforms is lost. This action can include shutting off escalators or some of the entry gates, or shutting some station entrances, up to full station closure. The crowd control procedures are set out within LUL's operational rule book. LUL have stated to the Assembly that they believe that the process is both procedurally robust and that in practice it works well.[32]

8.3. Comparisons with Overseas

8.3.1. CoMET

The CoMET database contains the following capacity-related indicators (top level in **bold**)

- **capacity km/route km;**
- **passenger km/capacity km;**
- passenger journeys/station; and

[31] See also section 5.2.1 above.

[32] *Further Information for the London Assembly - Tube Future Priorities Investigative Committee* LUL Ltd, June 2002.

- proportion of cars used in peak hour.

On the passenger km per capacity km operated measure, LUL ranked 9th out of 9 in 2000 (ie it had the lowest average crowding conditions). In part, this reflects the suburban nature of much of LUL's network, with load factors at the outer ends of routes often relatively low. Most other systems in CoMET are more urban. It would therefore be misleading to attach too much weight to this statistic alone.

8.3.2. New York

New York City Transit's decisions as to how much capacity to offer are principally based on its rapid transit loading guidelines, developed in 1988. These guidelines prescribe the minimum amount of subway service that will be scheduled to meet demand. Since train lengths are usually fixed, capacity adjustments are mainly made by varying frequency levels.

Key points from the guidelines are:

- During peak hours, a minimum standing space of 0.28m² (3 sq. ft) is specified at the maximum loading point. This guideline provides for scheduling around 65 per cent of actual observed maximum loadings. The difference with the observed "crush" capacity allows for uneven distribution of passengers among the cars of a train, and for small service irregularities.
- During midday and on Saturday, a seated load is provided at intervals of four minutes and more. For more frequent intervals, a seat will be provided to one-half of the *additional* passengers generated by the frequency increase. The same is true for weekday evenings and Sundays, although at intervals of four minutes and more during these times, vehicles will be scheduled to carry ¾ of a seated load.

8.3.3. Other cities

In **Paris**, crowding guidelines have been agreed between the operator, the transport authority and consumers' associations. In the guidelines, minimum standing spaces for the various periods of the day are specified as follows:

- peak: 0.25m², failing which the interval between two trains must be less than three minutes;
- shoulder: 0.33m²; and
- off-peak: 0.50m².

The guidelines also determine the required *likelihood* that a customer is carried in these or better conditions. The requirement varies between 80 and 90 per cent, according to the period of the day.

The guidelines in **Madrid** are that the average standing space per passenger in any of the Madrid metro lines has to be higher than 0.16 m^2 at any time of the day. This parameter combined with maximum allowed waiting time (six minutes) is the reference used to define the minimum transport services to be offered by the Madrid metro. Table 8.2 shows data on the standing space of the different Madrid metro lines at the peak hour in 2001, both on the *averages* by line and on the standing space on the *busiest section* on its line. It can be seen that on two lines, the standing space at the peak hour on the busiest section is at the 0.16 m^2 minimum level.

Table 8.2
Standing Space in the Madrid Metro Lines at the Peak Hour, 2001

Madrid Metro Lines	Average standing space (m^2)	Standing space at sections with highest demand (m^2)
1	0.23	0.20
2	0.30	0.20
3	0.22	**0.16**
4	0.23	**0.16**
5	0.32	0.29
6 I	0.20	0.17
6 II	0.31	0.28
7	0.36	0.36
8	1.38	1.16
9	0.28	0.21
10	0.23	0.20
11[33]	16.6	4.00

8.3.4. General

Another measure of metro capacity levels is the average seat occupancy and car occupancy. Average 1995 figures for these two indicators for London and our comparator cities shown in Table 8.3.

[33] The 11 Madrid metro line has been recently opened and the demand level is still very low.

Table 8.3
Average Seat and Car Occupancy on Comparator Systems, 1995

	Car occupancy (passengers/car)	Seat occupancy (passengers/seat)
Paris	26.6	1.09
Madrid	24.8	0.90
Barcelona	24.1	0.75
New York	19.6	0.57
Berlin	18.2	0.35
Stockholm	17.3	0.36
London	17.0	0.39

Source: UITP Millennium Cities Database for Sustainable Transport

Although Table 8.3 suggests that London's underground is less crowded than most of our comparator systems, as noted above, the above figures need to be evaluated in the context of the different characteristics of the various systems. In particular London Underground operates a system of a more suburban nature than most of the comparator cities. Passengers on long trips into the outskirts of the city, which can take up to one hour, require a seat for at least part of their journey. The desire to maintain certain frequency levels on outer ends of routes means that trains to the suburbs will normally tend to be emptier on the outer ends of the routes.

These factors will reduce London's averages in the Table, without necessarily implying that Underground trains in London are less crowded than in other cities on the central sections of the system.

A comparison of crowding levels between our comparator cities and London is difficult because of the suburban nature of London Underground's network and the consequent longer average journey lengths. London Underground's crowding measures are therefore different than those in other cities, where crowding statistics look at the amount of standing space that each person has.

8.4. What Can Londoners Reasonably Expect?

Evidence provided to the Committee identifies reducing overcrowding as a key priority. Direct comparisons with overseas are difficult, given the differing measures of overcrowding used and differing cultural attitudes to overcrowding levels. However, it is very clear that Londoners at least *desire* reductions in current level of crowding, and it is reasonable to expect that at a minimum, they should not get any worse.

Improving reliability and increasing service frequency are two key ways to increase capacity in the short to medium-term, and these are discussed in the Sections on Reliability and

Waiting and Journey Times. Those providing evidence have confirmed improving reliability as the key *short term* way in which overcrowding can be minimised, a view that is echoed in the Mayor's Transport Strategy.

However, as the Mayor's Transport Strategy sets out, *even with upgrades to the existing network*, the problem of overcrowding on the London Underground is set to get *worse* over the next ten years. Planned upgrades to the network are estimated to yield a maximum of an eight per cent increase in capacity between 2001 and 2011. Demand is expected to grow in this period by *seventeen* per cent.[34] There will be some sections where crowding will get worse: London Underground indicated that over the next few years increases in loadings on the Jubilee Line will mean that it will become the most crowded line on the network (though capacity enhancements will then alleviate this).[35]

If Londoners are to be provided with an Underground system where overcrowding does not continue to get worse, and, where possible, should be reduced as passengers clearly desire, the only option available is significant further investment in new capacity by *extending* the network.

Currently, extensions to the network are planned through the following major schemes:

- **East London Line Extension** – due for completion 2006.
- **Thameslink 2000** – running North-South, due for completion around 2008. With current design plans, it should provide up to 24 trains per hour through Central London, yielding 33,000 extra seats between Farringdon and Blackfriars during the weekday morning peak. Access to and capacity in London Bridge, Blackfriars and Farringdon stations should also be expanded.
- **CrossRail** – running East-West, and due for completion in 2011 – it should have the capacity to carry at least 150,000 people during the weekday morning peak, taking pressure off current Underground lines. It should also reduce East-West journey times significantly. Together with Thameslink 2000 it will provide London with an equivalent to Paris' RER system.
- **Hackney-South West Line** – running roughly North East to South West, due for completion in 2015 – expected to reduce current overcrowding on the Victoria Line, and to increase capacity in Central London by six per cent, carrying approximately 125,000 passengers during the weekday morning peak.
- **Extra Thames river crossings** (timing to be determined) – three possible crossings are currently under consideration, with TfL affording highest priority to a rail crossing at Woolwich.

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[34] *The Mayor's Transport Strategy* section 4C.56

[35] Hearing, May 16th.

In addition, TfL has plans for a number of "intermediate mode schemes" that are bus and tram based.

Details of these schemes are provided in the Mayor's Transport Strategy, including some estimates of the extra capacity that they with create (section 4Q). All schemes (except for the extra river crossings) are currently in the design and consultation phase. While indicative timescales for completion have been given, these are at present only estimates, and are subject to appropriate levels of funding being secured. There has been a worrying tendency for major capital projects to slip. Of the schemes identified above only the East London Line has commenced, this is despite plans for the others having been under detailed development since the late 1980's. The introduction of the SRA has brought an additional player into the field and appears to have been accompanied by further delays to major projects. Work on Thameslink 2000 is now expected to commence in 2003 whilst Crossrail is now listed in the SRA's lowest category of "Priority Projects" as one of the "Schemes for further development" and no longer has an implementation date against it,[36] this is despite the detailed design work having been largely completed almost a decade ago. However, if overcrowding on the Underground is to be prevented from getting worse, it is vital that schemes such as these go ahead.

The only other way of reducing pressure on London's Underground system is to improve or introduce alternative modes so as make them more attractive to potential users. To some extent initiatives to accelerate bus journey times are likely to have some impact. However, the introduction of efficient new modes such as high quality Light Rapid Transit (LRT) systems to Central London can be expected to have the greatest impact in removing short distance trips from the most intensively used parts of the system, as a supplement to the new lines discussed above.

[36] Source SRA Strategic Plan, January 2002

9. PROVISION OF INFORMATION

9.1. London Performance

Evidence received from passenger groups and the results of passenger surveys (such as London Underground's 2000/01 Customer Satisfaction Survey) show that current satisfaction levels with the provision of information are generally high, particularly for "static" information such as maps and signage, both at stations and on trains.

The area customers are least satisfied with is the provision of "dynamic" or "real time" information. LUL's use of dot matrix displays, and station and train announcements were welcomed by those providing evidence. However, key suggestions for how LUL might further improve performance included:

- more consistent use of on-train announcements, particularly when there are delays. Respondents remarked that some drivers already do this very well, and that extending the practice to all drivers would improve things further (perhaps by putting greater emphasis on this point in driver training);
- improved use of the PA system at stations, particularly for providing real-time information. It was also noted that PA announcements are sometimes inaudible and that staff might benefit from better training on how to speak more clearly over the PA system;
- more regular updates to "real time" information on service delays presented on whiteboards and dot matrix displays, for example, in ticket halls. It was noted that passengers often have the impression that the information provided by these means is out of date;
- in some cases dot matrix displays are not readily visible due to, for example other signs obstructing the view, or due to their location at one end of the platform only. This situation might be improved by careful consideration over the location of displays, and, if necessary, by installing more displays per platform particularly at very crowded stations.

Information provision was an issue raised by many of the representatives of groups with disabilities. This report considers initiatives to improve information provision for these groups in particular in the Accessibility chapter.

9.2. Comparisons with Overseas

9.2.1. CoMET

The CoMET database does not include specific indicators for information provision.

9.2.2. New York

In its Passenger Environment Survey, New York City Transit has included a number of specific indicators measuring the quality of information provision in its trains and stations. These are:

- cars with all system maps correct/legible;
- cars with all signage correct;
- cars with public address announcements;
- stations with legible/correct system maps;
- stations with correct Passenger Information Centre;
- stations with control areas with a correct subway map available; and
- station delay announcements: understandable/correct.

We note that the Passenger Environment Survey is very detailed, and also the fact that the results of the survey are always published, allowing maximum external scrutiny of New York City Transit's performance. However, the survey only includes outturn values for the indicators without setting targets for them.

We do not present New York City Transit's performance on these indicators here since it would not be possible to compare any of these scores with the other cities or London. However, detailed figures are available in Appendix D.

9.2.3. Other cities

- We have not been able to obtain useful information on the provision of information for any of our other comparator cities.

9.3. What Can Londoners Reasonably Expect?

Satisfaction with "static" forms of information is already high on London Underground. Londoners should reasonably be able to expect that these good standards are maintained.

However there are problems with the provision of dynamic information to keep passengers informed. There are a number of initiatives that LUL could take to improve dynamic

information, including greater consistency in the standards of announcements on trains and in stations, and ensuring that real time information is kept as up to date as possible. In their evidence at the final hearing, LUL indicated that information provision was one of the two areas (the other being reliability) where they were most unhappy with their present performance. They indicated that they were just about to launch a system to improve this without any reliance on improved technology, but rather through levelling up to best practice by better use of staff, by better motivation, and by staff training and monitoring. In view of the lack of consistency in quality of provision of information noted in section 9.1, this is much to be welcomed – as a consequence Londoners should expect short-term improvements in the information they receive as they make their journeys, and especially for those particular journeys (but hopefully fewer ones) where problems are experienced.

10. ACCESSIBILITY

10.1. Introduction

This Chapter considers issues related to the accessibility of the Underground system to those with disabilities.

10.2. London Performance

As part of this Scrutiny, the Committee received both oral and written evidence from groups representing disabled and mobility impaired passengers, as well as from LUL. This section examines LUL's performance on a number of key areas affecting accessibility.

10.2.1. Step free access

The age of the London Underground system, the fact that many stations were designed and built long ago, the existence of deep tunnels, and planning, heritage and space restrictions all contribute to the fact that currently, only a small proportion of LUL's stations can be classed as truly "step-free". Data provided by LUL indicates that at present, 36 (13 per cent) out of the total of 275 stations provide step-free access from street to platform. A further 15 (5 per cent) have partial step-free access. London Underground's current policy is to introduce step-free access at all new stations, and to introduce it where possible (eg where funds allow) at other stations when they undergo major refurbishment. LUL's current 15 year investment plans do not include the rolling-out of step-free access to all stations, though they do have plans to develop a "Key Network" of step-free stations over the next twenty years. They estimate that completion of this "Key Network" will allow 42 per cent of all journeys to be wholly step-free.The evidence received by the Committee indicates that groups representing those with disabilities largely accept that complete step-free access is a long-term goal rather than one that can be attained in the short to medium term. However, passenger groups raise concerns about the fact that the stations being converted for step free access during station refurbishments are those that are "easiest" to convert, rather than those that would be particularly useful to mobility impaired passengers. It was suggested that converting a few stations at key locations in the centre of London would be more effective in increasing accessibility.

It is noted that there are two dimensions to the problem: vertical and horizontal step distances. The desirable dimensions for both are a maximum of around 50 millimetres, this is very difficult to achieve even for new construction due to the lateral kinematic movements of the train, and, vertically, the need to keep boarding sill levels above platform edge level for all conditions of loading and wheel wear to eliminate the potentially dangerous trip hazard that would otherwise occur. These considerations dictate that step free access is dependent on having platforms that are straight and on a constant gradient. Many of London's Underground platforms cannot meet these criteria and thus cannot be provided with step free access sensibly. It is however considered that stepping distances can be

reduced through innovative rolling stock design; the technology for shorter lower floored fully articulated rolling stock is now available. Platform edges could be fitted more closely to this type of rolling stock in "problem" stations. Such rolling stock should also have a higher capacity but of course would require substantial investment.

Groups representing those with disabilities pointed to the fact that lifts and escalators out of order further compound accessibility problems for the mobility impaired. Where possible, advance warning of eg lift maintenance would be particularly useful to such groups.

10.2.2. Rail vehicle accessibility

New Rail Vehicle Accessibility Regulations (RVAR) apply to all new trains entering service after 31st December 1998. However, new trains built for the Central, Northern and Jubilee lines were all in production before December 1998, and so are not covered by the regulations. Around the time that the RAVR were formulated, LUL was procuring the new Northern and Jubilee line fleets, and have indicated that they attempted to ensure that the trains complied with the spirit of the regulations within design constraints of the trains. The regulations do not currently apply to existing trains, nor to refurbishments of stock.

10.2.3. Staffing issues

Several groups representing those with disabilities suggested that having more staff available to provide help, including on the platform, who are better trained in assisting disabled passengers would improve current levels of accessibility significantly. It was suggested that the current, general, disability awareness training that LUL staff receive could be further improved with more training on how to actually assist passengers. Increased availability of staff would also reduce fear of crime by those with disabilities and the elderly, who frequently report feeling particularly vulnerable. This again appears to be an issue of sub-optimal deployment of staff at present. LUL have indicated that they will ensure that disability awareness training will be given to staff who carry out customer-facing duties at stations and on trains, with specific guidance on communicating with disabled people.

10.2.4. Initiatives for those with visual and hearing impediments

Recent years have seen a number of initiatives taken by LUL to improve accessibility, and, particularly, safety, for those with visual and hearing impairments. Examples include "doors closing" chimes, high visibility and tactile platform edge markings, barriers at the ends of platforms to help prevent passengers accidentally going onto the track, and "skirts" between train carriages to help the visually impaired distinguish these gaps from door gaps (but mainly to discourage train "surfing"). These initiatives were very much welcomed by those providing evidence to the Committee on behalf of disabled users.

A number of further potential improvements to information provision for those with visual and hearing impediments were suggested to the Committee. These included the provision

of both visual and spoken versions of information such as announcements, station stops and train destinations. The introduction of audio information in train carriages (for example on the Central line) was welcomed by disabled passenger representatives, and a desire was expressed for these initiatives to be expanded to cover the whole system. The possibility of using platform-based PA systems, and greater use of announcements by drivers were suggested as ways in which improvements might be made in the short term.

The recent improvements by LUL in the provision of visual information (for example the greater use of dot matrix displays on platforms) were welcomed by passenger groups. Suggestions for how visual information could be further improved for those with visual impairments included the use of consistent colour-coding and style of signage across the network, and the use of both upper and lower case on dot matrix displays to help the visually impaired with word–shape identification.

Other, relatively simple initiatives that could be taken in the short term include the use of tactile markings at the beginning of escalators, and the use of more colour contrast between surfaces. For example, some respondents expressed disappointment that the newly-designed Jubilee Line stations have very little colour contrast.

10.2.5. Platform barriers

A number of those providing evidence to the Committee expressed a desire that the platform barriers introduced on the new Jubilee line station platforms be extended to other stations too, pointing to the positive benefits for safety, particularly for the visually impaired. Platform barriers of this type are used on a number of the more modern metro systems around the world (for example, on parts (but not all) of the Hong Kong MTR system), though, as noted above, LUL have stressed the difficulties of installing them on curved platforms.

10.2.6. Consultation

One of the key ways suggested in which improvements could be made to the current system would be to actively consult with groups representing those with disabilities in a more formal way at the *design* stage of new/refurbished stations. Anecdotal evidence was provided to the Committee of how a failure to consult at an early-enough stage led to initiatives not being taken that would have been relatively simple and cheap to implement during construction or refurbishment. Examples included a lack of consultation at an early stage on the design of the new Jubilee Line stations (where groups representing those with disabilities were able to view the stations before opening, but only after the main construction work was finished, when it was too late to make many modifications that might have been appropriate), and failure to consult with groups representing those with disabilities on the new staff uniforms, which led some groups to complain about their visibility.

10.3. Comparisons with Overseas

10.3.1. CoMET

The CoMET database does not include specific indicators for accessibility.

10.3.2. New York

In the United States, the Americans with Disabilities Act requires in principle all public buildings to be fully accessible. However, it is recognised that it would not be cost-effective for **all** subway stations to be fully accessible.

At the moment, almost 40 stations (8 per cent) on the subway network are fully accessible. This compares to around 20 per cent of London Underground stations that currently have partial step-free access, and around three per cent that have full step free access including no step up onto the train. Under the relevant legislation, MTA New York City Transit to have 54 stations accessible in 2010 and 100 stations in 2002. For the remaining subway stations, no accessibility will be required and the law provides a formal exemption for this (except for new subway construction).

Furthermore, 80 stations (around 17 per cent) will be equipped with braille and tactile signs by 2004. Currently, only a small number of stations are equipped with such signs.

It is important to note in this context that all 4,500 buses of New York City Transit are currently fully accessible with wheelchair lifts and securing devices, public address systems, required priority seating signage and kneeling features. For the disabled, buses in New York are therefore a good alternative to the subway in many cases. In addition, a paratransit service operates throughout New York City for those people that are unable to use the conventional modes of transport. Consequently, according accessibility of the transit system to the mobility impaired in New York is less important than it is in London

Further to accessibility, New York City Transit measures the proportion of escalators and elevators that are actually in service. Typically, this proportion is between 90 and 95 per cent. In 2000/01, the average was however just under 89 per cent.

10.3.3. Other cities

In **Paris,** only the newly constructed automated Metro Line 14 is fully accessible. Total accessibility of the network is not envisaged for technical and financial reasons (although most of the newer RER express network will be made accessible). In Paris too, priority is given to making the bus network fully accessible, which is scheduled to be completed at the end of 2006.

The management contract between the transport authority and the metro operator specifies a target for the percentage escalators to be in service. The precise target has not been disclosed to us. In 2000, 93.9 per cent of passengers found their escalator in working order.

In **Stockholm**, the metro network will be fully accessible in 2003 when all stations will have lifts installed, making it possible to go by wheelchair all the way to the train. The operator is presently looking into ways to reduce the gap between the trains and the platforms, which is currently between 2 and 10 cm.

In **Berlin**, 50 metro (U-Bahn) stations are currently accessible, or around 30 per cent of the total number of stations. At these stations, the metro drivers operate mobile ramps to allow wheelchair users access to the trains. Some 40 stations are equipped with an orientation system for the blind.

Toronto provides another example of a system that has attempted to address accessibility issues, particularly step-free access, using a combination of initiatives. Like many other systems, Toronto has recognised the costs and practical difficulties of extending step free access to *all* subway stations. The approach taken in Toronto has been to ensure that lifts to platforms are provided at *key* locations (including major interchanges and central locations, such as Union Station). An network of pre-booked "Wheeltranz" fully-accessible mini buses provide a door to door service (1.4 million passenger trips were made in 1999, using a total of 220 vehicles) to help "cover the gaps" in other public transport services, and community buses that are also accessible for the mobility impaired operate on set routes, focussing on connecting homes for the elderly/mobility impaired with community centres, medical centres and shopping areas.

Eighteen per cent of the **Madrid metro** stations are already fully accessible to the mobility impaired and have been equipped with lifts, whilst architectural barriers have been removed. All Madrid metro stations are equipped with escalators.

The accessibility of the **Barcelona metro** is subject to the framework defined in the Accessibility Code of the Catalonian local government. Specifically the Accessibility Promotion and Architectural Suppression Act (Ley 20/1991) stipulates that Barcelona metro stations must be fully accessible to the mobility impaired by the end of 2005. The Act defines that a metro station is fully accessible when the mobility impaired can move from street level to the inside of a train without outside assistance.

To meet the required deadline, Barcelona metro stations are being equipped with:

- lifts fitted with intercoms, braille, and tactile signs;
- tactile markings for blind people;
- acoustic signals in ticket machines;

- tactile markings on tickets to indicate the correct orientation for insertion into ticket barriers;
- ticket barriers adapted for wheelchairs; and
- acoustic signals in trains to notify arrival at the next station.

The Act also specifies the architectural barriers to be removed and the specific parameters for the re-design of potential obstacles (i.e. height of risers in staircases).

All new metro stations constructed since 1992 have been designed to be fully accessible; 20 per cent of the remaining stations in the Barcelona metro network has already been adapted.

London Underground's policy on making stations accessible is broadly similar to that in most of our comparator cities, where a pragmatic approach is taken as well. Only the relatively new systems in Stockholm and Barcelona will become fully accessible. In both New York and Paris, however, all buses will be fully accessible, so that they provide an alternative to the metro system.

10.4. What Can Londoners Reasonably Expect?

London Underground's investment plans, and the information provided on the practical and cost implications of converting stations shows that a fully accessible Underground system is still some way off for Londoners and is highly unlikely to be achieved in anything other than the long term. Evidence received from a range of parties, including LUL, disabled passenger groups and evidence from overseas has suggested that Londoners cannot reasonably expect a fully accessible system in the next 15 years.

However, evidence also points to a relatively large number of initiatives that LUL might reasonably be expected to take to improve current accessibility levels. Key examples include:

- introducing more formal, active, and early consultation with groups representing those with disabilities in the design of new and refurbished stations;
- improving accessibility for the mobility impaired at a selection of "key" central stations;
- introducing a range of improvements for the visually impaired, such as improvements to signage and information boards, more tactile markings and increased colour contrasts;
- expanding recent initiatives such as audio announcements of train destinations and station stops across the network.

At their Hearing on May 16th LUL announced that they were about to launch a strategy for accessibility on the Underground (to be called *Unlocking London for All*) that will be made available to the Committee. Londoners can expect improvements in the accessibility of the Underground for the disabled and others such as those with pushchairs or cycles, but the complex nature of the system and the configuration of all but the newest stations[37] means that progress may seem slow and that concerns will still remain

[37] It is noticeable that the Underground's map which shows fully accessible stations reveals how they are clustered on the Jubilee Line Extension (and on the Docklands Light Railway).

11. INTEGRATION ACROSS TRANSPORT MODES

11.1. Introduction

The extent to which the London Underground achieves good integration with other modes of transport can be evaluated by looking at three key areas:

- Physical integration – the ease with which passengers can move from one transport mode to another. For example, whether bus stops are located close to tube stops and whether Underground timetables reflect bus and mainline train/DLR timetables and *vice versa*.
- Information integration – how well information on different transport modes is provided, including timetables and information on the location of other transport modes.
- Ticketing integration – the extent to which customers can switch easily from mode to another, without having to buy a separate ticket.

We consider each of these in turn below.

11.2. London Performance

11.2.1. Physical integration

London's performance in terms of physical integration is currently quite mixed. Integration with mainline train services is generally regarded as quite good. With the exception of Fenchurch Street, all major mainline train termini have direct concourse links to Underground stations and signage on the Underground indicating mainline rail links are generally good. This also generally applies to Docklands Light Railway (DLR).

Physical integration between Underground and bus services is often more difficult because of physical constraints – in many cases, especially in the centre of London, the location of station exits at road junctions means that kerb-side bus stops cannot be located directly outside station entrances.

Indeed, LTUC report that in terms of physical integration, there has been historically very little co-ordination of London Underground service planners and bus service planners, and that integration tends to be relatively poor even on more modern sites. It should however be noted that London Underground has taken steps to improve signage to bus services in recent years within Underground stations, including the provision of maps showing bus stops.

In some cases, it has been suggested that timetabling integration between transport modes might be improved. However, this is an issue for mainline rail operators as much as it is for

London Underground and generally only applies to the periphery of the London Underground network.

11.2.2. Information integration

Information integration appears to be reasonably good, with details of bus services and fares provided in Underground stations, and with signage to mainline rail stations and DLR (and in some cases bus stations/stops). London Underground maps show mainline rail, river, and DLR connections and the location of cycle storage facilities/racks. A leaflet and signs at stations indicate when and where cycles may be taken on Underground services. Telephone information lines also integrate bus, Underground and DLR service information, as does information provided over the Internet.

11.2.3. Ticketing integration

Ticketing integration with other transport modes is mixed. Pre-paid Travelcards can be used on the Underground, buses, DLR, Tramlink and National Rail. The introduction of these has been an undoubted success, but cash fares are non-transferrable. While it is possible to purchase tickets for journeys on National Rail that also extend to the Underground system, it is not possible to purchase single tickets at Underground stations that can also be used on National Rail. The introduction of "smart card" ticketing systems (Prestige) will increase the scope for fares integration for LUL and other London transport modes.

11.3. Comparisons with Overseas

11.3.1. CoMET

The CoMET database does not include specific indicators for integration across transport modes.

11.3.2. Physical integration

Comparing the degree of physical integration of the public transport systems in different cities is inherently difficult. All cities have a dense bus network that supplements the underground network. Also in all cities, main railway stations are served by the metro network, and in some cases there are good examples of integration between rail and underground networks (e.g. the RER express metro lines in Paris). Most cities also tend to have a number of Park&Ride stations. In New York, certain subway stations are equipped with holding lights, informing buses to wait for an incoming train.

11.3.3. Information integration

11.3.3.1. New York

In New York, the various modes of public transport are all advertised by New York City Transit and well integrated. The basic subway map is available at each subway stop and provides information on subways, commuter railways, ferries, airport connections and key bus routes. In addition, subway stations have posters showing New York City Transit bus and subway transfer points at each station along the route. Also, in-station signs direct passengers to nearest bus stops at major transfer points.

All schedules are also available on the integrated New York City Transit website. However, importantly, an integrated journey planner is not available.

11.3.3.2. Other cities

As far as can be inferred from a desk research study, the information integration between the various modes of transport in **Paris** is good, though perhaps not best practice. Although maps obviously contain a lot of detail already, they seem more than in our comparator cities focused on presenting the individual modes rather than integrated networks. A very good multi-modal map is however available for the disabled, showing lines and stations of all modes that are fully accessible. The website also features a good journey planner providing advice from address to address, including local maps.

In **Berlin**, the integration between the various modes in terms of information provision is excellent. Clear maps are available that focus on showing the public transport *network* as opposed to showing the individual *modes*, integrating the U-Bahn and S-Bahn systems with the tram and bus systems. As in London these maps are readily available free of charge. The maps also show clearly which stations have disabled access, which ones have Park&Ride facilities, connections with long-distance trains etc. The BVG website features a state-of-the-art journey planner providing travel advice between any two Berlin addresses, including detailed maps.

The degree of information integration of the public transport system in **Stockholm** is mixed, again as far as can be concluded on the basis of a desk study. The metro maps are very basic and do not show any information on other modes. Separate bus maps are available printed in a similar style. Both are widely available free of charge and are carried by many users. Integrated bus and metro maps are however available, though perhaps not of the same quality as can be found in Berlin. On the website, a journey planner covering all modes is available. This planner does not however allow for trips from address to address, only from stop to stop.

11.3.4. Ticketing integration

11.3.4.1. New York

Main single fares in New York ($1.50) are not integrated with other modes, though they can be used for making transfers between subway lines.

An integrated ticketing system was only introduced in New York relatively recently (in 1997). Metrocard allows either unlimited weekly or monthly trips on subways, local buses and (as additional option) express buses; or carnet-style pay-per-ride tickets. The pay-per-ride tickets are 10 per cent cheaper than ordinary tickets and offer one free transfer between subway and buses.

In 2000, the unlimited and pay-per-ride Metrocard options accounted for over 80 per cent of non-student trips on New York City Transit.

11.3.4.2. Other cities

In **Paris**, single tickets permit journeys with unlimited changes between metro, bus and express metro (RER) lines for the zones in which the ticket is valid. All travelcards and season tickets are fully integrated; they can be used on all modes.

The main €2.10 (£1.30) single tickets in **Berlin** allow unlimited transfers between all modes for a period of two hours (and can therefore be used as return tickets within this period). The €1.20 (£0.74) tickets valid up to three stops do not allow transfers. All travelcards and season tickets can be used on all public transport modes in the zones in which they are valid.

Single tickets in **Stockholm** also allow unlimited transfers between all modes within the zones in which they are valid, but during one hour only. Here, too, travelcards and season tickets are fully integrated.

In **Madrid** it is possible to buy integrated tickets that allow use of different public transport modes (suburban buses, Madrid metro, RENFE suburban railways and other transport services operated by public companies). There are two kinds of integrated tickets:

- Abono Transporte Mensual, which is a monthly ticket that can be used for different transport modes (suburban buses, Madrid metro, RENFE suburban railways and other transport services operated by public companies). Its cost is €32.30 (£18.60) (for zone A); and
- Metrobus, which is a CARNET ticket that can used to travel in the Madrid Metro and the suburban buses. Its cost is €5 (£2.90).

In **Barcelona,** it is also possible to buy integrated tickets that allow use of different public transport modes (suburban buses, Barcelona metro, suburban railways managed by the

Catalonian local government and other transport services operated by public companies). There are several kinds of integrated tickets depending on:

- the ticket validity period;
- the number of rides permitted during the validity period; and
- the number of zones.

The costs of the integrated ticket vary according to these characteristics. For instance, the price of the day-ticket that permits any number of rides within the same zone is €4.20 (£2.40), and a monthly ticket that permits 50 rides within the same zone is €23.30 (£13.40).

Case Study: Service Integration in Toronto

The Toronto subway system, operated by Toronto Transit Commission provides an interesting example of good integration between public transport services, including integration with services provided by other operators (particularly the commuter train and bus company, GO Transit).

The TTC subway system has direct links with GO commuter rail and bus services at key locations such as the city centre, and at the ends of subway lines. In some cases bus, train and subway stops are all incorporated within the same concourse. In others, bus links are provided at the exits, immediately adjacent to the subway and station concourses. In some cases "ticket paid" zones operate, where, once passengers have passed the main entrance ticket barriers, they can move freely from mode to mode, without having to go through further barriers. Where further barriers are in place, Toronto makes use of a pre-paid token system, which allows passengers to pass automatically through ticket barriers without first having to buy a ticket, in order to speed up movement. These tokens operate in addition to weekly, monthly, or annual travelcards that cover both TTC and GO services (known as Metropass).

At stations outside the city centre, a "park and ride" culture is encouraged by the provision of free parking for Metropass holders. Take up of these schemes has been so good that in some areas car parks frequently become full. Customers can pay a premium to "reserve" a car parking space if desired.

A rather unique feature of Toronto's transport integration system is PATH, the underground walking network that links directly into subway/GO stations, major shopping areas and places of work and entertainment. PATH provides a fairly comprehensive walking network for the CBD. It is particularly relevant to Toronto due to the bad winters. GO Transit have reported a close correlation between the extension of the PATH network and their ridership levels. Being able to walk to and from the GO station and their place of work without having to brave the elements has increased the attractiveness of the public transport option for many commuters.

In terms of ticketing integration, TTC has full integration between all transport modes (subway, streetcar and bus). A flat-rate fare operates on all services, and passengers can obtain free transfers between modes, so long as the journey is part of one continuous trip. Where passengers use a TTC service immediately before *and* after a GO service, they can board the second TTC vehicle for free. Special Twin Passes are also available which are valid on both GO and TTC services, which offer a discount on the cost of buying two weekly passes separately. One particularly feature to note is that Toronto achieves its current levels of ticketing integration *without* the use of any smart-card technology.

11.4. What Can Londoners Reasonably Expect?

Levels of physical integration between the Underground and other services are mixed, though signage between modes is generally good. Improving physical integration would often require significant capital expenditure, but is not possible in many cases because of road layouts and proximity of existing buildings. Further improvements might be made in the future by careful planning of the physical links between transport modes at the design stage. Some of the new stations on the Jubilee Line Extension, such as Canada Water and North Greenwich, show what can be achieved in the way of physical integration between bus and Underground services with new build (and unrestricted physical sites). But Londoners can expect relatively slow improvements in physical integration at existing stations.

Information integration is generally regarded as good. Londoners should reasonably be able to expect that current standards should be maintained. Ticketing integration on the other hand is quite patchy and evidence from overseas suggests that Londoners might reasonably expect some improvements in this area. One need is for multi-modal single journey tickets. The introduction of "smart card" ticketing systems (Prestige) should provide an ideal opportunity to do this, although smart card ticketing is not necessarily an automatic pre-requisite for improved ticketing integration.

Detailed best practice guidelines for integration between modes are already published by TfL, in association with London Underground, ATOC, and Railtrack (*Intermodal Transport Interchange for London: Best Practice Guidelines*). These provide detailed guidelines on how links between different transport modes should be taken into account both at the design stage, and in day to day operations. Examples of areas covered include accessibility, route identification and journey planning. It would seem reasonable for Londoners to expect that these guidelines are consistently and demonstrably adhered to by LUL – and that lessons from physical integration on underground systems in other countries are applied in London to improve provision of "seamless" public transport journeys.

12. COMFORT, CLEANLINESS AND CUSTOMER CARE

12.1. London Performance

London Underground Customer Satisfaction Surveys shows cleanliness to be an area with low levels of current satisfaction. For example, the Customer Satisfaction Survey for 2000/01 shows:

- cleanliness to be one of the areas that customers are currently least satisfied with, particularly cleanliness on trains;
- customer care in the form of staff available when needed records the lowest satisfaction score of all questions asked; and
- crowding and smoothness of journey, which contribute to comfort levels also record relatively low scores.

We have dealt with the issue of crowding in a separate Crowding and Capacity chapter. The issue of staff availability is discussed in more detail in our chapter on Safety and Security, but the fact that customers have commented on it and raised the issue within the context of customer case as well, further illustrates that this is an area of particular concern for passengers.

LUL have currently undertaken a number of initiatives to try and improve cleanliness, particularly litter problems. Examples include publicity campaigns encouraging passengers to dispose of litter appropriately, and the use of full-time station cleaners during peak hours at major stations.

LUL are currently aims to keep both stations and trains free from litter by collecting and disposing of litter "at frequent intervals", but actual standards achieved on sometimes fail to meet these levels, and "frequent intervals" are not precisely defined. One of the key difficulties raised in this area on trains are the logistical problems involved in ensuring that train cleaning teams are available at the right place at the right time when trains are turned round.[38]

It is understood that as a part of the proposed PPP performance régime LUL has formulated statistical methods of measuring cleanliness and has been keeping records of the resultant trends. This information has not been made available to the study team.

[38] Note that not all lines have turn-around points – for example the Circle line and the Piccadilly line Heathrow loop.

As far as graffiti is concerned, LUL's CSDS state that "*trains, stations and trackside structures must be kept free from graffiti. A train vandalised with graffiti should not be allowed to leave the depot..*" (except in the case of scratched glass graffiti). However, this Scrutiny has not uncovered any evidence of how LUL monitor adherence to these targets.

12.2. Comparisons with Overseas

12.2.1. CoMET

The CoMET database does not include specific indicators for comfort and cleanliness.

12.2.2. New York

In the quarterly Passenger Environment Survey, New York City Transit measures the following dimensions for comfort and cleanliness in subway **trains**:

- litter conditions in subway cars;
- cleanliness of car floors and seats;
- cars with no interior graffiti;
- cars with no exterior graffiti;
- cars with no graffitied windows;
- cars with no broken or cracked windows;
- lighting conditions in cars; and
- climate control conditions in cars.

For **stations**, the following indicators are measured:

- litter conditions in stations;
- floor and seat cleanliness conditions in stations; and
- graffiti conditions in stations.

As already noted in Section 9.2.2, the Passenger Environment Survey is very detailed. The results of the survey are always published, allowing maximum external scrutiny of New York City Transit's performance. However, the survey only includes outturn values for the indicators without setting targets for them.

We do not present New York City Transit's performance on these indicators here since it would not be possible to compare any of these scores with the other cities or London. However, detailed figures are available in Appendix D.

12.2.3. Other cities

The management contract between the transport authority and the metro operator in **Paris** specifies a target level for the appearance of stations, which includes odour, cleanliness, condition of equipment and lighting. The precise target level has not however been disclosed to us. In 2000, 82.9 per cent of stations met the standards set.

Table 12.1 shows the total number of hours that ventilating equipment worked as a percentage of the total number of hours that they were planned to be functioning in the Madrid metro system from 1999 to 2000.

Table 12.1
Availability of Ventilating Equipment in the Madrid Metro from 1999-2000

	1999	2000
Ventilating equipment	99.63%	99.59%

A direct comparison of comfort, cleanliness and customer care between London and the comparator cities is not possible due to data availability problems and differences in the definitions used. However, we note the richness of the quarterly Passenger Environment Survey in New York, and the fact that the results of this survey are always published.

12.3. What Can Londoners Reasonably Expect?

Current levels of satisfaction with cleanliness, comfort and customer care record some of the lowest scores out of all measures included in LUL's Customer Satisfaction Survey. Increased availability and helpfulness of staff and increasing cleanliness on trains have been identified as areas of particular customer concern and therefore priority for improvement.

While LUL monitor customer satisfaction with the cleanliness of trains and stations on a regular bases, this Scrutiny has not found any evidence of similar, *regular*, monitoring of factors such as litter levels and graffiti levels, nor specific, well defined targets for actions such as "regular cleaning". Evidence of extensive monitoring of graffiti, litter and vandalism levels in New York in particular suggest that more could be done to monitor LUL progress in these areas.

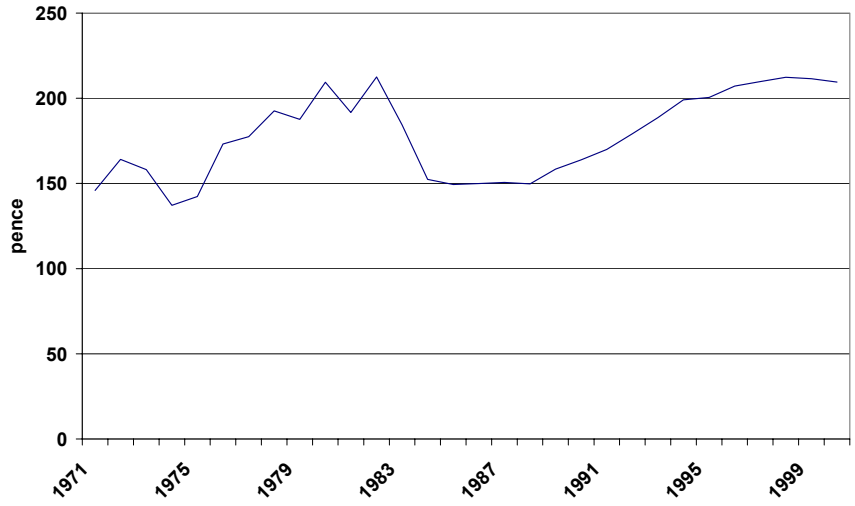
As with reducing staff absenteeism (section 6.5) and improving provision of dynamic information to customers (section 9.3), improved standards of cleanliness is another area where management action can produce short-term improvements by levelling up to best practice across the system through better staff training and motivation. Londoners can reasonably expect that this will be done.

13. FARES

13.1. General Observations and London Fare Levels

Figure 13.1 illustrates the **trend in fares** on London Underground from the 1970s to the present day, adjusted for inflation.[39] As the graph shows, fares have grown in real terms overall, especially from the late 1980s to late 1990s, with a more static level in the most recent years.

Figure 13.1
Passenger Receipts per Journey *per annum* 1971 to 2000



Currently, the price of a single adult fare varies from £1.00 for travel within a single zone outside Zone 1, to £5.40 for a Zones 1 to 6 journey. Concessionary fares are available for the under 16s (with identification), free travel is provided for disabled persons (in the form of a Freedom Pass) and family travelcards can also be purchased. A number of travelcards are available (adult and child) for different periods stretching from a day to a year. There is some use of off-peak charging (in the form of weekend travel cards, and one-day travelcards which are valid from 9.30am).

13.2. Overseas Comparators

In all cities, decisions on appropriate fare levels are either made by politicians or controlled by them. The level of fares on underground systems varies widely and in part reflects the political attitude as to whether public transportation should be funded by users or through other means, such as general taxation or levies on employers.

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[39] Passenger receipts provide a good approximation of fares trends, given that there have been no large changes in factors such as the average journey length over this period.

For this reason, the usefulness of comparing fares between cities is rather limited. The fact that underground fares in Paris are lower than in London does not necessarily imply that the Paris metro system is "cheaper", since the deficits will be paid by taxpayers and by employers.

In addition, fares comparisons can be difficult due to different zoning systems, different ticket types, etc. The comparisons in Table 13.1 are therefore by way of illustration only. The Table shows those fares in the comparator cities that we believe are the most equivalent to the London fares shown.

Table 13.1
Illustrative Comparison of Fares in Comparator Cities, 2002

	Single (£)	One-day ticket (£)	Monthly ticket (£)
New York	1.03	2.75	43.00
Paris	0.80 (Zone 1-2)	3.10 (Zone 1-2)	27.00
Berlin	1.30	3.75	36.00
Stockholm	1.04 (Zone 1)	5.20	32.00
Madrid	0.58	n/a	20.00
Barcelona	0.61	2.60 (Zone 1)	22.50
London	**1.60** (Zone 1)	**5.30** (Zone 1-2 peak)	**74.20** (Zone 1-2)

Source: company fares information

When **compared with fares overseas**, London Underground fares are relatively expensive. For example, the price of a single ticket on the New York Subway (covering all distances) is approximately £1.03, a Zone 1 and 2 fare on the Paris Metro is approximately £0.80 and a single journey on the Madrid metro costs around £0.53.

13.3. What Can Londoners Reasonably Expect?

Given that fares in London are higher than those on our comparator systems, Underground passengers aware of these differences might regard themselves as receiving relatively poor Value for Money. However, such comparisons ignore the fact that subsidies are lower in London than in other cities. While London Underground recovers 129 per cent of its operating costs from the farebox, New York only recovers 77 per cent and Paris 63 per cent.[40] Overall Value for Money is therefore more difficult to determine, and will depend also on adjustments to take account of differences in costs of providing services and differences in service quality.

Fare levels in London are the result of wider policy initiatives and are at least partially a political decision. We therefore do not make any explicit conclusions in this area and do not suggest any specific targets. However, Londoners will be very concerned about the levels of

[40] Source: LTUC.

fare they pay, and we recommend that the Assembly monitors overall trends in fare levels, particularly after adjusting for inflation.

We considered the issue of fares and ticketing integration in the Chapter on Integration Across Transport Modes.

PART III: THE FUTURE

14. PRIORITIES FOR INVESTMENT

14.1. Londoners' Priorities

As indicated in Part II of this report, this Scrutiny project has been able to establish what Londoners' priorities are for the Underground by hearing evidence from passenger groups, by analysing the results of a range of passenger surveys, and by some direct feedback received from passengers by e-mail. These investigations point to some very clear priorities for passengers:

- **Safety** – generally the first priority for all passengers when asked, although high levels of safety are frequently taken "as given" and so safety is not generally regarded as a priority area *for further improvement.*
- **Improved frequency**
- **Improved reliability** – of trains, but also of lifts and escalators.
- **Reduced overcrowding** – improving frequency and reliability in the peak will go some way to reducing overcrowding. Indeed, working to ensure even headways between trains, particularly at peak times, is seen as the main short-term initiative that can be taken to minimise overcrowding. However, given the long term upward trend in demand and current levels of overcrowding, further measures to increase capacity are also needed.[41]

Other priorities that are generally less "investment intensive", but were also identified as important priorities for improvement by customers were:

- **Improvements in the helpfulness and availability of staff.**
- **Improving cleanliness, particularly on trains.**

14.2. LUL's View

LUL's written submission and oral evidence to the Committee also identified improved frequency, improved reliability and increased capacity as the key priorities for investment. Addressing overcrowding and unreliability were also identified as key aims in the Mayor's Transport Strategy. LUL's written submission also pointed to improved safety, cleaner stations and cleaner trains as other customer priorities.

Many of LUL's current investment plans reflect these priorities. For example:

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[41] This point was also made in the Mayor's Transport Strategy.

- Victoria line route modernisation, including new track, trains and signalling to increase reliability and train frequency;
- completion of Northern Line modernisation;
- Piccadilly line upgrade, including new signalling and control centres;
- upgrades to Central and Jubilee line signalling to increase maximum train frequencies to 33 and 24 trains per hour respectively;
- station reconstruction/modernisation at over 50 locations, including initiatives to increase capacity.

14.3. Conclusions on Priorities

This Scrutiny investigation has found that priorities for the Underground are clear, and that customers' and LUL's views seem to match very closely, particularly on the "investment intensive" issues of frequency, reliability and capacity. The only area which LUL does not appear to attach particular priority to that customers *do* is the availability and helpfulness of staff.[42] This is perhaps understandable, as this is primarily a management and cultural issue within LUL rather than a demand for external funding for major capital projects.

LUL's investment plans show that it already has plans to address these issues to a certain extent. However, the analysis in Part II suggests that there is more that could be done in a number of areas if London is to achieve close to world-class performance. We consider their broad implications for investment levels in Chapter 16. First, though, Chapter 15 considers targets that have and should be set.

[42] Note that LUL have emphasised that current staffing *levels* are high relative to many other metro systems and mainline rail.

15. TARGET SETTING

15.1. Current Target Setting

15.1.1. London Underground's Customer Service Delivery Standards

London Underground already operates its own internal system of targets for levels of service, known as the Customer Service Delivery Standards (CSDS). The CSDS cover the following key areas:

- **Accessibility and interchange** – covering for example, interchange with buses, national rail, cars, and bicycles, layout planning, opening hours, step free access and the provision of lifts.
- **Ambience** – covering eg advertising, lighting, air quality, train condition, litter, graffiti and station condition.
- **Amenities and facilities** – eg space, seats, clocks, telephones, litter bins and retail units.
- **Customer relations** - eg handling of customer comments, and the Customer Charter.
- **Customer information** – eg visual electronic information, audible information, signed information and information provided by staff.
- **Personal security** – eg design considerations, security monitoring, emergency help facilities and staff action.
- **Standards for staff** – eg staff numbers and deployment, skills, knowledge, appearance, and helpfulness.
- **Standards for ticketing** – eg availability of ticket vending facilities, and the behaviour and knowledge of ticket office staff.
- **Standards for train service** – eg service frequencies, on-train congestion, closures, operating hours, and travelling time.

The CSDS are detailed, and the examples given above are just a selection of the high level headings under which more detailed standards are set. CSDS are made available to the public on request.

However, to our knowledge, LUL does not currently publish details of its performance against all of these targets. Indeed, some of the targets are quite descriptive in nature and it would be difficult for LUL to measure exact progress against them. They are also a mix of short-term targets which LUL either already attain or aim to attain within the near future (such as ensuring all staff undergo disability awareness training, ensuring all lights are in working order, and ensuring there is the capability for audible information to be delivered into all train cars), and longer-term targets which it will not be possible for LUL to attain

without significant levels of investment and time (for example, "the provision of step free access at all new stations and at existing stations as funds allow").

While the Assembly should be aware of CSDS when setting targets and monitoring LUL's performance going forward, using the CSDS as the sole basis for monitoring is not recommended, given the very large number of standards covered and the descriptive nature of some of the standards which may make monitoring progress difficult. The CSDS are aimed at articulating LUL's commitment to the customer, rather than at setting specific performance targets for the future.

As noted in Chapter 12 of this Report it is known that LUL have also been developing asset condition, reliability and performance measures associated with the proposed PPP scheme. This process has also involved the establishment of benchmarks which it considers to be appropriate and measuring performance against these benchmarks. This information has not been made available to us. However it is known that many of these measures are exceptionally complex and difficult to comprehend. The final outputs of these measures are therefore not likely to be suitable for the Assembly's purposes. However we consider that some of the considerable quantity of input data that are currently being measured is likely to be exceptionally useful in measuring the state, reliability and performance of London's Underground system.

15.1.2. Targets set by TfL

The Mayor's Transport Strategy sets out the Mayor's targets for the Underground over the next ten years. Some of these targets are qualitative rather than quantitative/easily measurable, and some do not have specific timescales attached to them. However, it will be important for the Assembly to bear these targets in mind when setting their own targets and monitoring future performance, not least to ensure that there are no inconsistencies in target-setting. Targets in the Mayor's Transport Strategy for the Underground include:

- Requiring LUL to produce proposals for returning the percentage of Underground services operated to levels observed between 1991 and 1996. It is unclear whether this refers to the minimum performance during this period (94.5 per cent), to the average (around 96 per cent) or to the best (97.5 per cent). The 2000/01 performance on this measure was 91.5 per cent.
- Requiring LUL to halve 2000/01 delays caused by equipment failures by 2008. (Whether this applies to delays of a specific duration, or to all delays is not clear).
- Requiring LUL "as a matter of priority" to implement a programme to solve the problem of out of service lifts and escalators. (The programme is to be in place by early 2002, but specific time targets for the solution are not given, nor is a definition of the solution.)

The Mayor's Transport Strategy also notes that "Targets will be set by TfL to improve Underground performance to reach the benchmark of comparable world city metros". Although we are not aware of any outputs in this area so far from TfL, the Assembly may wish to keep a close watch on any targets that subsequently emerge.

TfL also monitors LUL's performance using a series of key indicators: on a six-monthly basis LUL submits a *Performance Report to the Rail Transport Advisory Panel* of TfL. Table 15.1 illustrates the key measures monitored in this report. An understanding of the measures already monitored may be useful to the Assembly in considering its own future target setting and monitoring of LUL performance.

Table 15.1
Key Performance Indicators Currently Reported to TfL

Service Performance Measures

- ***Number of station closures lasting 15 minutes or more*** – including break-down by cause and by line.
- ***Percentage of customers in a ticket queue for more than three minutes*** – including breakdown by line. Examples of excess ticket purchase times at selected stations are also provided.
- ***Percentage of escalators and lifts not in service*** (including a breakdown by line).
- ***Percentage chance of waiting for a train less than 5, 5-10, 10-15 and over 15 minutes*** (including breakdowns by lines, but not by inner and outer London). These data are only provided for one quarter.
- ***Percentage of headways missed*** (including a breakdown by line).
- ***Number of train delays of 15 minutes or over*** (including a breakdown by line and by cause of delay).
- ***Percentage of peak trains cancelled*** (including a breakdown by line and by cause of delay).
- ***Percentage chance of being on a train with: all seats full; at least one person standing to each sitting; and at least two people standing to each sitting*** (including a breakdown by line and between peak and off-peak, but not between Central and Outer London).
- ***Percentage of scheduled kilometres not operated*** (including breakdown by line).
- Details of ***excess weighted journey time*** over scheduled journey time, including a breakdown of the reasons for the excess (eg ticket queues, platform waits, etc.)
- Details of the top ten incidents causing over 30 minutes of delay in the previous period, and the top ten contributors to unplanned closures.

Safety and Security Measures

- ***Customer fatalities and major injuries***.
- ***Employee/contractor fatalities and employee major injuries***.
- A selection of other safety incident data: ***SPADs, person-train incidents, and incorrect door openings***.
- ***Crime statistics*** (by type of crime).

Customer Satisfaction Measures

- Reports on ***customer satisfaction levels*** on a range of issues (eg crowding, journey times, safety, information provision, helpfulness of staff)

Accessibility Measures

- Stations with partial ***step free access.***

We note that in addition to these data, LUL also collects a wide variety of data for internal uses. Examples include the number of delays at shorter intervals such as those causing delays of more than two minutes, five minutes, etc, and more detailed information on safety and security incidents. As noted above, some of the wide variety of other information that is being collected for proposed PPP monitoring will be of considerable use in monitoring the system and improving public accountability. We also note that while some historic data are provided in this report to TfL, this is not the case for all measures, which limits the extent to which a long term trend can be established.

It is important that LUL develops formal procedures for using the information that it collects to improve either the system as a whole, or aspects of it, that fall short of acceptable. In this context the wide and often seemingly inexplicable variations that we found between lines in the internal benchmarking exercise that we undertook (see Chapter 6) is significant. At their second hearing LUL did give examples of where they used information on differences between lines to improve performance, and this is to be welcomed. Although Railtrack is an organisation which has been subject to considerable criticism for its stewardship of the national rail network, regular monthly meetings were held at main Board level to review, analyse and reduce the top ten causes of delays for which it was responsible each month. This clearly indicates the point that whilst collection of data to analyse the performance of the LU and its public accountability is important, what is really vital is the way in which the data are used to improve the system.

15.2. Setting Benchmarks for the Future

In this section, we set out suggested measures against which the Assembly might monitor LUL progress in each of the key performance areas discussed in Part II. Where appropriate, we also provide specific target levels reflecting service levels that Londoners should reasonably be able to expect.

During this Scrutiny project, concerns were raised that a balance should be struck between setting a sufficient number of targets to cover all key performance areas, against the danger of setting too many targets, which would become more difficult to monitor and might be less meaningful to, for example, the general public. We have therefore identified a combination of "headline indicators" (shown in bold) and other, secondary indicators that we consider it important for the Assembly to also monitor.

When setting targets, it is important that they do not conflict with targets imposed by others (eg TfL). As this report has demonstrated, a significant amount of monitoring already takes place, both within LUL and by others (eg TfL, Crime Concern, LTUC, GLAD and Capital Transport Campaign).

Similarly, it is important that they do not create "perverse incentives" for managers to concentrate on performance in specific areas to the detriment of performance in other areas that, while still high priority to passengers, are not measured. For this reason, we would

encourage the Assembly to take a broad approach to its monitoring, and not to over-emphasise LUL's performance against just a few headline indicators. For example, if the Assembly is considering publishing details of performance against headline targets, it will be important to note that these measures are just *some* of the measures monitored by the Assembly, and that while they may give a good "first look" indication of progress in particular areas, the Assembly is also conscious of the need to look at the wider picture. We note that publication of performance against targets can act in many cases as an incentive to increase service levels, provided that it is qualified by the observations made above.

At some of the evidential hearings, frustration was expressed with the fact that targets and monitoring measures used tend to change over time, sometimes making it difficult to compare trends over anything more than a few years. While some change is inevitable given shifting changes in consumer preferences and expectations and in technology, changes over time to the definitions of targets set should be minimised so as to allow effective comparisons with previous years and to permit, wherever possible, a continuous trend to be monitored with the earlier data.

Note that the targets given below can only be indicative at this stage and are based on the information that has been made available to us during this Scrutiny project. For example, in many cases we have had to make judgements on performance levels based on relatively limited historic information. The Assembly may wish to give LUL the chance to respond with their views on these indicative targets. For example, LUL may have operational and historic performance information that has not been provided as part of this Scrutiny, but which demonstrates that some of these targets are unreasonably challenging, or, possibly, not challenging enough, or might require a specific timescale to achieve. However, any information from LUL suggesting targets are unreasonable should always be considered in the context of "what Londoners can reasonably expect of a world class rail system", including, where available, evidence of what has already been achieved overseas.

15.2.1. Safety and security

- Satisfaction with current levels of **safety** is already relatively high. There are however some concerns (for example more trips/falls eg on escalators and platforms due to overcrowding). LUL already collect a relatively wide range of safety data, some of which are made available to TfL. LUL also have to have their safety case approved by HSE. Rather than having key "headline", targets in this area against which performance can be monitored, we suggest that the Assembly monitor the data LUL already supply/collect. These data should:

  - avoid focussing exclusively on "extreme" safety breaches, such as fatalities. Monitoring and reporting on injuries (particularly major ones) should also be included. LUL already collect these data and this should be continued.

- Avoid focussing on injuries alone. Monitoring the number of incidents that have the *potential* to cause injuries is also important. Examples include incorrect door openings and contact between people and trains.

- **CCTV –** LUL has undertaken to introduce this onto all trains. We suggest that the Assembly monitor progress by examining as "headline" measures:

  - **the proportion of trains with CCTV**;
  - **the proportion of stations with CCTV covering all main areas** (eg all platforms, main walkways, ticket hall).

Other information in this area which the Assembly may wish to monitor:

- the number of CCTV cameras per monitoring staff member;
- the initiatives the LUL are taking to ensure that CCTV provides good coverage (eg installing extra cameras/changing camera locations to minimise "blind spots");
- the proportion of help points that are fully operational – LUL might aim for close to 100 per cent within 12 to 18 months, given their undertaking to repair help points. Initiatives to ensure that all new help points are easily accessibly for disabled passengers, and to increase customer awareness of help points might also be monitored.

- **Secure Stations Scheme –** the Assembly could monitor the **proportion of stations that have been awarded accreditation**.

- **Staff at stations –** headline indicators might include:

  - **proportion of stations that are staffed during *all* opening hours**;
  - **total number of station staff, disaggregated by function**;
  - **proportion of stations with staff available outside the ticket office and concourse area during all opening hours**.

  In addition the Assembly may wish to monitor how LUL recruits and trains staff to ensure that they are as helpful as possible, are well trained to assist disabled passengers, and to ensure that they feel confident in being visible and available to customers in quiet stations, particularly late at night. LUL might also be asked to provide regular updates on how it is managing shift patterns and staff location in order to maximise the availability of staff across the whole network, including late at night.

15.2.2. Reliability

Headline measures for LUL are shown in bold – but the Assembly may also find it useful to monitor the measures shown in normal type:

- **Number of delays over 2, 5 and 15 minutes attributable to LUL disaggregated by key cause** (eg staffing problems, signalling, rolling stock, etc). An appropriate target for LUL would be to require these totals to fall every year until London reaches appropriate targets set by reference to CoMet benchmarks and the best standards achieved by key comparator cities. We recommend a three stage process of increasingly challenging targets over five, ten and twenty years which reflect realities and the investment position. These benchmarks would reflect any influence that cultural factors, the age of the system, etc, has, so that, for example, rolling stock reliability would be benchmarked against the best world standard, whilst general infrastructure faults would have a lower benchmark. LUL's measure of 15 minutes currently provided to TfL is much longer than that used by many other metros, and is much longer than what most customers would generally regard as a delay. LUL already collect data for delays shorter than 15 minutes, so providing these data should not create a significant extra burden. This target should be monitored on a line-by-line basis as well as for the system as a whole.

- **Percentage of escalators and lifts out of service –** a reasonable target for LUL might be under five per cent for escalators, and under one per cent for lifts across the network as a whole. Performance should be monitored on a line-by line basis and specific priority should be given to improving reliability on the currently worst-performing lines (eg bringing the percentage of escalators out of service on all lines down below ten per cent).

- **Percentage of headways missed –** LUL should aim to return to performance levels in 1997/98 of around 4.5 per cent on the network as a whole. Performance should be monitored on a line-by line basis.

- **Percentage of peak trains cancelled –** LUL should aim to return to cancellation levels of around 2 per cent (for cancellations attributable to LUL on the network as a whole). Performance should be monitored on a line-by line basis, with particular attention paid to the lines that are currently performing badly (Circle and Hammersmith, Bakerloo and Piccadilly). The figures for the peak and off-peak periods should be separately monitored, otherwise good off-peak performance, which constitutes a high proportion of the total mileage run, could mask poor performance at the times when most customers and business depend on it. It would also be useful to monitor the reasons for cancellations, and whether they are attributable to LUL or not.

- **Percentage of scheduled kilometres not operated –** LUL should aim to return to historic performance levels of around 4 per cent. Performance should be monitored on a line-by line basis**.**

- **Number of station closures lasting ten minutes or more –** note that LUL currently provides this indicator for fifteen minutes or over to TfL. However, given that fifteen minutes represents a very significant delay to the average passenger, this threshold might be lowered to ten minutes. The reasons for closures should also be monitored (eg staffing problems, lift/escalator problems, fire alerts, etc.) a distinction should also be made between reasons attributed to LUL and those that are not.

15.2.3. Waiting and journey times

Suggested "headline" targets/benchmarks for the Assembly to monitor:

- **Percentage chance of waiting for a train - less than five minutes, 5 to 10 minutes, and over 10 minutes, broken down by Central and Outer London, and by peak and off peak.** A reasonable but challenging target for LUL would be to reduce the percentage chance of waiting over ten minutes to less than two per cent on the system as a whole (ie, a reducing current chances by just over half). In central areas in peak times, a reasonable target might be to reduce the percentage chance of waiting over five minutes to less than five per cent. Figures per line would also be needed for internal benchmarking.
- **Average commercial speed by line** (ie end to end average speed including all stops). It is imperative that present standards are maintained, but fairly difficult to improve these, although some improvements are possible. Relaxation of these standards is a means of "massaging" the reliability figures, as the former BR did when the Government introduced the "Passenger's Charter". Thus the benchmark should be set at the existing best timetabled time with the measured figure representing the average timetabled figure.
- **Reducing the percentage chance of waiting over three minutes to buy a ticket to 6 per cent or less across *all* lines** (not just on average). It will be important to monitor performance against this target for each line, rather than just the average, given current divergences on performance in this area.

15.2.4. Crowding and capacity

Suggested headline measures:

- **Number of train kilometres operated by line;**
- **Number of seats and square metres of standing space per hour provided by line and split by peak and off peak, and by Central London and Outer London;**
- **Percentage of trains with all seats full, split by peak and off peak, and by Central London and Outer London** (eg within Zone 1 or Zone 1and 2, and outside that area);
- **Percentage of trains with at least one person standing to one sitting** (split as above);

- **Percentage of trains with at least two people standing to each sitting** (split as above).

Note that LUL already collects these data and provides it to TfL (except for the Central *vs* Outer London break-downs).

The Assembly may also wish to monitor station counts, particularly in the peak, the numbers of station entry and ticket barrier closures, however brief, as a result of passenger crowding and progress against the major capacity expansion projects that are planned but not yet secured (eg Cross Rail 1, the Hackney-South West Line, etc).

15.2.5. Provision of information

LUL's current standards of provision in terms of static information are generally regarded as good, and measuring performance is largely qualitative rather than quantitative. We suggest that LUL are set a target of maintaining current high standards. These might be further improved by increasing clarity and consistency of signage, particularly in consultation with groups representing those with disabilities.

For dynamic information, LUL should aim to keep to their CSDS target of providing information that is as up to date as possible, and promptly removing information (eg from white boards) that is out of date. LUL might be asked to demonstrate the the Assembly what initiatives they have taken to improve the visibility of dot matrix screens, eg by increasing the number of them, ensuring views are not obstructed by other signs etc, and increasing the use of upper and lower case to aid those with visual impairments.

Targets for accessibility below include targets on the provision of audible information on trains.

15.2.6. Accessibility

Suggested headline targets/benchmarks for the Assembly to monitor:

- Requiring LUL to implement formal processes for actively consulting with relevant groups representing those with disabilities at the design stage for new stations and station refurbishments. LUL might be required to implement this within a specific timescale (a maximum of two years would seem reasonable, but within twelve months may also be achievable). The Assembly might also wish to receive regular feedback from groups representing those with disabilities on how effectively their comments are being incorporated by LUL.
- **The proportion of stations providing**:
  - **complete step-free access** (including no step up/down into the train);

- **partial step-free access** (eg on some lines but not others)

The Assembly may also find it useful to monitor:

- The number of stations within Zone 1 providing step free access
- The number of major interchanges (eg stations with mainline rail and/or with several other Underground lines) providing step-free access.
- The proportion of trains providing both audible and visible destination and station stop information.
- Progress against TfL's proposals for the creation of a "core accessible network" of Underground stations[43], including the requirement on LUL to produce a plan for this by mid 2002.

15.2.7. Integration across transport modes

The quality of integration between transport modes is, to a large extent, measured subjectively rather than quantitatively. We do not propose any "headline targets" for LUL in this area, but we do think that it would be useful for the Assembly to monitor progress in the following ways:

- Requiring LUL to demonstrate to the Assembly that they have consulted with other transport modes at the planning and design stages of all new stations and stations undergoing major refurbishments. One way of doing this might be for LUL to give a report on to what extent they have **complied with the *Intermodal transport interchange for London best practice guidelines.***
- The Assembly may wish to monitor plans for improving ticketing integration on the run up to the introduction of **Prestige**. Monitoring could include:

  (i) **progress against original timetable** (current estimates given by TfL say that Prestige should be operational in 2003 – the original deadline noted in the Mayor's Transport Strategy was "late 2002";

  (ii) what **improvements Prestige brings to inter-modal journeys**.[44]

- Number of main transport interchanges (eg tube stations that link with major mainline rail stations) offering secure cycle parking.

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[43] Mayor's Transport Strategy Proposal 4.C.11.

[44] TfL's website notes that "inter-modal journeys will be easier".

15.2.8. Comfort, cleanliness and customer care

Suggested targets for LUL:

- Asking LUL to implement a public strategy for **monitoring cleanliness, graffiti and vandalism levels** in addition to its current monitoring of customer satisfaction in this area. This information could be collected and provided to the Assembly in summary form for monitoring purposes. We have already noted that this information is already being collected as a part of the shadow PPP process.
- Targets based around the availability and helpfulness of staff are dealt with under safety and security.

15.2.9. Fares

We do not recommend any specific headline targets/benchmarks for fares *levels*, as these are often the subject of wider policy initiatives. Targets could however be introduced for fares integration, but these would have to be developed with consideration of other transport modes. Targets for the roll-out and scope of Prestige might be an example (see also ticketing integration).

16. IMPLICATIONS FOR INVESTMENT

16.1. Current Investment Programme

16.1.1. Historic investment

London's Underground system has benefited from considerable investment over the past 15 years, including:

- completion of the Jubilee Line Extension;
- route modernisation of the Central Line, including new track, trains and signalling system;
- complete replacement of the existing rolling stock by new trains on the Central, Northern, Jubilee and Waterloo & City Lines;
- heavy refurbishment of all rolling stock on the Victoria, Circle, Metropolitan and East London lines, and a lighter refurbishment for many others. This work has included enhanced safety features, improved passenger ambience, modifications to improve reliability, and significant improvements to rolling stock fire safety - now only the District Line rolling stock still has traditional wooden floors;
- station refurbishments. Again these have mainly been driven by safety issues. These primarily arose out of the Kings Cross fire, leading to the removal of toxic and flammable materials and the construction of new fire escapes in deep tube tunnels. Extensive reconstruction of Angel station on the Northern Line arose from a desire to eliminate dangerously narrow platforms;
- enhanced passenger security measures, including installation of CCTV, improved lighting and ticket barriers and insertion of car end windows; and
- flood protection measures on tunnels crossing under the River Thames.

One criticism that can be made of this programme is that, other than essential safety work, it has tended to concentrate on the areas that are most visible to the public rather than the ageing hidden infrastructure. One example of this is in the case of the Northern Line, where the proposed route modernisation stalled due to funding constraints but new rolling stock was acquired (the funding mechanism available for the rolling stock greatly assisted in this). Nevertheless we recognise the benefits of employing resources in the parts of the system seen by customers. One benefit of the programme is that London now has one of the youngest looking fleets of rolling stock in the world. As we showed in Table 3.2 the average age of the fleet since either construction or heavy refurbishment is around 8 years.

Not all of the assets purchased have performed satisfactorily. Some like the "1992" stock purchased for the Central and Waterloo & City Lines, or the new escalators for Angel

station, have not done so. Consequently safeguards need to be inserted into any future investment programme to ensure that public money is spent appropriately. In addition it is clear that the cost of the Jubilee Line Extension has had an adverse effect on investment in the rest of the system.[45] Indeed, it could be argued that the desirable goal of better serving Docklands and East London has been bought at a price of foregoing improvements in capacity in Central London.

Thus LUL's 15 Year Plan (or indeed any other investment programme) should be seen as part of a continuum of major investment. Despite the monies invested, London arguably has a system that is less adequate to its needs and in worse condition than it was 25 years ago. The lesson of history is that if London is to have a world class system it either needs to obtain much better value for money from investment funds or requires investment of a scale not seen since the majority of the deep tube network was built in the first decade of the Twentieth Century, or quite probably both.

16.1.2. LUL's 15 year plan

Highlights of LUL's current 15 Year Plan include:

- East London Line extension northwards to Dalston and Finsbury Park (under construction), and then southwards to Queens Road Peckham and Wimbledon;
- Hackney–South West Line ("Chelsea – Hackney Line"/Crossrail 2): we consider that it is highly unlikely that this will be open by 2015 as forecast as this will require a complete culture change in the ability of governmental bodies to progress such schemes rapidly;
- completion of the Northern Line route modernisation;
- route modernisation of the Victoria Line including new track, trains and signalling;
- extensive upgrade of the Piccadilly Line infrastructure, including new signalling and control centres;
- new trains for the Metropolitan Line. These will introduce a new concept to London by being open gangwayed within each set, so that the interior of each is an open "tube" from end-to-end, similar to Paris Line 14 and Copenhagen metro cars;
- refurbishment of the last unrefurbished trains on London's Underground, the District Line "D-78" stock, prior to its replacement in 2015;

[45] There have also been some minor line closures over the last decade, namely: the southern section of the original Jubilee line, between Green Park and Charing Cross; the Aldwych branch between Holborn and Aldwych; and the Epping-Ongar branch right at the periphery of the system.

- Central and Jubilee Line signalling to be upgraded to 33 and 24 trains per hour capability respectively;
- 25 per cent capacity increase for the Waterloo & City Line;
- 100 kilometres of track to be replaced;
- refurbishment and renewal of civil engineering infrastructure, eg bridge renewals and embankment works, etc;
- "over fifty" station reconstructions to increase capacity and station modernisations - the exact number in each category is unclear although the number of station modernisations can be expected to greatly exceed the number of reconstructions;
- additional measures to improve passenger security, including on-board CCTV and improved station security.

This programme, if fully implemented, should answer some of the criticisms of recent investment schemes by providing a greater concentration on the less visible areas of the infrastructure that require urgent attention, and on improving the capacity of the system in a way that is relevant to more uses, whilst still improving areas that visible to travellers.

16.1.3. LUL's PPP investment proposals

As articulated in London Underground's document *London Underground Limited Public Private Partnership - Final Assessment Report* (7 February 2002) there appear to be a number of subtle differences to the plans outlined in their earlier 15 Year programme. The investment schemes that it states will be delivered under PPP include:

- the installation of "modern signal and control systems" on all lines by 2019 with ATO (including ATP). This includes transmission based signalling (of which the most advanced, moving block, is one type). The plans are to renew the signalling on all lines other than the Central and Waterloo & City;
- capacity increases of 22 per cent on the Jubilee Line, 15 per cent on the Victoria Line and 17 per cent on the Metropolitan and Circle Lines within 10 years;
- replacement of all rolling stock that is currently more than 10 years old by 2019 (ie all sub-surface rolling stock, and Victoria, Bakerloo and Piccadilly line rolling stock) with the bulk being replaced between 2008 and 2014;
- modernisation or refurbishment of Oxford Circus, Kings Cross, Liverpool Street, Piccadilly Circus, Waterloo, Leicester Square, Tottenham Court Road, Charing Cross, Paddington and Victoria stations by 2010;
- modernisation of 60 more stations and refurbishment of a further 139 also by 2010, with stations refurbished again every 7½ years;

- 68 stations to have step-free access by 2012;
- 320 km of track to be replaced by 2033.
- all infrastructure to be brought into "good repair" by 2018.

The above programme does not include the construction of new lines, which are not included within the scope of the PPP.

Notwithstanding the exclusion of new capacity schemes, it can be seen that this proposed programme is more extensive than the proposed 15 Year Plan. However some elements of the 15 Year Plan have been dropped, for example the limited upgrade of the Piccadilly Line.

We understand that these upgrades will be procured against performance specifications. However, we also understand that there is some concern that specifications might be over-prescriptive in part. Since the specifications are not in the public domain, the content of work packages such as "station modernisation" is unclear. It is important that the Assembly is satisfied with the specifications for the work and equipment that is to be procured in the event that the PPP proceeds, since the infrastructure and equipment provided will accord to these specifications for the contract period (30 years) – we are uncertain as to the extent that it will be possible to adjust this at each 7 ½ year review period. The PPP contract is thus likely to fix the investment programme for the next thirty years. The danger is that the output performance targets set for investment schemes appear to be uncoupled from the input requirements as identified by the performance measures discussed in Chapter 15 and that unexpected changes (for example in the pattern of demand) may only be accommodated by contract renegotiation.

16.2. The Investment Programme that Londoners Can Reasonably Expect

16.2.1. The programme

We consider that all of the items in LUL's 15 year plan are appropriate, and represent the minimum required to permit the system to continue to function and maintain its position in London's transport system. We therefore consider that the more ambitious programme now outlined under the proposed PPP scheme appears to be more appropriate. However, we consider that further programme items will be required if London is to regain its place as world class system.

In planning investment we consider that the primary ("high level") objectives of a programme for London's Underground system should be as follows:

- to maintain and enhance safety and security levels;
- to provide sufficient capacity to accommodate all of those who wish to use the system at any point and time of the day without delay;

- to carry all of those who wish to use system at adequate standards of comfort and without excessive overcrowding;
- to provide an ambience and travelling experience for customers that is competitive with that provided by alternative modes, particularly the private car;
- to improve the efficiency of the system.

The achievement of these objectives should in the main be driven by the benchmarks for the system discussed in Chapter 15.

In the context of achieving the high level objectives discussed above and the benchmarks that will be set, we consider that there are a number of investment programmes that should occur concurrently with LUL's 15 Year plan:

- the construction of new capacity in a timely manner to keep ahead of demand. This particularly applies to the construction/extensive upgrading of mainline rail routes across London that will help release pressure from London's Underground system by providing a higher quality alternative to their target markets, ie Crossrail and Thameslink 2000;
- capacity increases on all lines where crowding standards will be exceeded, ie resignalling and purchase of additional rolling stock, and not just on the lines identified in the 15 year plan;
- installation of platform edge doors, as soon as appropriate signalling systems are installed, as a minimum in the most heavily used Central London stations and those with narrow platforms (eg the Victoria Line), to reduce the continuing loss of life and injuries from passengers falling on the track and to safely handle the increasing passenger flows through stations that rising demand creates;
- reduction of step widths to a practicable minimum, including achievement of a maximum value of 75 millimetres both horizontally and vertically wherever platforms are straight and on a constant gradient within 15 years;
- provision of air conditioning on sub-surface lines. The lack of air conditioning on Underground trains will become unacceptable to passengers due to the very rapid spread of air-conditioning on other modes, particularly the private car. Consequently, to maintain a competitive ambience, the Underground must respond. There are plans to introduce "comfort cooling" on the network in the next ten years under the PPP.[46] However, there are significant technical difficulties associated with the dissipation of heat from air conditioning systems on the deep tube network.

[46] LUL Hearing, May 16th.

Nevertheless, we believe that research should be undertaken to discover how these difficulties might be resolved.

16.2.2. Broad indicative costs

The costs of engineering works tends to be driven largely by detailed engineering factors This is particularly true of retrofitting and upgrading works to existing assets. However detailed factors are still significant in "green field" construction. Consequently giving broad indicative costs on the basis of "top down standard rates" is likely be highly misleading. It is for this reason that the costs of almost all major engineering schemes tend to rise sharply as schemes are developed. Even when more detailed estimation has been undertaken, it is still common for the cost of schemes to rise sharply. This frequently occurs with publicly funded and constructed projects, where there is an onus on keeping projected costs down to the lowest credible figure to gain Treasury approval, until the scheme reaches the point of no return. Examples of cost overrun on recent LUL schemes include overruns of 67 per cent on the Jubilee Line Extension and 31 per cent on the Central Line route modernisation[47].

Cost estimates that are in the public domain for the major new capacity schemes are:

- East London Extension £115 million[48];
- Hackney–South West Line £4,800 million[49];
- Thameslink 2000 £711 million[50] (excluding rolling stock);
- Crossrail £3,800 million.

The extent to which inflation occurs to engineering schemes as they are developed is shown by the figure for the Hackney–South West Line. This was reported in December 2001 as costing £4.8billion, whereas in July 1997 the same source had reported the estimated cost as £2.8billion. The route of the proposed line has yet to be firmly fixed and so the cost is likely to be subject to considerable further variation.

The costs of either LUL's proposed 15 Year plan or the price tag associated with the investment under the proposed PPP do not appear to be publicly available. The only figures that we have seen are in LUL's *Final Assessment Report* on the proposed PPP which are for track and signalling on JNP Infraco and quote totals of £170million for replacement and £83million for renewals.

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47 Source *London Underground Limited Public Private Partnership - Final Assessment Report* February 2002.

48 As stated by LUL March 2000.

49 Source *Modern Railways* December 2001, same source for Crossrail figure.

50 Source Railtrack website, evidence given at Public Inquiry February 2000.

The Mayor's Transport Strategy acknowledges that cost information on LUL's plans is not available, noting that a proper engineering assessment will be needed "to determine both the cost and time required to address the deficiencies of the existing Underground infrastructure and to identify immediate and longer term priorities". The Mayor's Transport Strategy noted that this should be done "as soon as possible". The Assembly may therefore wish to monitor what progress is being made in this area.

Accordingly we have estimated "broad brush" figures for the costs of the investment programme identified. The following figures should be treated with considerable caution and should only be regarded as an indication of the broad order of magnitude of the costs involved:

- Capacity increase of 10 % (Central London) £3.75m/route km
- Capacity increase of 20% (Central London) £5.0m/route km
- Capacity increase of 30% (Central London) £6.0m/route km
- Incremental capacity increase 10% to 20% (Central London) £1.5m/route km
- Incremental capacity increase 20% to 30% (Central London) £1.25m/route km
- Incremental capacity increase 10% to 30% (Central London) £2.75m/route km
- Capacity increase of 10% (Outer London) £2.0m/route km
- Capacity increase of 20% (Outer London) £3.75m/route km
- Capacity increase of 30% (Outer London) £4.25m/route km
- Incremental capacity increase 10% to 20% (Outer London) £2.0m/route km
- Incremental capacity increase 20% to 30% (Outer London) £2.75m/route km
- Incremental capacity increase 10% to 30% (Outer London) £1.5m/route km
- New rolling stock £6.5m/route km
- Mobility impaired & step free station access £50k - £10m/station
- Platform edge doors £3m/station per line
- Air conditioning on sub-surface lines no additional cost for new stock

APPENDIX A. ORGANISATIONS ATTENDING HEARINGS

18th December 2001	Presentation and evidentiary hearing with London Underground Limited
31st January 2002	Evidentiary hearing with Crime Concern
12th February 2002	Evidentiary hearing with Greater London Action on Disability (GLAD), Capital Transport Campaign, London Transport Users Committee (LTUC)
16th May 2002	Evidentiary hearing with London Underground Limited

APPENDIX B. ORGANISATIONS PROVIDING WRITTEN EVIDENCE

Organisations

- AEA Technology
- Age Concern
- Capital Transport Campaign
- Commission for Integrated Transport
- Crime Concern
- Describe Online
- Greater London Action on Disability
- Institute of Logistics and Transport
- Joint Committee for the Mobility of Blind and Partially Sighted People
- London Transport Users Committee
- London Underground Limited
- Metronet
- Metropolitan Police
- New York Metropolitan Transit Authority
- Nexus
- Royal National Institute for the Blind
- Royal National Institution for the Deaf
- Strathclyde Passenger Transport
- Transport Research Laboratory

Individuals

- Mr J Baher
- Ms Eugene Donnelly
- Mr Justine Fallis
- Mr R Fenlon
- Mr N R Gansell
- Mr Christian Grobel
- Mr P G Hawes
- Miss J L Hetherington
- Mr Nick Inman
- Mr C E Johns
- Mr C Lawrence
- Mr Simon Maier
- Ms Jan Owen
- Mr C J Roffey
- Dr Jack Sultoon
- Mr S Turceninoff
- Ms Sophie Wiggins
- Mr Nigel Wilson

APPENDIX C. COMMITTEE MEMBERS

- Lynne Featherstone (Chair)
- John Biggs
- Angie Bray*
- Samantha Heath
- Jenny Jones
- Andrew Pelling

** Roger Evans replaced Angie Bray on the Committee from 16th May 2002*

APPENDIX D. NEW YORK PASSENGER ENVIRONMENT SURVEY

In this Appendix, we present key figures from New York City Transit's detailed Passenger Environment Survey. The discussion in the main text of this survey can be found in Sections 9.2.2 and 12.2.2.

Below, we present the scores for each of these indicators between July 2000 and June 2001. To reduce the amount of information, only *average* (as opposed to quarterly) scores are included.

We note that the Passenger Environment Survey only includes outturn values for the indicators without setting *targets* for them. For some indicators, targets were however set in NYCT's 2001 Departmental Goals, which we have included in the appropriate Tables.

Cars with all system maps correct/legible

Each car on New York City Transit must at least have two system maps present, both correct and legible. The only exception to this is allowed in the case of **minor** service changes: a "grace" period will then be given for the remainder of the quarter in which the change occurs. The following quarter, any maps that have not been updated will be rated incorrect.

In 2000/01, the score for this indicator was either 99 or 100 per cent with an average of 99.5 per cent.

Cars with all signage correct

For each car of a train, side and front signs must be present, which must match and be legible and correct. If the front sign of a train is incorrect, then the signage for all cars of that train is also considered to be incorrect.

In 2000/01, the score for this indicator varied from 96 to 100 per cent. The average of all four quarters was 98.5 per cent.

Cars with public address announcements

This indicator measures the number of correct and understandable announcements as a percentage of the total potential announcements expected. For each station stop, all announcement types (next station; transfer options; route designation and destination; next station; and stand clear of closing doors) are assessed.

In 2000/01, the score on the measure increased from 76 per cent in the summer of 2000 to 83 per cent in the spring of 2001, with an average of 79 per cent.

Stations with legible/correct system maps

Each station is expected to have a legible and correct system map in both the areas within and those outside ticket barriers. For minor service changes only, a "grace" period will be given for the remainder of the quarter in which the service occurs.

In 2000/01, the score for the indicator varied between 19 and 38 per cent with an average of just under 30 per cent. A programme to upgrade the remaining stations is underway.

Stations with correct Passenger Information Centre

All stations on New York City Transit are supposed to have a Passenger Information Centre (PIC) with a system map, a bus map, a neighbourhood map, a notice board, etc. A station is rated as acceptable if it has a PIC with correct and legible information. In reviewing system and bus maps, for minor service changes only, a "grace" period will be given for the remainder of the quarter in which the service occurs.

The score on this indicator varied between 78 and 81 per cent in 2000/01. The average was just under 80 per cent.

Stations control areas with a correct subway map available

At each ticket window, a correct subway system map must be available on request. As with the other indicators involving maps, a "grace" period will be given for minor service changes.

During 2000/01, between 84 and 93 per cent of stations were found to be acceptable on this indicator. The average was 88.5 per cent.

Station delay announcements: understandable/correct

This indicator monitors the extent to which at stations with dedicated announcers (around 18 per cent of the total), understandable and correct delay information can be heard. The average 2000/01 score on this measure is contained in Table D.1. It is clear that New York City Transit's score on this indicator is not particularly high.

Table D.1
New York Station Delay Announcements: Understandable/Correct, 2000/01

Degree of understandability/correctness[51]	2000/01 average (%)
Understandable/correct	20
Partially understandable/correct	18
Marginally understandable/correct	14
Not understandable/correct	49

Source: New York City Transit Passenger Environment Survey, Second Quarter 2001

Litter conditions in subway cars

This indicator is both measured at terminals that have cleaners, and throughout the day while in passenger service. This way, both the effectiveness of cleaners as the appearance of cars to the customers can be measured. Average scores for 2000/01 are contained in Table D.2.

Table D.2
New York Litter Conditions in Subway Cars

Presence of litter[52]	Throughout the day at terminals that have cleaners	Throughout the day while in passenger service	
	2000/01 average (%)	2000/01 average (%)	2001 target (%)
None	77	43	93
Light	19	48	
Moderate	2	4	
Heavy	2	6	

Sources: New York City Transit Passenger Environment Survey, Second Quarter 2001; New York City Transit Strategic Business Plan 2001-2005

[51] Understandable/correct: all appropriate delay announcements were understandable and correct. Partially understandable/correct: some delay announcements were understandable and correct. Other delay announcements were unintelligible. Marginally understandable/correct: all delay announcements attempted were not understandable. Not understandable/correct: no delay announcements were heard.

[52] None: basically litter free. Light/Moderate: lightly scattered or moderate dry litter. Heavy: heavy litter, **any** opened or spilled food, malodorous of hazardous conditions (e.g. rolling bottles)

Cleanliness of car floors and seats

Like the previous one, this indicator is measured both at terminals that have cleaners, and throughout the day while in passenger service. Average scores for 2000/01 are contained in Table D.3.

Table D.3
New York Cleanliness of Car Floors and Seats, 2000/01

Cleanliness of car floors and seats (degree of dirtiness)[53]	Throughout the day at terminals that have cleaners (%)	Throughout the day while in passenger service (%)	
	2000/01 average (%)	2000/01 average (%)	2001 target (%)
None	34	15	86
Light	55	68	
Moderate	7	8	
Heavy	5	10	

Sources: New York City Transit Passenger Environment Survey, Second Quarter 2001; New York City Transit Strategic Business Plan 2001-2005

Cars with no interior graffiti

This measure is defined as the percentage of cars with no graffiti on the interior. Cars with visible traces of graffiti where an attempt was made to remove the graffiti are rated as accepted. The measure excludes the evaluation of car windows for either graffiti, scratched or clouded conditions since these are subject to a separate indicator.

In 2000/01, the score varied from 92 to 96 per cent with an average of 94.

Cars with no exterior graffiti

New York City Transit aims for all cars in service to be free of graffiti on the exterior. In 2000/01, the score on the performance indicator was 100 per cent in all four quarters.

Cars with no graffitied windows

This indicator measures the percentage of cars with no graffitied windows and door glass. In this case, windows with visible traces of graffiti where an attempt has been made to remove the graffiti are still considered graffitied. The indicator does not include an assessment of the scratched or clouded conditions of the windows.

[53] None: basically dirt free. Light: occasional spots but generally clean. Moderate: dingy floor, one or two sticky dry spots. Heavy: heavy dirt, **any** opened or spilled food, hazardour (e.g. rolling bottles) or malodorous conditions, sticky wet spots, any seats unusable due to unclean conditions.

In the four quarters of 2000/01, the score was either 98 or 99 per cent with an average of 98.5 per cent.

Cars with no broken or cracked windows

The score on this measure was 99 per cent in all quarters of 2000/01. Again, the indicator does not include an assessment of the scratched or clouded conditions of the windows.

Lighting conditions in cars

Cars are rated acceptable under this measure if at least 90 per cent of the lights are on. Cars surveyed outside during daylight hours on open-cut/elevated track are excluded from this measure.

In 2000/01, the score was either 99 or 100 per cent with an average of 99.25 per cent.

Climate control conditions in cars

This indicator measures the percentage of cars with functioning air conditioning or heating (with the temperature in the car being between 10 and 25.6 °C), or fans (at least 75 per cent operating when the temperature is above 25.6 °C).

In 2000/01, New York City Transit's score on this measure varied from 93 per cent in the summer to 100 per cent in the winter, with an average of 97 per cent.

Litter conditions in stations

In a similar way to the car cleanliness indicators, this measure and the next one (floor and seat cleanliness conditions in stations) are measured both before heavy passenger utilisation (pre AM peak) and after (post AM peak).

The station litter indicator is reported as a weighted average of the ratings for each of the components of the station (e.g. mezzanines, stairways and platforms). Track bed litter as viewed from the station platforms is evaluated together with station litter. The indicator not only assesses the quantity of litter but also the nature of it.

The average 2000/01 score is reported in Table D.4.

Table D.4
New York Litter Conditions in Stations, 2000/01

Litter conditions in stations[54]	Pre AM peak (%)	Post AM peak (%)	
	2000/01 average (%)	2000/01 average (%)	2001 target (%)
None	27	10	79
Light	51	56	
Moderate	21	32	
Heavy	2	2	

Sources: New York City Transit Passenger Environment Survey, Second Quarter 2001; New York City Transit Strategic Business Plan 2001-2005

Floor and seat cleanliness in stations

This indicator is measured in a similar way to the previous one, i.e. a weighted average of all components both pre and post AM peak periods. The measure also takes account of any ingrained stains or continuous leakage from drains.

The average 2000/01 scores are contained in Table D.5.

Table D.5
New York Floor and Seat Cleanliness Conditions in Stations, 2000/01

Floor and seat cleanliness conditions in stations[55]	Pre AM peak (%)	Post AM peak (%)	
	2000/01 average (%)	2000/01 average (%)	2001 target (%)
None	7	2	47
Light	38	38	
Moderate	46	48	
Heavy	9	13	

Sources: New York City Transit Passenger Environment Survey, Second Quarter 2001; New York City Transit Strategic Business Plan 2001-2005

Graffiti in stations

For this indicator, stations are measured before heavy passenger utilisation, i.e. pre AM peak. Like the other station indicators, a weighted average is calculated for each of the various areas of a station. Not only the quantity but also the type and locality of graffiti is

54 Definitions as in footnote 52.

55 Definitions as in footnote 53.

taken into account. **Any** vulgarity or graffiti obstructing signage results in a "heavy" rating for the area of the station concerned.

Table D.6 contains the average scores during 2000/01.

Table D.6
New York Graffiti Conditions in Stations, 2000/01

Graffiti conditions in stations[56]	Pre AM peak (%)
None	7
Light	38
Moderate	46
Heavy	9

Source: New York City Transit Passenger Environment Survey, Second Quarter 2001

[56] None: graffiti free or traces of removed graffiti. Light/moderate: lightly or moderate scattered graffiti. Heavy: heavy graffiti; **any** vulgarity or obstructed signage.