Police Research Series
Paper 20

Cost benefit analysis of traffic light & speed cameras

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Police Research Group: Police Research Series

The Home Office Police Research Group (PRG) was formed in 1992 to carry out and manage research in the social and management sciences relevant to the work of the police service. The terms of reference for the Group include the requirement to increase the influence of research and development work on police policy and practice.

A key area of work for the group is identifying and disseminating good policing practice. The aim of the Police Research series is to present results of externally funded studies, and those carried out by the Police Research Group, in a way that will inform policy and practice throughout the police service.

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Foreword

Over the last decade, the police service has made an increasing use of technology in order to provide effective and efficient policing. The use of camera technology for the enforcement of road traffic law is yet another example of how technology can assist the police.

We must not assume, however, that such technology automatically generates benefits in excess of its costs. The current study has made a detailed assessment of the costs and benefits associated with traffic camera technology. This demonstrates that the benefits generated by such cameras far outweigh the costs of purchasing, installing and running them.

S W BOYS SMITH
Director of Police Policy
Home Office,
August 1996

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- the study steering group, which represented both the Home Office and the police service and which provided support and advice throughout the duration of the research.
- the chief constables, officers and staff of the main study forces of Dorset, Devon and Cornwall, Essex, Gloucestershire, Greater Manchester, Lancashire, the Metropolitan Police Service, Northumbria, Thames Valley and Wiltshire.
- the Association of Chief Police Officers (Traffic Committee).
- representatives from highways authorities in the ten study areas, the Traffic Control Systems Unit (TCSU) and the Department of Transport.
- the Justices' Clerks' Society and representatives from the magistrates' courts in the ten study areas.
- lawyers and staff from Crown Prosecution Service branches in the study areas.
- academics, researchers and practitioners from organisations and interest groups involved in the development of camera enforcement strategy.

The Authors

The authors are consultants employed by Price Waterhouse Management Consultants. Andrew Hooke, Jim Knox and David Portas are members of the Price Waterhouse team which specialises in consultancy support to the Home Office and Criminal Justice Agencies.

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Executive Summary

Terms of reference

In November 1995, a cost benefit analysis of traffic light and speed cameras was commissioned by the Home Office working in conjunction with ACPO Traffic Committee. The overall terms of reference for the study were:

> *"to provide a detailed and rigorous cost benefit analysis in relation to traffic light and speed cameras by identifying and quantifying the whole range of relevant factors and producing a comprehensive and clear account of the analysis process"*.

The types of costs and benefits considered relevant included:

- the costs of purchasing, installing, operating and maintaining the cameras
- the costs to the courts and the Crown Prosecution Service (CPS) resulting from the use of the cameras
- the costs of associated publicity campaigns
- savings in human life and injury, as well as those associated with reduced damage to property
- savings experienced by the police and emergency services as a result of attending fewer road accidents
- savings experienced by the health service as a result of dealing with fewer road accident victims
- fine income generated as a result of camera use
- improved traffic flow, reduced journey times and an 'improved environment'.

Study methodology

The cost benefit analysis was carried out between November 1995 and March 1996 by management consultants employed by Price Waterhouse. The data collection exercise focused on ten police force areas which were selected in accordance with a range of pre-defined criteria including number of cameras, experience of their use, force size, degree of urbanisation, road length and number of traffic officers. Detailed information was also collected from local authorities, magistrates' courts and CPS branches in each of these ten force areas.

During the course of the study, supplementary information was obtained from a range of other agencies involved in establishing and operating traffic light and speed cameras. These included the Department of Transport and the Driver Vehicle Licensing Agency. The research was also informed by interviews with academics and other interested parties.

Key study findings

Use of cameras: The number of police forces using speed and traffic light cameras has increased steadily in recent years. In 1994, it was estimated that just over half of all police forces were using cameras. The number of cameras in use then was still relatively small with just over 30 speed cameras and 54 traffic light cameras. Data from the current study indicates that by March 1996, in ten forces alone, there were 102 cameras servicing more than 700 sites (475 speed cameras plus 254 traffic light) - confirming the continued growth in the use of camera technology.

The majority of the cameras in use, at the time of the current study, were `wet film' cameras which are usually unmanned and mounted on fixed roadside poles. Some cameras were mounted on portable tripods to allow them to be shifted between sites and a small number of video cameras were found to be in use.

Costs of cameras: Data was collected in the ten force areas on the costs associated with the installation (fixed costs) / operation (recurrent costs) of traffic light and speed cameras and with related prosecutions. These were as follows:

Traffic light cameras

– The average fixed cost per traffic light site was just over £9,200 and average recurrent costs were over £5,600 per annum for each site

– 86% of the fixed costs for traffic light cameras were met by local authorities and the police service met 67% of recurrent costs. (Magistrates' courts accounted for 25% of these recurrent costs.)

– The average number of traffic light prosecutions per site was 123 with an average cost per prosecution of £46. (80% of these offences were dealt with by way of fixed penalty.)

Speed cameras

– The average fixed cost per site for a speed camera was £12,500 and average recurrent costs were just over £8,500 per annum for each site.

– 68% of the fixed costs for speed cameras were met by local authorities and 20% were met by the police service. The police service also met 64% of the recurrent costs associated with speed cameras. (Magistrates' courts accounted for over 30% of these recurrent costs.)

– Each site generated an average of 316 speed related prosecutions per annum, although there was considerable variation between sites. The average cost per prosecution was £27. (86% of these offences were dealt with by way of fixed penalty.)

Benefits of cameras: The following benefits were identified in the ten force areas:

– Accidents fell by 28% at speed camera sites or by 1.25 accidents per site per year

– Accidents fell by 18% at traffic light sites or by 0.48 per site per year

– Speeds were reduced by an average of 4.2 mph per site

Wider benefits: It was also noted that:

– Many forces had found that the use of camera technology released traffic officers for other duties. (An earlier Police Research Group study indicated that a saving of just one percent in traffic officer time could equate to a saving of up to £4 million at a national level.)

– Camera technology can contribute to the investigation and detection of other crime by, for example, identifying stolen vehicles and those involved in other crime or by providing information for criminal intelligence units.

– Anecdotal evidence indicated that local communities derive benefit from the knowledge that speeds will be reduced and accidents will fall.

Cost benefit analysis: The costs of installing and operating traffic light and speed cameras were contrasted with the monetary value of benefits brought about by accident reduction and prosecution. This showed that a significant net benefit was generated for both speed and traffic light cameras.

The results of this cost benefit analysis for the ten force areas are summarised in the table below for the 420 operational sites:

Table: Summary of costs and benefits over one, five and ten year periods

All areas	No of sites	Annual fixed costs (£000)	Annual recurrent costs (£000)	Annual Fine income (£000)	Accident reduction benefit (£000)	Net present value of benefit (cost) in £000 to all areas by:		
						1 year period	5 year period	10 year period
Speed cameras	420	(5,264)	(3,595)	6,730	30,239	26,391	136,074	241,690
Traffic light cameras	241	(2,188)	(1,353)	1,632	6,663	4,243	26,527	47,986

Note: Accident reduction benefits shown above are based on figures provided within Department of Transport's Highways Economics Note 1.

Some of the analysis in the main text also covers 55 planned sites. Thus, summary data is not directly comparable in all cases.

Detailed findings included the following:

– The £5.3 million investment made to install speed cameras *generated a return of five times this amount* after one year and more than 25 times the amount after five years. All areas achieved a positive return after one year and, in nine out of ten forces, fine income covered the 'cost' of operations;

– For traffic light cameras, all areas but three achieved a positive benefit within a year of the investment. Overall, the return was nearly twice the investment after one year and twelve times this by year five;

– Modelling with more pessimistic assumptions (e.g. decline in incident reductions, reductions in fine income) still produced a substantial net benefit for both speed and traffic light cameras.

Conclusions

The cost benefit analysis demonstrated that the use of both traffic light and speed cameras generated substantial net benefits. It was also shown that the 'pay back' period for this technology was fairly short and that implementation has led to a reduction in the number of road traffic accidents at camera sites.

The study also generated a number of good practice guidelines which are presented in the main report. These suggest that the level of benefit derived from the use of cameras was linked to the manner in which they are deployed. Further gains might be produced by careful implementation of existing Home Office/Department of Transport guidelines.

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1. Introduction

Background to the study

Road traffic accidents represent a considerable cost both to those individuals directly affected and to society as a whole. The government has set a national target to reduce traffic casualties by one third by the year 2000 (as compared to the average level between 1981 and 1985). The most recently published figures for accident levels are reproduced within Table 1 below. This shows that, in 1995, there were 311,208 casualties resulting from traffic accidents of which 3,655 were fatal and 45,221 were serious. Overall, the total number of casualties in 1995 was over 3% lower than a decade earlier and the number of fatal and serious accidents was more than a third lower. (The size of the overall reduction was deflated by the fact that slight injury accidents had increased by 8%.) Nonetheless, current accident levels still represent a considerable toll in personal and economic terms and there is need for further progress if the national target is to be met and maintained.

Table 1: Numbers of fatal, serious and slight road traffic accidents in 1993-95 compared to average for base period 1981-85

Severity	1995	1994	1993	1981-1985 (average)
Fatal	3,665	3,650	3,814	5,598
Serious	45,221	46,531	45,009	74,532
Slight	262,322	265,008	257,197	241,782
All	311,208	315,189	306,020	321,912

Reducing the level of road traffic accidents

Responsibility for safety on the roads is shared between a number of agencies in England and Wales. The recent Review of Police Core and Ancillary Tasks (Home Office, 1995) defined “the reduction of road accidents and consequent casualties” as being a key aim of traffic policing. Traffic law enforcement is primarily focused on this problem. However, local authorities also have a responsibility to promote road safety on roads within their area, whilst safety on motorways and trunk roads is the concern of the Highways Agency of the Department of Transport.

For many years, the above agencies have actively worked to reduce road traffic accidents and a range of factors have been identified which influence both their number and seriousness. For example, road layout, signing and lighting have been found to be of importance, as have improved vehicle safety features. Research has also demonstrated that securing greater compliance with road traffic law can play a

key part in reducing accidents. Research by the Transport Research Laboratory (TRL) suggested that each one mile per hour reduction in average speed can produce a 5% reduction in injury accidents (Maycock, 1993). Other research shows that non-compliance with traffic light signals also increases the risk of an accident occurring (Hall, 1986). Research based evidence is supported by guidance contained within Department of Transport circular 1/92 which argues that:

> *"increasing compliance with speed limits and traffic light signals should therefore bring about significant reductions in accidents, thereby contributing to the overall target for casualty reduction".*

Use of technology

In recent decades, increasing use has been made of technological innovations, such as the radar gun, to promote compliance with road traffic law. This trend was supported by the 1988 North Report, which recommended that modern camera technology should play a greater role in the context of traffic law enforcement (Department of Transport/Home Office, 1988). The necessary legal framework to support this recommendation was put in place by the Road Traffic Act 1991. The Act came into force on 1 July 1992 and introduced:

- a power for local authorities to install and maintain roadside camera equipment
- expanded police powers to require information about the identity of a driver (granted under Section 172 of the Road Traffic Act 1988)
- provision for evidence generated by speed and traffic light cameras to serve as the sole evidence against the offender (without corroborative evidence from police officers) providing that the technology used was a type approved by the Home Secretary
- a new conditional offer of fixed penalty which could be sent through the post thus allowing increased volumes of recorded offences to be dealt with.

Since the introduction of the Road Traffic Act 1991, the number of police forces using camera technology, and the extent of their use, has increased steadily. By 1994, just over one half of all police forces were using speed cameras, although the number of cameras in use was still relatively small – approximately 30 speed cameras and 57 traffic light cameras. Data gathered as part of the current research exercise indicates that by 1996 there were, in ten forces alone, 102 cameras serving more than 700 sites confirming the continued growth in this type of technology.

Current research aims

Speed and traffic light cameras represent one technology available to those agencies engaged in the overall strategy to reduce traffic accidents. Research undertaken outside the UK has supported the introduction of such technology and has provided some evidence regarding accident reduction (see, for example: Victoria Police, 1994). Assessments of the impact of camera technology have also been undertaken on behalf of a number of police forces within England and Wales, but accounts of these largely remain unpublished. This issue was given detailed consideration by the Review of Police Core and Ancillary Tasks which recommended that current arrangements for funding camera technology should be reviewed (Home Office, 1995).

In response to the Review's recommendations, representatives of the Home Office and of the Traffic Committee of the Association of Chief Police Officers (ACPO Traffic) agreed that a detailed study of the costs and benefits of traffic light and speed cameras should be commissioned. The study formally commenced in late 1995 with the following terms of reference:

> *"to provide a detailed and rigorous cost benefit analysis in relation to traffic light and speed cameras, by identifying and quantifying the whole range of relevant factors and producing a comprehensive and clear account of the analysis process".*

The types of costs and benefits addressed by the study were to include:

- the costs of purchasing, installing, operating and maintaining the cameras
- the costs to the courts and the Crown Prosecution Service (CPS) resulting from the use of the cameras
- the costs of associated publicity campaigns
- savings in human life and injury, as well as those associated with reduced damage to property
- savings experienced by the police and emergency services as a result of attending fewer road accidents
- savings experienced by the health service as a result of dealing with fewer road accident victims
- fine income generated as a result of camera use
- improved traffic flow, reduced journey times and an 'improved environment'.

Research methodology

The primary data collection exercise for the research was completed between November 1995 and March 1996. This focused on ten police forces areas, which were selected using a range of criteria, including numbers of cameras, experience of their use, force size, traffic officer establishment, urban/rural split and typical prosecution procedure (fixed penalty versus summons). It would be unrealistic to suggest that these ten areas perfectly represented all 43 police forces within England and Wales. Accordingly, no national estimates have been generated from sample results. However, the sample was considered to reflect all key features.

During the course of the research, data on costs and benefits was collated from all agencies directly involved with the introduction and operation of speed and traffic light cameras in the force area. These agencies included the police service, local authorities, the Highways Agency of the Department of Transport, the magistrates' courts and the CPS. The data was used to provide separate accounts of the costs and benefits experienced by each agency. An overall assessment of costs and benefits, known as the cost benefit equation, was then produced using this material.

The research was also informed by interviews with the Department of Transport, the Driver Vehicle Licensing Agency (DVLA), academic institutions and other interested parties.

Structure of the report

The remainder of this report is structured as follows:

- Use of cameras: Section 2 provides an account of background issues linked to traffic light and speed cameras in order to place subsequent analysis in context.
- Costs: Section 3 examines the costs associated with the use of traffic light and speed cameras and indicates the degree to which these were borne by each of the principal agencies involved.
- Benefits: Section 4 provides an account of the key benefits generated by traffic light and speed cameras.
- Overall cost benefit equation: Section 5 draws together the cost and benefit information in money terms and indicates what overall gains and losses follow from the use of traffic light and speed cameras.
- Good practice: An account of good practice issues identified during the research is provided in Section 6.
- Conclusions: The overall conclusions of the report are presented within Section 7.

2. Traffic light and speed cameras: the context

Cameras included in the research

Speed cameras

The categories of speed camera considered were:

Wet film speed cameras: These consist of a basic camera attached to a radar unit which measures vehicle speed and 'triggers' the production of still-frame photographs when a subject is identified as travelling above a specific speed. Information on vehicle speed is recorded electronically on the picture to produce evidence of an offence. A second picture of a speeding vehicle is usually taken fractionally later to provide an independent method of proving the speed.

Wet film cameras are normally unmanned and mounted on the roadside on fixed position poles. They can also be mounted on portable tripods and moved between sites e.g. to deter speeding at temporary roadworks.

Video based cameras: These are typically used to take a continuous picture of traffic moving along a stretch of road. A police presence is maintained at the roadside in order to monitor the video pictures. Vehicle speed information is generated by either permanent or portable road level sensors and recorded on the picture.

Traffic light cameras

Traffic light cameras are invariably wet film cameras mounted on a fixed position pole close to the traffic lights under surveillance. They are activated when a vehicle travels beyond the stop line at a specified period (e.g. one second) after the red light shows. The conditions under which such cameras are activated can be varied e.g. to avoid drivers being photographed after stopping very slightly over the stop line.

The current study focused exclusively on the cameras described above and these will be referred to collectively as "traffic cameras" within the current report. No consideration was given to:

- radar guns or other devices used to assess vehicle speed which do not record a photographic image of the offence.
- cameras used to monitor traffic flow or volume.

The study does not cover the M25 Controlled Motorway pilot which uses variable speed limits. This is the subject of a separate evaluation.

Installation and operation of cameras

Procedures used as part of the installation and operation of traffic light and speed cameras vary to some degree between force areas. However, the research suggested that typically the process will include the following elements:

Planning

Whilst a local authority has the wherewithal to install a camera, only the police have the authority to use the camera for law enforcement purposes. Thus, the effective deployment of traffic camera technology requires close collaboration between the police and the local authority. In the London Metropolitan Police area, a Traffic Control Systems Unit (TCSU) operates to support deployment planning (as well as installation and maintenance) for cameras on behalf of the local authorities.

In other areas, the relationship is less formalised and the process usually begins with the local authority preparing a list of high risk sites (often supported by accident data from preceding years). Sites may sometimes be suggested by the police on the basis of local knowledge. The police and the local authority will then identify 'deserving sites' and consider whether camera installation is:

– necessary e.g. will an alternative approach suffice?

– feasible e.g. can power be provided? will the camera obstruct pedestrians or obscure existing road signs?

– operable e.g. can access to the camera be arranged for maintenance?

Consideration will also be given to whether a site requires a dedicated camera or whether, as usually happens, the equipment can be rotated between a number of sites. Guidance from the Department of Transport (circular 1/92), the Home Office (HON 38/1992) and the Welsh Office (circular 22/92) is that in:

> *"developing strategies for deployment and in identifying sites, authorities need to bear in mind that the ultimate objective is to maximise the road safety benefits which can be achieved in any given area".*

In other words, the aim of deploying cameras is not to maximise the number of offenders prosecuted, but to contribute to road safety and accident reduction. The joint guidance also stresses:

- the need for camera siting to take into account accident statistics

- that cameras should be used as a measure of last resort e.g. where other solutions (such as traffic calming) are impractical or have proved insufficiently effective.

Procurement

Once the planning process is complete, procurement procedures are put in place and, most commonly, these lead to the acquisition of static wet film cameras, but mobile video cameras are also popular. In order to make cost effective use of resources, most forces have also acquired 'dummy' cameras (which can, for example, flash at speeding vehicles as if a picture was being taken). These are intended to maximise the deterrent effect of the technology.

The costs of procuring both real and dummy camera equipment are met by the either the police or the local authority or shared between them.

Installation

The installation of an operational wet film camera site requires the erection of a fixed position pole and the provision of a continuous supply of electricity. Road markings are usually made to allow a secondary assessment of vehicle speed. Video camera equipment requires road sensors to measure vehicle speed. These may be either portable – in the form of tubing installed by the police – or permanently set into the road.

Signing

Department of Transport guidance suggests that the presence of traffic enforcement cameras should be signed in order to maximise the deterrent effect, but advises against the signing of specific sites. Signing is a cost borne by the local authority. A number of different approaches to signing have been adopted. These may involve a camera symbol alone or a camera symbol accompanied by words of warning or both.

Publicity

Police forces and local authorities can also use publicity to promote awareness of cameras among drivers in order to encourage them to modify their behaviour without need for enforcement. Such publicity may include the production of leaflets and poster campaigns, as well as appearances on the television and radio. Publicity costs are therefore both direct (e.g. costs paid to a print company) and indirect (e.g. officer or staff time spent briefing journalists).

Operation

Camera equipment is operated by the police. Wet film cameras at permanent sites are usually left unmanned, but there are a number of discrete tasks requiring police input:

- moving cameras and dummy cameras between sites
- removing and developing camera films on a regular basis
- viewing processed films to identify inappropriate prosecutions (e.g. emergency service vehicles en route to an incident)
- where a prima facie offence is confirmed: identifying the vehicle's 'registered keeper' (via the police national computer) and initiating the enforcement process.

Video cameras are highly portable and are frequently moved from site to site. They are usually accompanied by police officers when filming and therefore have an additional resource cost – in terms of police officer time – compared to unmanned wet film cameras.

The costs of camera operation are generally borne by the police. However, in at least one case, a local authority has made a grant contribution towards operating costs.

Maintenance

Both camera equipment and their housings need to be maintained. (Camera equipment must be calibrated at least annually to check the accuracy of the system.) Ad hoc repairs may also be required, for example, when camera flash bulbs expire. The costs of maintaining camera equipment are usually borne by the police, whilst the costs of maintaining the sites are met by the local authority. Generally speaking, site maintenance requirements are not great unless a camera site is damaged. Police and local authorities may have a service contract with a camera supplier, or facilities management company, or may pay for repairs on an ad hoc basis.

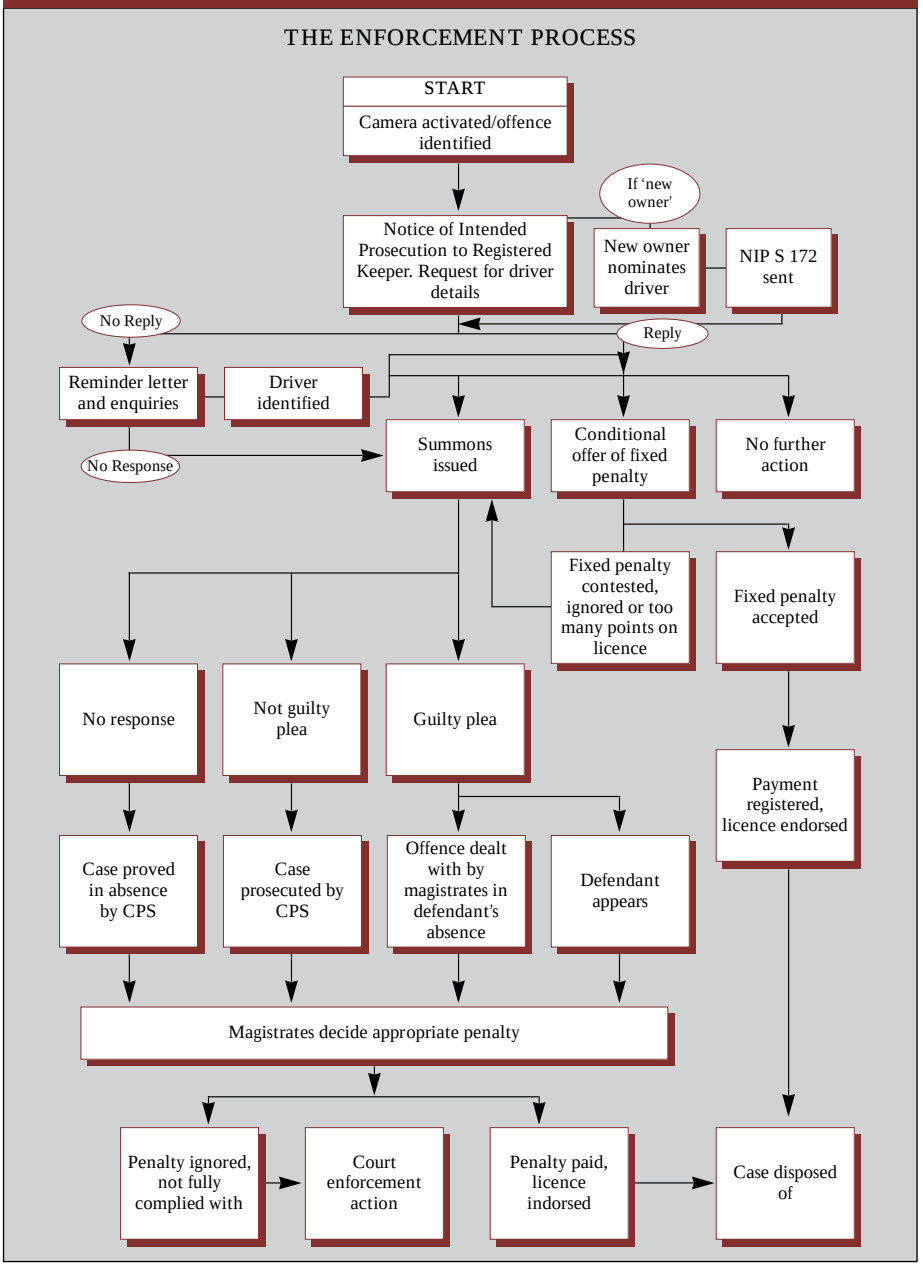
Enforcement of offences detected by camera

A broad overview of the process of enforcement of offences detected by traffic cameras is set out in Figure 1. This is explained more fully below.

Notice of Intended Prosecution

Details of an offence captured on camera are recorded on file and a Notice of Intended Prosecution (NIP) is sent out to the registered keeper of the vehicle. This

Figure 1: Overview of the process of enforcement for offences detected by traffic cameras



is accompanied by a statutory notice (Section 172 Road Traffic Act 1988) requiring the registered keeper to provide details of the driver at the relevant time.

If the keeper replies within the allotted 28 day period and identifies the driver either a conditional offer of fixed penalty or summons is issued to the offender. Generally speaking, a summons is used where the offence cannot be appropriately dealt with by fixed penalty (e.g. because the driver was exceeding the speed limit by an excessive amount). However, a limited number of forces deal with all camera generated offences by way of summons. Use of the conditional offer of fixed penalty requires appropriate processing software and this had not been purchased by all forces at the time of the research.

Fixed penalty enforcement

Conditional offers of fixed penalty are usually issued by police central ticket offices. (This office also administers other types of fixed penalty, but additional work is obviously generated by camera related detections.) If the fixed penalty is accepted by the offender, a payment of £40 (plus driving licence) must be returned to the Fixed Penalty Office of the local magistrates' court. The office then registers the payment, endorses (and returns) the licence and informs the DVLA.

Summons

If the driver of the vehicle does not accept the conditional offer of fixed penalty, or makes an inadequate response, the prosecution proceeds by way of summons (along with cases initially identified as being inappropriate for fixed penalty processing). A summons is also issued for those registered keepers who fail to respond to the Section 172 notice within the allotted 28 day period. It is a separate offence for the registered keeper to fail to notify the police of the identity of a driver at the time of the offence and this can lead to a fine and the endorsement of a licence.

Usually, a summons is issued by the police following a request from the court which will determine the appropriate day for hearing the case. The recipient of the summons has the option of pleading guilty by post without attending court. (The vast majority of summons offences are disposed of in this way.) Some defendants, though admitting the offence, will choose to attend the court to put mitigating circumstances. Only a small minority of cases will be contested. In another group of cases, there will be no response to the summons whatsoever.

If the defendant denies the offence or does not respond to the summons, a prosecution file will be produced by the police 'process unit' and sent to the CPS. (The unit is part of a police force and is responsible for generating paperwork needed by the CPS to prepare cases.) The CPS will review the prosecution file and

determine whether the case is justified. If the prosecution proceeds, the CPS will attend the court and can prove the case in the absence of the defendant.

Magistrates' courts decide the penalties appropriate in summons cases which are admitted or upheld. These penalties usually involve a fine and the award of costs to the police or to the CPS. If a fine is not paid, the court may initiate recovery proceedings either through bailiffs or, more exceptionally, through police warrant.

3. Traffic cameras: related costs

Fixed v recurrent costs

Traffic camera costs can be grouped into two types as follows:

- Fixed costs are incurred on a one-off basis and include, in this instance, planning, procurement, installation and signing costs.
- Recurrent costs are incurred every year and include the operation and maintenance of cameras, and related liaison and publicity. Costs associated with enforcement also constitute recurrent costs.

The remainder of this section presents a detailed picture of the fixed and recurrent costs associated with speed and traffic light cameras respectively. The extent to which these categories of costs are borne by the various agencies involved is also considered. This cost information is based on material collected from a wide range of agencies during the course of the research. A detailed account of the data collection process, and the methods used to convert this into cost estimates, is contained within Appendix A.

Fixed costs

Tables 2 and 3 show the composition of fixed costs within the ten study areas for speed cameras and traffic light cameras respectively. The costs shown are the total costs expected to be spent up to the end of the financial year 1995/96. The number of sites to which these costs relate is also shown, along with the fixed cost per site. Some of these sites were not fully operational when fieldwork commenced (January 1996), but areas could not always separate out expenditure on operational sites. Hence, total fixed costs cover planned as well as operational sites.

Speed cameras: fixed costs

Overall, the ten areas considered as part of the research had invested some £5.9 million in planning, procuring and installing 475 speed camera sites and 66 cameras and in providing associated signing and support equipment (e.g. systems for viewing photographs). The average fixed cost per site across all ten areas was around £12,500.

More than 80% of the fixed costs for speed cameras related to the procurement and installation of cameras. Signing accounted for just under 5% of total fixed costs and other equipment for just over 10%. The costs associated with planning were relatively very small (under half a percent).

There was considerable variability in the average fixed cost per site between areas. Factors which may at least partially explain this include:

* Site camera ratio: The number of sites at which each camera was used (the site camera ratio) was found to vary significantly – from 1:2.4 (force area 3) to 1:17 (force area 4). A basic camera can cost some £20,000 and differences in these ratios will inevitably have a significant impact on the fixed costs per site.

* Degree of urbanisation: In rural areas, the costs of camera installation can be substantially inflated. For example, by the difficulty of providing power to a remote location.

* Support equipment: Force strategies affected the amount of additional or support equipment costs to be covered. (For example, software to speed up production of Notices of Intended Prosecution). This is one factor explaining the exceptionally high costs per site in area 10.

It was also noted that some areas had no dummy cameras, while others employed this cheaper form whenever a real camera was not in use. The impact of using dummy cameras was not explored within this study, but this can be expected to affect the level of fixed costs – and to influence driver behaviour – to some degree. (The issue is discussed again in Section 6.)

Table 2: Speed cameras – analysis of fixed costs for 1995/6 (total and per site)

Area	Planning £	Procure-ment and installation £	Signing £	Other fixed costs £	Total fixed costs £	No of sites	Fixed cost per site £	Sites per camera
1	1,697	355,855	13,093	5,204	375,849	46	8,171	7.7
2	778	269,266	2,542	6,249	278,835	23	12,123	11.5
3	1,503	337,221	19,705	121,629	480,057	19	25,266	2.4
4	2,812	257,162	5,951	10,323	276,247	17	16,250	17.0
5	0	128,662	10,048	2,443	141,153	12	11,763	6.0
6	3,782	218,418	15,195	4,831	242,226	27	8,971	13.5
7	4,715	1,075,968	62,540	0	1143,223	129	8,862	8.1
8	3,833	224,119	0	3,614	231,566	21	11,027	7.0
9	4,253	1,922,757	130,585	454,028	2511,623	176	14,271	7.3
10	2,982	177,428	14,688	96,075	291,173	5	58,235	2.5
All areas	26,355	4,966,856	274,347	704,396	5,971,952	475	12,573	7.2

Note: Zero values in Tables 2-7 represent nil costs and not “information unavailable”.

Traffic light cameras: fixed costs

The ten areas spent some £2.4 million on 254 traffic light sites and 36 traffic light cameras. Almost 94% of these costs were accounted for by procurement and installation. The average fixed cost per site was £9,266 across all ten forces. The lower cost per site, relative to that for speed cameras, is partially explained by the fact that areas invested less in signing traffic light camera sites. (In three areas, there was no spending on signing for these types of cameras.) The installation costs for traffic light cameras can also be cheaper as power will already be available for the lights themselves.

As with speed cameras, there was considerable variation in fixed costs per site. The site camera ratio may again explain these differences to some degree. Those areas with the lowest number of sites per camera – areas 3 and 10 – were also found to have the highest fixed costs per site.

Table 3: Traffic light cameras – analysis of fixed costs for 1995/6 (total and per site)

Area	Planning £	Procure-ment and installation £	Signing £	Other fixed costs £	Total fixed costs £	No of sites	Fixed cost per site £	Sites per camera
1	869	158,661	0	546	160,076	21	7,623	7.0
2	1,478	184,817	3,035	1,401	190,731	21	9,082	7.0
3	902	213,427	14,386	18,279	246,994	11	22,454	2.8
4	4,062	206,204	9,557	17,454	237,277	20	11,864	10.0
5	0	124,331	0	357	124,688	13	9,591	6.5
6	1,335	71,883	5,117	4,769	83,104	6	13,851	6.0
7	4,678	771,584	35,958	0	812,220	128	6,345	8.0
8	3,593	230,080	0	386	234,059	15	15,604	15.0
9	450	207,439	324	8,072	216,285	18	12,016	6.0
10	596	35,013	2,122	10,425	48,156	1	48,156	1.0
All areas	17,963	2,203,439	70,499	61,689	2,353,590	254	9,266	7.0

Recurrent costs

Speed cameras: recurrent costs

Table 4 shows that, across the ten areas, some £3.6 million per year was spent operating the speed camera sites. The cost per site per annum was £8,560.

Table 4: Speed cameras – analysis of recurrent costs (total and per site)

Area £	Liaison £	Publicity £	Operation £	Maintenance £	Camera Unit Administration £	Fixed penalty enforcement £	Summons enforcement £	Other costs £	Total costs £	Cost per site £
1	1,144	3,551	141,387	8,608	48,190	56,795	153,919	1,741	415,335	10,130
2	170	8,519	23,910	821	39,729	26,526	20,479	5,963	126,117	12,612
3	4,448	863	23,897	2,931	137,035	70,955	161,924	1,198	403,251	26,901
4	5,112	1,905	4,197	1,541	9,090	0	119,149	1,517	142,512	15,835
5	2,898	765	9,272	1,099	0	48,957	150,942	12,502	226,435	28,304
6	1,202	752	3,750	170	43,281	5,516	3,587	0	58,257	3,427
7	1,981	1,215	145,222	21,600	210,448	476,226	312,703	30,009	1,199,404	9,298
8	2,507	285	19,142	2,415	27,979	40,954	127,567	0	220,849	13,803
9	7,334	9,337	57,607	30,074	161,024	151,871	259,986	414	677,647	3,986
10	1,135	2,702	14,877	4,702	7,398	0	94,586	0	125,400	25,080
All areas	27,931	29,894	443,261	73,961	684,174	877,800	1,404,842	53,344	3,595,207	8,560
% of total costs	0.8%	0.8%	12.3%	2.1%	19.0%	24.4%	39.1%	1.5%	100%	

It can be seen that the bulk of the recurrent costs for speed cameras was accounted for by enforcement with over 63% being taken up by fixed penalty and summons enforcement. Publicity costs, and the costs of liaising between agencies involved with cameras, were small – in total they accounted for less than 2% of costs. All areas had taken some steps to publicise the cameras in their areas, but – in the main – this consisted of briefing the press and radio and accounted for relatively small amounts of officer or staff time. There were only a few examples of the production of leaflets or posters for dissemination.

Maintenance costs also represented only a small fraction of total recurrent costs for speed cameras. The experiences of the force areas involved in this research suggested that the cameras and their sites were typically very reliable.

The analysis highlights the differences in the annual recurrent costs per site. These varied between £3,427 (area 6) and £28,304 (area 5). Two important reasons for these differences are:

* differences in the volume of prosecutions per site: for example, area 6 generated only 93 detected offences per site compared to 2,134 for area 5 which had a much higher average cost per site.

* differences in the composition of prosecutions: some areas (4 and 10) did not use conditional offers of fixed penalty and dealt with all offences by way of summons. This inflates enforcement costs. It is estimated that a fixed penalty can be administered by the courts for the cost of a few pounds; the cost of processing a summons case is closer to £50.

There also appeared to be significant differences in the costs of camera unit administration (a police cost). This cost is mainly allied to variations in the volume of detections since it involves issuing Notices of Intended Prosecution and dealing with associated correspondence and enquiries. However, it should be noted that responsibility for camera operation is distributed differently in different police forces and this may be reflected in the way costs have been recorded under camera operation, camera unit administration and police fixed penalty work.

Traffic light cameras: recurrent costs

Table 5 shows that the ten areas considered by the research spent over £1.35 million per annum operating traffic light cameras, equating to a cost of £5,613 per site. This is significantly less (34%) than the cost of operating a speed camera site. Much of this difference is explained by the fact that each traffic light camera site (across the ten areas as a whole) generated on average only 40% of the total prosecutions of a typical speed camera site. Hence, the costs of enforcement (as well as camera unit administration) were proportionately lower, but nonetheless accounted for 77% of recurrent costs.

As with speed cameras, there were substantial differences between areas in terms of annual operating costs per site. These varied from £1,307 (area 9) per site to £22,500 (area 10). This variation is largely explained by the number of cases generated by each site and the enforcement route taken. For example, area 10 was found to prosecute all offences by way of summons, whereas area 9 generated the lowest number of prosecutions per site per year. (The 37 prosecutions per site in area 9 compares with over 450 in area 6.)

Table 5: Traffic light cameras – analysis of recurrent costs for 1995/6 (total and per site)

Area £	Liaison £	Publicity £	Operation £	Maintenance £	Camera Unit Administration £	Fixed penalty enforcement £	Summons enforcement £	Other costs £	Total costs £	Cost per site £
1	589	841	57,815	4,646	5,053	5,982	19,656	897	95,479	4,547
2	330	295	21,296	1,349	8,908	5,997	9,625	1,337	49,138	2,586
3	2,682	440	11,144	1,885	21,069	10,958	26,122	722	75,012	8,335
4	7,365	1,851	5,566	2,601	15,300	0	193,060	2,183	227,926	17,533
5	4,002	1,105	2,618	1,213	0	7,127	21,983	1,820	39,867	3,624
6	424	0	1,742	85	42,728	8,466	29,235	0	82,680	13,780
7	1,966	1,215	86,438	21,600	111,284	282,191	175,702	30,009	710,404	5,550
8	2,318	400	6,705	1,010	2,993	4,102	8,678	0	26,206	1,747
9	814	2,000	5,019	3,852	2,863	2,659	6,278	46	23,532	1,307
10	229	1,450	6,143	3,804	803	0	10,077	0	22,506	22,506
All areas	20,719	9,597	204,486	42,045	211,001	327,482	500,416	37,014	1,352,760	5,613

Camera related costs borne by key agencies

Fixed costs: key agencies

Tables 6 and 7 show the proportion of fixed costs, relating to speed and traffic light cameras respectively, which were borne by each agency. It can be seen that collectively the local authorities bear the majority of fixed costs. Considering both types of cameras together across all ten areas, the local authorities contributed nearly £6 million, compared to £1.5 million by the police and nearly £0.7 million by the Highways Agency. There was some variation by camera type:

- for speed cameras (across all ten forces), local authorities contributed 68% of fixed costs versus 23% from the police.
- for traffic light cameras (across all ten forces), the local authority contributed 86% of fixed costs and the police 8%.

For both camera types, the involvement of local authorities went beyond installation and signing and, in many cases, extended to the purchase of cameras or even of necessary viewing equipment for use by the police. In areas 2, 3, 5 and 6, the police had to make only a very small contribution to the overall investment in traffic light

cameras in their areas. In areas 3, 5 and 6, the contribution of the police to the speed camera investment was very small. The major differences observed reflect the different budgetary positions of the police and the local authority across the areas. In some areas, camera usage would be drastically reduced without the observed level of local authority contribution.

Table 6: Speed cameras – analysis of fixed costs by agency for 1995/6 (% of costs contributed in each force area)

Area	Speed cameras			
	Police	Local Authority	Highways Agency	Total
1	158,681 *42.2%*	171,119 *45.5%*	46,049 *12.3%*	375,849 *100.0%*
2	7,027 *2.5%*	271,808 *97.5%*	0 *0.0%*	278,835 *100.0%*
3	39,512 *8.3%*	429,805 *89.5%*	10,740 *2.2%*	480,057 *100.0%*
4	37,726 *13.7%*	99,300 *35.9%*	139,219 *50.4%*	276,245 *100.0%*
5	2,095 *1.5%*	131,631 *93.3%*	7,427 *5.2%*	141,153 *100.0%*
6	8,618 *3.6%*	207,308 *85.6%*	26,302 *10.8%*	242,228 *100.0%*
7*	4,715 *0.4%*	1,138,508 *99.6%*	0 *0.0%*	1,143,223 *100.0%*
8	32,887 *14.2%*	123,123 *53.2%*	75,556 *32.6%*	231,566 *100.0%*
9	900,240 *35.8%*	1,454,349 *57.9%*	157,034 *6.3%*	2,511,623 *100.0%*
10	181,677 *62.4%*	30,093 *10.3%*	79,403 *27.3%*	291,173 *100.0%*
All	1,373,178 *23.0%*	4,057,044 *67.9%*	541,730 *9.1%*	5,971,952 *100.0%*

* The contribution of the Highways Agency could not be separately identified for this area.

Table 7: Traffic light cameras – analysis of fixed costs by agency for 1995/6 (% of costs contributed in each force area)

Area	Traffic Light Cameras			
	Police	Local Authority	Highways Agency	Total
1	23,215 *14.5%*	131,566 *82.2%*	5,295 *3.3%*	160,076 *100.0%*
2	2,879 *1.5%*	187,852 *98.5%*	0 *0.0%*	190,731 *100.0%*
3	4,893 *2.0%*	242,101 *98.0%*	0 *0.0%*	246,994 *100.0%*
4	34,523 *14.5%*	99,197 *41.8%*	103,557 *43.0%*	237,277 *100.0%*
5	305 *0.2%*	111,915 *89.8%*	12,468 *10.0%*	124,688 *100.0%*
6	6,104 *7.3%*	77,000 *92.7%*	0 *0.0%*	83,104 *100.0%*
7*	4,678 *0.6%*	807,542 *99.4%*	0 *0.0%*	812,220 *100.0%*
8	31,520 *13.5%*	202,539 *86.5%*	0 *0.0%*	234,059 *100.0%*
9	63,023 *29.1%*	136,198 *63.0%*	17,064 *7.9%*	216,285 *100.0%*
10	11,021 *22.9%*	26,525 *55.1%*	10,610 *22.0%*	48,156 *100.0%*
All	182,161 *7.8%*	2,022,435 *85.9%*	148,994 *6.3%*	2,353,590 *100.0%*

* The contribution of the Highways Agency could not be separately identified for this area.

Local authorities may be appointed as agents for the Highways Agency of the Department of Transport and can make a financial contribution to procurement and signing of cameras on roads for which the latter has responsibility. This expenditure is then reimbursed by the Highways Agency. Information was collected from the local authorities about the proportion of fixed cost met by the Highways Agency.

Overall, the proportion was 6% for traffic light cameras and 9% for speed cameras. (These figures may be a slight underestimate as the Highways Agency contribution could not be identified in one area.) Highways Agency involvement was found to vary between areas, accounting for more than 20% of camera investment in some areas (4, 8 and 10) and nothing in others.

Recurrent costs: key agencies

Tables 8 and 9 show the breakdown of recurrent costs by agency for speed and traffic light cameras respectively. The funding profiles presented differ markedly from those

Table 8: Speed cameras – analysis of recurrent costs by agency for 1995/6 (% of costs contributed in each force area)

Police Force	Speed Cameras				
	Police	Local Authority	Courts	CPS	Total
1	223,486 *53.8%*	12,021 *2.9%*	176,715 *42.5%*	3,113 *0.8%*	415,335 *100.0%*
2	85,490 *67.8%*	11,052 *8.8%*	29,239 *23.2%*	336 *0.2%*	126,117 *100.0%*
3	216,691 *53.7%*	7,191 *1.8%*	176,254 *43.7%*	3,385 *0.8%*	403,521 *100.0%*
4	69,673 *48.9%*	6,875 *4.8%*	64,465 *45.2%*	1,499 *1.1%*	142,512 *100.0%*
5	61,133 *27.0%*	3,902 *1.7%*	158,462 *70.0%*	2,938 *1.3%*	226,435 *100.0%*
6	52,822 *90.6%*	33 *0.1%*	5,357 *9.2%*	45 *0.1%*	58,257 *100.0%*
7	919,915 *76.7%*	51,609 *4.3%*	223,808 *18.7%*	4,072 *0.3%*	1,199,404 *100.0%*
8	127,989 *58.0%*	3,203 *1.5%*	87,846 *39.7%*	1,811 *0.8%*	220,849 *100.0%*
9	423,450 *62.5%*	34,059 *5.0%*	216,845 *32.0%*	3,293 *0.5%*	677,647 *100.0%*
10	74,129 *59.2%*	10,549 *8.4%*	39,797 *31.7%*	925 *0.7%*	125,400 *100.0%*
All	2,254,778 *62.7%*	140,494 *3.9%*	1,178,788 *32.8%*	21,417 *0.6%*	3,595,477 *100.0%*

Table 9: Traffic light cameras – analysis of recurrent costs by agency for 1995/6 (% of costs contributed in each force area)

Police Force	Traffic light camera				
	Police	Local Authority	Courts	CPS	Total
1	67,985 *71.3%*	5,474 *5.7%*	21,622 *22.6%*	398 *0.4%*	95,479 *100.0%*
2	33,453 *68.1%*	5,490 *11.2%*	10,037 *20.4%*	158 *0.3%*	49,138 *100.0%*
3	42,218 *56.3%*	4,428 *5.9%*	27,832 *37.1%*	534 *0.7%*	75,012 *100.0%*
4	111,951 *49.1%*	9,093 *4.0%*	104,454 *45.8%*	2,428 *1.1%*	227,926 *100.0%*
5	11,244 *28.2%*	5,120 *12.8%*	23,076 *57.9%*	427 *1.1%*	39,867 *100.0%*
6	61,154 *74.0%*	11 *0.0%*	21,148 *25.6%*	367 *0.4%*	82,680 *100.0%*
7	533,356 *75.1%*	51,609 *7.3%*	122,554 *17.3%*	2,288 *0.3%*	710,404 *100.0%*
8	16,378 *62.5%*	3,357 *12.8%*	6,348 *24.2%*	123 *0.5%*	26,206 *100.0%*
9	13,835 *58.8%*	4,880 *20.7%*	4,737 *20.2%*	80 *0.3%*	23,532 *100.0%*
10	16,007 *71.2%*	2,161 *9.6%*	4,240 *18.8%*	98 *0.4%*	22,506 *100.0%*
All	907,581 *67.1%*	91,623 *6.8%*	346,645 *25.6%*	6,901 *0.5%*	1,352,750 *100.0%*

considered for fixed costs (Tables 6 and 7). The police met around two thirds of the recurrent costs ie operating cameras and prosecuting linked offences. The courts covered another quarter of the recurrent costs for traffic light cameras and nearly one third of the recurrent costs associated with speed cameras. The contribution of the local authority to recurrent costs was much smaller – 7% for traffic light cameras and 4% for speed cameras. The local authority contribution was mainly directed to publicity and monitoring of sites, but occasionally took the form of a grant towards police operational costs (e.g. in area 10).

Other costs

Considerable efforts were made as part of the study to identify other, less obvious costs which might be associated with the introduction of camera technology. This issue was discussed with all the key agencies involved, but no additional costs of any significance were identified. Particular attention was paid to determining whether there was any “public hostility” to the new technology, as this could have represented a major cost. There was no evidence that this was a factor. All of the areas quoted examples of drivers who had contacted their camera enforcement units (or equivalent) expressing concerns about a potential prosecution. There were also odd examples of drivers who were hostile following receipt of the Notice of Intended Prosecution. However, these types of response represented a very small proportion of overall cases.

4. Traffic cameras: related benefits

In the early stages of the study, detailed consideration was given to the benefits which traffic camera technology might yield. A number of potential benefits were identified which fell into the following three categories:

(1) the value of accident reductions linked to the use of traffic cameras resulting from:

- savings in human life and injury, as well as those associated with reduced damage to property
- savings experienced by the police and emergency services as a result of attending fewer road accidents
- savings experienced by the health service as a result of dealing with fewer road accident victims

(2) the value of fines and penalties generated by prosecutions based on evidence from traffic cameras

(3) wider benefits

- improved traffic flow, reduced journey times and an 'improved environment' resulting from both speed and accident reduction.
- improved criminal information

An assessment of these benefits is presented below.

Value of accident reductions

Camera related accident reductions

Analysis was undertaken to determine the extent to which the deployment of cameras had resulted in a reduction in the number of accidents at camera sites. The analysis was based on a 'before and after' comparison in which:

> the number of accidents on a given stretch of road or at a given traffic light location over a period (usually 3 years) before the installation of cameras
>
> was compared with
>
> the number of accidents at the site for the period following the installation of cameras.

Nine of the ten force areas were able to supply reliable data on accident levels for use in the analysis. In total, this took into account results from 174 individual speed camera sites and 78 individual traffic light sites.

Table 10 shows the average personal accident reduction per site per year for each of the nine areas providing data. This suggests that traffic cameras can contribute towards reducing the level of accidents with all but one of the areas showing either static or reduced accident rates following the introduction of cameras. (The exception – area 6 – displayed a slight increase in accident levels at traffic light sites after camera technology was introduced.) The extent of the reduction was smaller, however, for traffic light cameras than for speed cameras. On average, accidents at speed camera sites fell by 28% (or by 1.25 accidents per site per year) and accidents at traffic light sites fell by an average 18% (or 0.48 accidents per site per year). These findings accord with those of other studies on the impact of speed cameras.

This suggests that, across the ten force areas, traffic light cameras produced an annual saving of 116 injury accidents and speed cameras prevented 525 injury accidents. (Detailed data is presented in Table 12.)

It should be noted that the sites covered within Table 10 were not randomly selected, but were chosen because the local authority responsible had already collated some "before and after" data in relation to them. It was not possible to

Table 10: Average personal accident reduction at traffic light and speed camera sites per year (annualised)

	Annualised injury accidents per traffic light site				Annualised injury accidents per speed camera site			
	Before	After	Reduction (%)	Sites sampled	Before	After	Reduction (%)	Sites sampled
1	1.19	0.85	0.34 (28.6%)	18	3.17	1.65	1.52 (47.9%)	33
2	4.17	4.12	0.05 (1.2%)	2	5.67	3.93	1.74 (30.7%)	3
3	0.80	0.69	0.11 (13.8%)	6	5.25	2.62	2.63 (50.0%)	4
4	2.94	2.62	0.59 (22.8%)	13	15.18	10.29	4.89 (32.2%)	13
5	2.94	2.62	0.32 (10.9%)	10	4.08	3.17	0.91 (23.3%)	8
6	3.83	4.00	(0.17)(4.4%)	6	9.67	7.18	2.49 (25.7%)	17
7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
8	4.01	2.92	1.09 (27.2%)	8	2.57	1.93	0.64 (24.9%)	7
9	3.51	2.64	0.86 (24.5%)	14	3.73	2.95	0.78 (20.9%)	95
10	4.00	4.00	0	1	5.75	3.50	2.25 (39.1%)	4
All	2.64	2.16	0.48 (18.2%)	78	4.48	3.23	1.25 (27.9%)	174

validate the data sources. In three areas, the traffic light cameras monitored appeared to be yielding no impact. Data collection differences between authorities may have affected the number of accidents measured in respect of particular sites. The results for area 4 reflect the fact that accidents were being recorded over an untypically long stretch of road.

Time restrictions also meant that it was not feasible to undertake precise matching exercises to determine whether any reductions identified formed part of a more general underlying trend, rather than reflecting the impact of traffic cameras. Careful consideration was given to whether other factors could have accounted for the identified reductions. No evidence was found to suggest that this was the case or that the conclusions reached were unduly optimistic.

It should also be noted that local authorities were able to provide information, relating to either the average speed of traffic or the 85th percentile of traffic speeds, for 53 of the speed sites involved in the accident reduction analysis. Data was generally collated through road sensor surveys conducted over a one or two day period during the twelve months either side of camera installation. Overall, the average traffic speed reduced in 52 out of the 53 sites, showing an overall reduction in speed of 4.2 mph per site. Given that TRL research (Maycock, 1993) has indicated that a reduction in average speed of 1 mph can produce a 5% reduction in accidents, a drop in accident levels would be expected at the camera sites.

The monetary benefit of accident savings

If cameras have the intended effect of reducing accidents, a number of parties can be expected to experience benefits (or cost savings). These include the police and other emergency services (who deal with the accident), the health service (who treat the injured), insurers (who may have to meet costs associated with the accident), as well as the economy as a whole (in terms of lost output if the injured cannot work) and, of course, the victim of the accident. The Department of Transport produces estimates of the monetary value of accidents of differing levels of severity which take into account all such “benefits” (Department of Transport, 1995). The latest available estimates produced in 1995 are shown within Table 11.

The Department of Transport methodology for producing these estimates has been refined over a period of more than a decade and has already been employed in a wide range of contexts. (For example, in estimates provided to the Treasury of the monetary benefits associated with the building of new roads.) The subject is not without controversy and arguments have been advanced suggesting that the value placed on human life is insufficient.

Nonetheless, the Department of Transport estimates were found to be the most reliable and comprehensive and have been accepted here as the central estimate of the value of cameras in terms of accident reduction. (Comments are provided in Section 5 on the sensitivity of results with reference to the Department of Transport methodology.)

Table 11: Estimates of monetary value of accidents for 1995

COST ELEMENT / TYPE OF ACCIDENT	CASUALTY RELATED COSTS (£)			ACCIDENT RELATED COSTS (£)			TOTAL
	Lost Output	Medical and Ambu-lance	Human Costs	Police Cost	Insurance Admin	Damage to Property	
Fatal Accidents	£305,310	£4,110	£596,660	£1,020	£160	£5,880	£913,140
Serious Accidents	£13,660	£8,190	£83,280	£140	£100	£2,710	£108,080
Slight Accidents	£1,570	£670	£6,710	£30	£60	£1,590	£10,630
All Injury Accidents	£7,910	£1,980	£27,940	£60	£70	£1,840	£39,800
Damage Only Accidents	–	–	–	£2	£30	£1,020	£1,050
Average accident cost per injury accident (including allowance for damage only accidents)	–	–	–	–	–	–	£55,650

(Source: Highways Economics Note 1 – Department of Transport – September 1995)

Value of accident reductions linked to traffic cameras

Table 12 shows the annual monetary value of traffic camera linked accident savings in each area. This suggests that, across the ten force areas, traffic light cameras produce an annual saving of £6.7 million (based on 116 injury accidents) and speed cameras accounted for £30.3 million (based on 525 injury accidents.)

In producing Table 12, it was assumed that all sites within a force area yielded the average annual reduction recorded by those sites for which evaluation data was available. For example, the accident reduction level for traffic light cameras in area 1 was based on data from 18 of its 21 sites. It was assumed that the remaining 3 sites were equally effective at reducing accidents.

It should also be noted that not all authorities were able to break accident data down according to the type of injury (fatal, serious or slight). Hence, the estimates contained within Table 12 were based on the most recently available "average accident cost" figure (see Table 11) produced by the Department of Transport. This figure (£55,650) was based on 1994 prices and was corrected for inflation (3.5%) to produce an estimate of "average accident cost" based on 1995 prices for use in the analysis. This correction produced an estimate of £57,598. The average accident cost includes an allowance to reflect the fact that, for every injury accident which occurs, an estimated 17.7 damage-only accidents occur on urban roads and 7.8 damage-only accidents occur on rural roads.

Information was available on accident severity from a small sample (20%) of traffic light sites. If this sample was representative of all sites, traffic light cameras could be expected to save 12 fatal accidents each year and 58 serious accidents. No account was taken of this finding in constructing Table 12, but it does provide a 'feel' for the distribution of accidents prevented.

Feedback from a number of the study forces suggested that the introduction of camera technology had released traffic officers to undertake alternative duties. This suggests that practical – and not simply theoretical – benefits were already being experienced by those agencies which bear the cost of accidents.

In policing terms, the potential for savings are enormous. An activity analysis undertaken on behalf of the Home Office (Ogilvie-Smith, Downey & Ransom, 1994) has suggested that almost 11% of traffic police time is devoted to dealing with road traffic accidents. On the basis of this activity study, it has been estimated that the cost of the time spent by traffic officers on road traffic accidents in England and Wales is some £42.8 million. Thus, a saving of just one percent in traffic officer time could equate to a saving of up to £4 million at a national level. (The precise amount saved would be dependent on the level of overheads which persisted regardless of the number of traffic officers employed.)

The activity analysis also suggests that non traffic officers spend more than 2% of their time on such accidents and significant additional savings might also be generated from this source.

Table 12: Monetary value of accident reduction generated by traffic light and speed cameras in 1995/6

Area	Traffic light cameras			Speed cameras		
	No of sites providing data	Annual reduction in accidents	Imputed monetary benefit	No of sites providing data	Annual reduction in accidents	Imputed monetary benefit
1	21	7.14	411,248	41	62.32	3,589,492
2	19	0.95	54,718	10	17.40	1,002,201
3	9	0.99	57,022	15	39.45	2,272,231
4	13	7.67	441,775	9	44.01	2,534,877
5	11	3.52	202,744	8	7.28	419,312
6	6	1.02	*0	17	42.33	2,438,113
7	–	–	–	–	–	–
8	15	16.35	941,723	16	10.24	589,801
9	18	15.48	891,613	170	132.60	7,637,462
10	1	0	0	5	11.25	647,975
All areas	241	115.68	6,662,937	420	525	30,238,950

* Although sites in this area showed an increase in accidents. It was assumed that these have not been caused by the cameras and the imputed monetary benefit is therefore zero.

Value of fines and penalties

Transfer payments

Traffic cameras also generate financial benefits in terms of fixed penalty income and the recovery of fines and costs awarded by the courts against offenders. These payments represent what can be described as a “transfer” between one section of the community and another i.e. the benefit to the Treasury of additional income is offset by costs to offenders.

Strictly speaking, transfer payments should be excluded from a cost benefit analysis, since they do not represent an *additional* gain to the community as a whole. However, it is arguable that fines should be treated as a benefit for the purpose of this cost benefit assessment, since it would seem perverse to treat the consequence of law enforcement as a ‘cost’ to offenders. There are parallels in other sectors, for example, the Department of Environment treats a reduction in rent arrears as a

benefit when assessing the costs and benefits of public housing renewal projects, although technically speaking this is also a transfer payment.

Therefore, fine income has been treated as a benefit for the purposes of the main assessment, although the exclusion of fine income has also been modelled in Section 5 to show how this affects the cost-benefit equation.

Level of fines and fixed penalties

Camera technology can be seen as generating income every time fines and penalties are imposed after evidence generated by it leads to a successful prosecution. The amount of a fixed penalty is standard across the country at £40, but courts do not record the levels of fines and costs awarded in *summons* cases which are generated by cameras.

A 'typical' fine for a summons case generated by traffic cameras was therefore calculated based on the views of 19 CPS branches. These branches were also asked to estimate the proportion of camera cases in which costs were awarded and the typical level. The CPS data suggested that, where a camera case is dealt with by means of summons, the combined total of fines and costs typically awarded is £112.

Prosecutions for speeding

In 1995, the ten force areas collectively accounted for nearly 133,000 prosecutions for speeding which resulted from the use of camera technology. Of these, 86% were dealt with using fixed penalties, but the proportion of cases dealt with in this way varied substantially between areas. A summary of speed camera enforcement in each of the ten forces is presented in Table 13.

Table 13 shows that each site generated an average of 316 prosecutions per annum. This number varied markedly between areas, from 2,134 per site per year (area 5) to 93 (area 6). Clearly, areas which have more cameras per site will have the ability to generate a greater number of prosecutions for each site. However, there are also considerable variations in the number of prosecutions generated per camera, suggesting that this may also reflect differences in enforcement and prosecution policy.

The last column of the table shows the recurrent cost per prosecution. Overall, the cost per prosecution for speeding was £27. There were variations between areas and this cost was markedly higher for areas 4 and 10, where the fixed penalty system was not used.

Table 13: Speed cameras – total offences prosecuted (by fixed penalty and summons) in 1995 with offences per site / camera and associated costs

Areas	Number of speed camera sites	Total number of fixed penalties	Total number of summons	Total number of offences	Offences per site	Offences per camera	Estimated recurrent costs per prosecution
1	41	19,267	2,780	22,047	537	3,674	19
2	10	6,660	300	6,960	696	3,480	18
3	15	13,793	3,023	16,816	1,121	2,102	24
4	9	0	1,338	1,338	149	1,383	107
5	8	14,453	2,623	17,076	2,134	8,538	13
6	17	1,545	40	1,585	93	793	37
7	129	20,665	2,636	23,301	181	1,456	49
8	16	4,477	1,617	6,094	381	2,031	36
9	170	33,872	2,940	36,812	217	1,533	18
10	5	0	826	826	165	413	152
All areas	420	114,732	18,123	132,855	316	2,013	27

Prosecutions for traffic light offences

The operational traffic light sites in all ten areas accounted for nearly 30,000 prosecutions for traffic light offences. Around 80% of these were dealt with by way of fixed penalty. Findings are summarised in Table 14.

The average number of prosecutions per traffic light site (123) was lower than the comparable figure for speed cameras (319). The average recurrent cost per prosecution (£46) for traffic light offences was also around 40% higher than for speeding. This latter difference may be accounted for by the fact that, whilst each site generates fewer offences, there are still costs (in terms of operation and maintenance) that need to be dealt with. The fact that proportionately more traffic light prosecutions were dealt with by way of summons will also have an impact.

Table 14: Traffic light cameras – total offences prosecuted (by fixed penalty & summons) in 1995 with offences per site/camera and associated costs

Police force	Number of red light camera sites	Total number of fixed penalties	Total number of summons	Total number of offences	Offences per site	Offences per camera	Estimated recurrent costs per prosecution
1	21	2035	355	2390	114	797	40
2	19	1461	141	1602	84	534	31
3	9	2178	477	2655	295	664	28
4	13	0	2168	2168	167	1084	105
5	11	2104	382	2486	226	1243	16
6	6	2451	326	2777	463	2777	30
7	128	12245	2047	14288	112	893	50
8	15	472	110	582	39	582	45
9	18	593	71	664	37	221	35
10	1	0	88	88	88	88	256
All areas	241	23539	6161	29700	123	825	46

Total income from fines and penalties

Speed cameras: The total annual income, across the ten force areas, from fines and penalties generated by prosecutions linked to speed cameras was calculated as follows:

Number of fixed penalties (114,732) X value of penalty (£40)

+ Number of summons (19,123) X estimated value (£112)

= £6.7 million

Traffic light cameras: The equivalent calculation was made using data on prosecutions linked to traffic light cameras. This indicated that the total annual income, across the ten force areas, from associated fines and penalties was £1.6 million.

Wider benefits

During the course of the analysis, a number of other, wider benefits were examined as follows:

Increased criminal intelligence: The study showed that photographic material which had been collected by speed and traffic light cameras had also been used in support of crime detection. For example, in identifying stolen vehicles or vehicles involved in crime.

Up to date Police National Computer (PNC) Information: Staff involved in the camera enforcement process continually update the PNC database and thus provide an up to date source of information which can also be used for other purposes (including the investigation of crimes involving vehicles or vehicle details).

Greater community reassurance: Anecdotal evidence suggested that the local community (in which the camera site was positioned) derived some benefit from the knowledge that speed would be reduced and that accidents would fall. This was supported by factual evidence which shows that speed is reduced in and around camera sites (see Section 4). There was, however, some evidence to suggest that driver behaviour may only improve in close proximity to the camera or its site and not beyond.

Monetary values could have been attributed to the above benefits to allow them to be incorporated into the cost benefit equation (see Section 5). Methods are available to calculate these values, although they would have been – to some degree – arbitrary and subjective. For example, the value of reduced speeds in environmental terms might have been costed in terms of average house prices in an area before and after the introduction of speed cameras. However, a number of other factors could influence such property prices and a subjective decision on the element attributable to speed cameras would have been required.

Regardless of how they were derived, the calculated values for the above benefits could have been open to question and could have undermined the validity of any cost benefit assessment based upon them. For this reason, these benefits were not taken into account within the main cost benefit equation presented in Section 5. The benefits should, however, be noted and can be treated as “added value” not reflected in the main cost benefit analysis.

5. Cost benefit assessment

The extent to which the costs of traffic camera operation were offset by the benefits they yield was subjected to detailed analysis in order to generate an overall cost benefit assessment.

Principles of cost benefit assessment

The essence of a cost benefit assessment is to bring together the whole range of relevant costs and benefits which are incurred and realised in a set time period and to determine whether an overall gain or loss is sustained. In the current study, the cost benefit assessment was undertaken for time periods of one, five and ten years. It was assumed for the purposes of this assessment that the fixed costs associated with camera technology were incurred in a single base year and that benefits were generated in following years. In reality, camera use is normally phased in over several years and benefits associated with the investment may build up as more cameras become operational and drivers become increasingly aware of their significance. However, for analytical purposes, the assumption made was sufficiently accurate.

A fundamental concept within any such assessment is that of Net Present Value (NPV). This concept recognises that an investment in year 1 cannot simply be compared against the sum of the benefits it yields in years 2, 3, 4 etc, since that investment has an “opportunity cost” in terms of the return it could have earned if put to an alternative use. In other words, an investment of £1,000 which yields a £200 return in each subsequent year would take more than 5 years to pay back, since £200 in a future year is worth less than £200 now. Thus, future benefits need to be discounted to place them on a comparable basis with present costs.

In the current study, all calculations were in current prices and a 6% discount rate was applied. An example calculation is provided within Appendix B of this report which shows in detail how this discount rate was used and how the overall cost benefit figures were produced.

Estimation of overall costs and benefits

The results of the cost benefit assessment for traffic cameras is summarised in Table 15. It can be seen that, in the ten force areas reviewed, both speed and traffic light cameras yielded a surplus of benefits over costs. The surplus was greater in the case of speed cameras, because these achieved greater levels of accident reduction and generated more prosecutions (and therefore more fine income).

Table 15: Costs and benefits associated with speed and traffic light camera sites for all agencies across ten study areas over 1, 5 and 10 year periods

Camera type	No of sites	Annual fixed costs (£000)	Annual recurrent costs (£000)	Annual fine income (£000)	Annual value of accident reduction (£000)	Net Present Value cost benefit analysis (£000)		
						1 year period	5 year period	10 year period
Speed cameras	420	(5,264)	(3,595)	6,730	30,239	26,391	136,074	241,690
Traffic light cameras	241	(2,188)	(1,353)	1,632	6,663	4,243	26,527	47,986

Speed cameras: cost and benefits

Table 16 presents more detailed cost benefit information for speed cameras for each of the ten force areas. The net benefit generated by the £5.3 million fixed cost investment in speed cameras in the ten study areas is marked. An amount five times the initial investment is returned after one year (£26.4 million) and a return of more

Table 16: Speed cameras – costs and benefits (in £000) by study area over 1, 5 and 10 year periods

Area	No of sites	Annual fixed costs (£000)	Annual recurrent costs (£000)	Annual fine income (£000)	Accident reduction benefit (£000)	Net present value of benefit (cost) (£000) to all areas by:		
						1 year period	5 year period	10 year period
1	41	(334)	(415)	1,082	3,589	3,680	17,594	30,991
2	10	(121)	(126)	300	1,002	988	4,834	8,536
3	15	(379)	(404)	890	2,272	2,224	4,243	19,927
4	9	(146)	(142)	150	2,535	2,252	10,563	18,564
5	8	(94)	(226)	872	419	910	4,391	7,742
6	17	(153)	(58)	66	2,438	2,155	10,151	17,851
7	129	(1,143)	(1,199)	1,234	9109	7,651	38,125	67,468
8	16	(176)	(221)	360	590	511	2,895	5,190
9	170	(2,426)	(678)	1,684	7,637	5,729	33,985	61,194
10	5	(291)	(125)	92	648	289	2,299	4,236
All areas	420	(5,264)	(3,595)	6,730	30,239	26,391	136,074	241,690

than 25 times is achieved after 5 years (£241.7 million). The analysis suggests that all areas achieve a positive return after one year.

Traffic light cameras: costs and benefits

Table 17 presents detailed cost benefit information relating to traffic light cameras for each of the ten force areas. This suggests that all but three of the ten areas achieved a positive benefit within a year of the investment, and all but one achieved a benefit after 5 years. These differences are explained by the fact that fine income generally exceeds or broadly matches the costs of operation and enforcement. Those areas experiencing significant reductions in accident levels quickly yield benefits over and above the fixed cost of the camera equipment. However, areas with minimal or zero benefits in terms of accident reduction (areas 2, 3, 6 and 10) take the longest time to yield a net benefit. Area 10, which has a single traffic light camera with no proven impact, generates fine income less than its operating costs and an increasing net cost over time.

Overall, the 241 sites are expected to produce a net return of nearly double the £2 million investment after a one year period and 12 times the return over a five year period (£26.5 million). This return is substantial but less than for speed cameras. The difference in returns arises because the biggest benefits, offsetting both fixed and recurrent costs, is the value of accident reductions. These benefits are three-times greater for speed cameras than for traffic light cameras.

Sensitivity analysis

In carrying out the cost benefit assessment, a number of key assumptions were made as follows:

- a similar level of benefit is experienced in each of the years considered.
- The accident reduction impact for all the operational sites in an area is proportionate to the accident reduction impact demonstrated by the smaller number of sites in that area with available monitoring data
- accident reduction in one of the areas, which could not provide a split of the data for traffic light and speed cameras, is similar to the average accident reduction impact observed across the other nine areas
- accident reduction benefits are constant over time ie there is no ‘drop-off’ effect as drivers become used to traffic cameras and accident levels ‘creep’ back up
- the number of prosecutions does not either decline or increase over time
- the level of fines and costs awarded is broadly constant over time
- operational costs are broadly constant over time

Table 17: Traffic light cameras – costs and benefits (in £000) by study area over 1, 5 and 10 year periods

Force	No of sites	Annual fixed costs (£000)	Annual recurrent costs (£000)	Fine income (£000)	Accident reduction (£000)	Net present value of benefit (cost) (£000) to all areas by:		
						1 year period	5 year period	10 year period
1	21	(161)	(95)	121	411	252	1,680	3,055
2	19	(173)	(49)	74	54	(97)	164	414
3	9	(202)	(75)	141	57	(86)	314	700
4	13	(154)	(228)	243	442	277	1,769	3,206
5	11	(105)	(40)	127	203	267	1,115	2,028
6	6	(83)	(83)	135	0	(34)	135	299
7	128	(812)	(710)	718	3,663	2,534	14,129	25,295
8	15	(234)	(26)	31	941	659	3,753	6,734
9	18	(216)	(24)	32	892	632	3,573	6,406
10	1	(48)	(23)	10	0	(10)	(102)	(141)
All areas	241	(2,188)	(1,353)	1,632	6,663	4,243	26,527	47,986

Note: Zero values represent nil expenditure and *not* "information unavailable"

- Department of Transport estimates of the value of personal injury estimates are relevant and do not change substantially over time.

Clearly the longer time goes on, the less plausible some of these assumptions become. However, to ensure that the assumptions did not distort the results over the various time frames considered, a number of alternative scenarios were modelled to see if the overall conclusion that camera technology yields significant net benefits changed. The scenarios modelled were:

- accident reduction benefits decline to zero over a five year period as drivers become more familiar with the location of the camera(s) and modify their behaviour by slowing up only a very short distance before the camera and accelerating afterwards

- accident reduction benefits are 50% offset by an increase in accidents away from cameras, caused by drivers either driving more recklessly because they think that they are immune from detection or because they are seeking to make up 'lost time' as a consequence of the camera having earlier forced a speed reduction

- fine income declines to zero over a five year period as potential offenders either comply with the law or drivers continue to drive above the speed threshold but remain undetected.
- fine income is no longer treated as a benefit
- no financial benefit is attached to accident reduction.

The results from modelling these alternative scenarios for speed and traffic light cameras respectively, across all ten force areas, are shown in Tables 18 and 19.

It should be noted that earlier explorations showed that the overall findings were relatively insensitive to the discount rate chosen and this factor was not subjected to further sensitivity analysis.

Table 18: Speed cameras – modelling alternative scenarios

Impact of speed cameras assuming:	Net present value* of benefit (cost) to all areas by:				
	year 1	year 2	year 3	year 4	year 5
Basic model	26,391	55,946	83,977	110,421	136,074
1: accident reduction to zero in 5 years	26,232	49,215	64,547	75,020	75,363
2: accident reduction 50% offset	11,964	28,215	43,547	58,014	71,656
3: fine income to zero over 5 years	26,232	54,448	79,654	102,100	122,019
4: fine income no longer a benefit	19,884	43,607	65,987	87,101	107,020
5: accident reduction given no value	(2,305)	485	3,117	5,600	7,943
* all measures in (£000)					

Table 19: Traffic light cameras – modelling alternative scenarios

Impact of traffic light cameras assuming:	Net present value* of benefit (cost) to all areas by:				
	year 1	year 2	year 3	year 4	year 5
Basic model	4,243	10,544	16,375	21,875	26,527
1: accident reduction to zero in 5 years	4,243	9,061	12,093	13,634	13,843
2: accident reduction 50% offset	1,219	4,434	7,426	10,327	13,025
3: fine income to zero over 5 years	4,363	10,181	15,326	19,858	23,827
4: fine income no longer a benefit	2,824	7,552	12,021	16,220	20,190
5: accident reduction given no value	(1,925)	(1,676)	(1,442)	(1,221)	(1,012)
* all measures in (£000)					

Substantial net benefits are generated within a relatively short period for both types of cameras under scenarios 1 to 4. Scenario 5 shows that, if accident reduction is given no money value, speed cameras are quickly 'self-financing' in terms of fine income. Traffic cameras – which generate proportionately fewer prosecutions – carry a net cost by the end of a five year period. In this example, it is estimated that it would take 11 years before a 'break-even' was achieved.

Wet film technology and video technology

Thus far, the costs and benefits of speed camera usage have been assessed without distinguishing between wet film cameras and video cameras. This was primarily because, at the time of the research, video cameras accounted for only a small minority of cameras and sites in use. Only four of the forces participating in this research owned a video camera and in two of these the camera was not being used, or was still on trial. However, one force (area 1) was able to provide data about the costs of using video equipment, the number of prosecutions it generated, along with accident reductions attributable to each camera type. This material was used to compare the costs linked to the two technologies and the results are presented in Table 20 below.

Table 20: Analysis of the costs and benefits of wet film and video technology

	Wet film cameras (5 cameras, 33 sites)	Video cameras (1 camera, 8 permanent sites)	Wet film as a % of video
fixed cost per camera	£53,090	£64,351	83%
annual recurrent cost per camera	£72,115	£57,064	126%
prosecutions per camera	3,549	4,301	82%
accident reduction per permanent site per year	1.56	1.28	121%
net present value of return per camera after 1 year	£611,961	£766,049	80%
net present value of return per camera after 5 years	£2,884,241	£3,068,509	94%

Given that this data is based on only one force area, it needs to be interpreted with considerable caution. However, the evidence does show that, in one force at least, the cameras were being used to generate broadly similar levels of benefit.

Debate on hypothecation

The analysis has shown that the use of traffic light and speed cameras generates significant net benefits. It should, however, be noted that a substantial part of the 'return' is to the community as a whole and not completely to the agencies involved

in the deployment and operation of cameras and in the enforcement process. All fine income that results from cases generated by camera technology goes to the Consolidated Fund at the Treasury. (Costs awarded by the courts in summons cases are paid to the police and the CPS, although for most forces these are few in number.)

The growth of camera technology has increased the costs and workload of many of the agencies responsible for promoting its use. This has, in turn, given rise to a debate about whether fine income (or a proportion of it) generated by cameras, and not just court costs, should be returned to those agencies who pay for their use. This concept is known as “hypothecation” and numerous police forces and local authorities have argued in its favour.

The Treasury approach to hypothecation has been to point out that the areas of Government which generate an “income” are not necessarily the same as those with the highest spending priority. The principle has therefore been not to “earmark” automatically income from one source for re-investment in that source, but to agree overall spending priorities. There are many areas of Government work which do not generate an income, but which deserve to have public money spent upon them.

In a recent House of Commons debate (Hansard, 24 November 1995), the Government indicated that it was not at this time in favour of hypothecation, but that this research and other information could inform any future decision. Recommendations on whether the fine income generated by cameras should properly be recouped by the police, the courts or the CPS are, however, outside the scope of this study.

6. Good practice issues

The way in which cameras are deployed and used can directly affect their effectiveness and the cost / benefits generated. Good practice is, therefore, a vital part of the process of obtaining the benefits described in this report and of improving them.

With the introduction of the Road Traffic Act 1991 and the increased use of traffic light and speed cameras, the Department of Transport, the Home Office and the Welsh Office recognised the need to provide guidance to assist agencies who were considering the use of camera technology. Accordingly, Department of Transport Circular 1/92, Home Office Notice 38/1992 and Welsh Office Circular 22/92 were issued to explain the road safety benefits which could be generated by cameras and to draw attention to key considerations which should be taken into account in their deployment. The research confirmed the principles set out in this guidance and found that these were generally followed by local agencies. Some additional good practice guidelines were also identified as follows:

Agency consultation

The Department of Transport guidance emphasised that:

> "… it is essential that from the earliest stages when the use of technology is being considered, discussions take place at a local level, and that agreement is reached on detailed plans for implementation. Co-ordination at a local level and on a regular basis is essential if the maximum benefit is to be gained".

The research highlighted at least four issues which local consultation should cover:

- Siting: Most camera sites were established with the agreement of the police and the local authority. However, in isolated instances, local authorities had erected a camera housing and the police had declined to support its use. This created a permanently empty (and ineffective) site, which might ultimately erode the deterrent effect of cameras more generally and certainly means that expensive assets are under-utilised.

- Signing and publicity: Both the police and the local authority can play a role in the signing and publicising of camera use. Despite the key importance of this activity, the efforts of the two parties were not always well co-ordinated. The advantages of a joint publicity strategy designed to achieve the broadest coverage and avoid conflicting messages should be considered.

- Operation: It was noted that, whilst the bulk of the fixed investment in camera technology is made by the local authority, it bears little of the financial burden of operation and enforcement. All decisions on camera deployment

need to take into account the likely resource cost for the police and to determine whether this accords with existing and future priorities.

- Enforcement: Camera prosecutions generate a chain of work for the police, the CPS and the courts. The legal enforcement process can only move as quickly as the slowest agency in the chain. There have been cases where the sheer number of cases generated by cameras have caused severe problems for the CPS and the courts. In one area, this led to the introduction of a defacto moratorium on new prosecutions whilst the backlog was being cleared. Obviously, there is an advantage for all agencies if before cameras are introduced case volumes are estimated, discussed and planned for.

The study also noted that liaison between areas was taking place either informally or through the medium of the national and regional sub-committees of the County Surveyors' Society. Such meetings provide opportunities for sharing of lessons learned, discussing innovations in the field (such as the benefits of newly type-approved equipment or processing software) and, possibly, the co-ordination of signing policy to maximise awareness for drivers across a region. The experience of using camera technology was considered to be sufficiently new and complex for such collaboration to have continuing value.

Siting of devices

The rationale for camera use is accident reduction and devices should be located in those areas where they can have the greatest impact. Local authorities use accident statistics combined with additional information, usually provided by the police, to draw up a short list of sites where either traffic lights or speed cameras may have an impact. In examining this data, the police and local authorities need to have in mind the following:

- Traffic accidents are relatively infrequent events and, if accident statistics are analysed for an inappropriately short stretch of road for only a short period, trends may be missed or misinterpreted. (What appears to be a high risk area may, in fact, be no more than a statistical 'blip.') Compiling accident data is not without cost, but using data for a more extended (three to five year) period will often pay dividends by ensuring that resources are not wrongly invested.

- The reasons behind the accident levels at short-listed sites should also be investigated. Accidents occur for a range of reasons (e.g. driver tiredness, road layout or vehicle defects) and may not be the product of speeding. However, the constraints on accident statistics should be borne in mind and these should, whenever possible, be supplemented by discussions with local police officers.

- In selecting sites, local agencies should take care to avoid any irrelevant justifications. For example, cameras can be expected to reduce overall speeds and for this reason alone may be popular with residents on busy roads. Sometimes these views are brought to the attention of elected Members and officials who serve them. Whilst few sites appeared to have been influenced by irrelevant considerations, it was clear that pressures sometimes occur. Having a clearly defined set of site evaluation criteria, agreed in advance of decisions about particular sites, will be a considerable assistance in deflecting such pressure.

- Once a problem area has been identified, alternative accident prevention measures should be fully evaluated. Department of Transport guidance states that cameras should be used only where other measures are likely be inappropriate or ineffective. On occasions, local authorities were found to have argued for camera installation because this was thought to be cheaper than another approach (e.g. sleeping policemen). This argument fails to take into account the full costs to all agencies. The most cost effective solution (from all points of view) needs to be identified in every case and the costs in this report should provide a useful comparative benchmark.

- If a site is selected for camera installation, careful consideration needs to be given to how the device should be located to maximise impact. Issues such as direction of traffic, proximity to junctions and lane monitoring need to be considered. There is also a possibility that, if a camera site is easily spotted ahead, drivers may be able to 'manipulate' the technology, slowing down just before the camera and then speeding up immediately afterwards. Dual lane, fast flowing roads afford most leeway to would-be 'manipulators' and heavily used, single lane roads the least. Such distinctions may be relevant when considering the disadvantages of a prominent camera gantry site.

- The effectiveness of a particular camera location must be balanced against the need to install the camera in a safe, accessible place with the required power supply. Consideration should be given to how vandalism can be avoided e.g. choosing gantry locks that cannot be blocked by inserting glue.

Ratio of cameras to housings

At any point in time, only a selection of camera sites will contain real cameras and drivers will have a number of opportunities to pass a camera site above the lawful speed threshold (or jump a traffic light) without being prosecuted. Whether drivers modify their speed, on entering a signed camera area, depends on how they perceive the risk of getting caught and, of course, their attitude to that risk. Ideally, cameras

should be deployed to maximise the perception of risk and increase the deterrent impact.

The research did not identify any clear relationship between the ratio of cameras to sites (and the use of dummy cameras) and the level of accident reduction. The following observations can, however, be made:

- Further research on driver attitudes is needed in order to determine what is – to the would-be offender – an unacceptable probability of being photographed speeding or traffic light jumping. However, there are ways of influencing driver perceptions of risk for any given camera to site ratio. For example, publicising the total number of prosecutions in any one year in the area (or even the country) may persuade some drivers to err on the side of caution.

- Mobile video cameras can be flexibly deployed and may add to driver perceptions of risk – providing that their capability is publicised. For example, mobile cameras could be deployed selectively to detect drivers who are accelerating over the speed limit having temporarily slowed down for a fixed camera site.

- The use of dummy flashes – to increase the uncertainty of drivers as to whether they will be prosecuted – may also play a role. Some forces do not use dummy cameras at all and argue that their deterrent impact is limited if those 'flashed' do not later receive a prosecution. Clearly, a site that is permanently empty (or invariably empty) could quite quickly be discounted as a risk by local motorists. However, whilst offenders wait to see if they are prosecuted, they may be less likely to reoffend. Thus, dummy cameras may have an additional effect on driver behaviour beyond the stretch of road on which the camera is sited.

  The role of dummy cameras could have a strong bearing on the costs associated with camera technology and further detailed attention should be given to this issue.

Signing and publicity

Standard signs which have been approved by the Department of Transport can take three forms:

– words explaining that speed or traffic light cameras are in operation;

– showing a symbol of a camera

– both of the above.

There is some evidence that signs achieve a high degree of recognition in areas where they are in use. A survey in one of the study areas showed that 96% of the (1800) drivers interviewed recognised the approved signs. However, recognition is only one element of the equation. In one Scottish area, the local authority became concerned that the local population was regarding the signs in a detached way and was not modifying its behaviour. The authority is experimenting with a new signing convention which not only focuses on the fact that cameras are in operation, but also refers explicitly to speed and the police's intent to prosecute offenders. Some practitioners believe that signing will have to develop in this way (i.e. by focusing more on the driver and the impact that speed has) in order to make more drivers modify their behaviour.

Most of the areas in the study did relatively little to publicise camera technology. To some extent, this was compensated for by the local media which was very interested, initially at least, in the introduction of cameras. However, some areas may need to place greater emphasis on publicity – not least to compensate for the gradual discounting factor which will come into play as drivers become more aware about camera technology. For example, drivers may currently confuse speed cameras with those used to monitor traffic flow or volume. This confusion may lead them to over estimate the prevalence of enforcement technology, but its effect is likely to be temporary. Arguably publicity is continually needed to alert drivers to the risks of detection.

Operation

Considerable differences were noted in the way in which the operation of camera technology was organised within police forces. It was not possible to determine which of these approaches was the most efficient, but the following points can be made:

- Forces should examine the costs of camera operation which they incur and, if they are not already doing so, monitor their efficiency over time against a number of measures (cost per site, cost per camera and cost per prosecution).

  Such monitoring may help encourage more efficient practice. In some cases, comparisons between forces may be illuminating.

- Many of the tasks associated with camera administration could be carried out by civilians (under an appropriate structure of police supervision) to generate savings.

- Camera workflow can be extremely volatile, particularly if portable cameras are used to deal with specific problems, such as motorway road works. This volatility can cause additional costs e.g. if large amounts of overtime are

consumed to deal with temporary backlogs. Forces introducing camera technology for the first time need to be aware of this problem.

- Some equipment (including software) – such as that used to view films or process Notices of Intended Prosecution – can serve all the cameras used in a force and produce considerable labour saving gains. (For example, where separate manual checks on the PNC are replaced by an integrated system for processing offences.) Forces need to be aware of the potential benefits of such equipment, whilst ensuring any capital outlay is justified in terms of lower operating costs in future years.
- If responsibility for video camera technology is delegated to regular traffic divisions, its usage needs to be monitored centrally to ensure that it is being put to good effect.

Enforcement

The research has shown that, for all agencies together, the cost of enforcement by way of summons is substantially greater than enforcement by way of conditional offer of fixed penalty. Some forces do not currently use the fixed penalty route. Ironically, this has advantages to them individually, because they are allowed to recoup some of their expenses from costs awarded by the courts. (There is no equivalent advantage for fixed penalties.) The courts may also experience some advantages from the summons route, since these types of case are taken into account when determining the level of funding they will receive from the Lord Chancellor's Department. (The volume of fixed penalties that they deal with is not taken into account.)

7. Conclusions

Overall results

This analysis has provided a comprehensive statement of the costs and benefits of traffic light and speed cameras. The use of both types of cameras has been shown to generate a net benefit:

* For speed cameras (across the ten forces), the net benefit was five times the initial investment after one year and more than 25 times after five years. Fine income covered the operational costs in all but one area.

* For traffic light cameras, seven of the ten forces generated a net benefit after one year. Only one force did not 'move into benefit' after five years and this was because of a significant investment in processing technology.

Overall, the cost benefit equation was very favourable and modelling different, more pessimistic assumptions also provided support for the use of cameras.

The cost benefit equation was influenced significantly by the prosecution route (summons versus fixed penalty). In cost benefit terms, there are strong arguments for using the fixed penalty route rather than summons, but incentives to follow this route may not always exist.

Role of camera technology

The use of camera technology can aid law enforcement in two ways: firstly, by making it possible to detect a larger number of offences without requiring a huge increase in the number of police officers devoted to this task; secondly, the very presence of the cameras could deter drivers who would otherwise be inclined to break the law.

Speed and traffic light cameras are one of a number of technological innovations harnessed by the police to help in the detection and prosecution of offenders. What is different about camera technology (compared to earlier innovations such as the radar gun) is that:

- photographic evidence is the primary evidence on which a prosecution is based

- it has the potential to detect a large volume of offences in a relatively short period.

Cameras are not, however, a panacea for all traffic problems. They must be viewed within the wider context of other strategies designed to improve driver behaviour and reduce accidents. Indeed, the primary objective of introducing camera technology – to help reduce the number and severity of accidents – must never be lost sight of. This objective has to be central to future development of camera enforcement strategies.

Good practice

The issues raised in the section on good practice highlight the need to base camera siting on factual analysis and to be rigorous in its application. This will be equally important for police forces and local authorities introducing cameras for the first time and to those who are developing further sites. The type of analysis underpinning this report could assist relevant agencies in their future planning.

Funding responsibilities

Although the hypothecation debate was not within the scope of this analysis, it is valuable to see where the costs and benefits lie. A mismatch was identified between those responsible for purchase and installation of cameras and those financing their subsequent operation and supporting enforcement.

Local authorities incur the highest proportion of fixed costs, whereas the police and the courts incur the highest proportion of recurrent costs. It could be argued that the financial incentives to reach an optimum level of camera use does not exist at present.

Future developments

Cameras and the associated processing technology are constantly developing. Even during the course of this research, new processing software became available which has the potential to reduce administration costs. In the near future, digital camera technology could come into use which may increase dramatically the number of offences that can be recorded. It is also expected to reduce the frequency of visits to sites and the cost of photographic processing.

It is important to realise that such innovations will change the cost benefit equation. Policy makers and practitioners will all need to remain aware of this and use the analysis in this report appropriately. A spread sheet was developed as part of this study to allow future changes to be taken into account readily. It is strongly recommended that cost benefit assessments are undertaken on a regular basis to ensure that the “returns” generated by camera technology remain as expected over time and at different locations.

Conclusion

In conclusion, this cost benefit analysis has shown that the use of both traffic light and speed cameras generates substantial net benefits. These do not, however, always accrue to those agencies who bear the costs of installing and running such cameras. The report also raises important issues regarding good practice, processing offences (fixed penalty versus summons) and the incentives that currently exist regarding funding. These and other issues are central to the current dialogue on the use of camera technology.

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APPENDIX A

COLLATION OF COST INFORMATION

FROM AGENCIES

Estimation of police costs

Fixed costs

Planning can be treated as a fixed cost because it takes place prior to camera installation and the investment can be spread across its life cycle. Most police costs in this area relate to staff time and, to estimate these, forces were asked to record the time which officers of varying grades spent on planning activities. The results were converted to monetary amounts using the Home Office police cost ready reckoner.

Procurement of camera equipment constitutes a significant fixed cost for many police forces, although some may be assisted by the local authority. However, the camera equipment per se is not the only fixed cost to be met by the police. Forces may also have to take responsibility for other one off expenditure e.g. on viewing equipment, on software to help process paperwork or on other non-camera equipment needed to facilitate prosecutions. A record was produced of the expenditure of the police on camera equipment and other such items in the year in which it occurred. (This expenditure was converted to a common price base (1995) to assist comparison.)

Recurrent costs to the police

The various recurrent costs to the police were recorded. The following principles were adopted:

- the costs of liaison with courts and other agencies on camera matters were calculated by obtaining the time officers spent on this activity and applying the Home Office ready reckoner rate
- the calculation of publicity costs took into account both the direct costs of publicity (e.g. the costs of printing leaflets) and the indirect costs in officer time (e.g. briefing the press)
- operational costs were calculated to reflect both the costs of staff working with cameras and non-staff costs (such as the costs of materials and postage)
- maintenance costs included both the annual amounts paid to contractors and the cost in police time of managing contractors, or carrying out repairs themselves, as well as the annual costs of calibration
- central ticket office costs were calculated by estimating the total cost of the office and apportioning an amount based on the ratio of camera enforcement workload relative to total workload

- police process unit costs were calculated by estimating the total cost of the process unit and apportioning an amount to camera enforcement proportionate to the level of process unit work attributable to cameras
- information was also collected on 'hidden' camera costs eg. where officers elsewhere in the force might from time to time help out by making Police National Computer checks.

Costs to the local authority and Highways Agency

Fixed costs

Fixed costs to the local authority include the costs of planning, any contribution to police camera procurement costs and the costs of installation and signing. As well as providing information on their own expenditure, local authorities were asked to identify any costs that had been covered by the Highways Agency. (This latter situation might occur where the local authority was acting as an agent for the Highway Agency and takes responsibility for motorways or trunk routes.)

The investment of local authority time in planning camera sites was treated as a fixed cost. The amount of local authority officer time dedicated to planning was recorded and converted to a money amount using a ready reckoner.

Records were also maintained on whether the local authority had incurred any other fixed costs associated with camera equipment. For example, one local authority had made a contribution to film viewing equipment used by the police.

Recurrent costs

The approach to estimating local authority publicity costs and maintenance costs was similar to that for the police. Local authorities do not as a rule devote their own officer time to operating cameras but in rare circumstances may make a grant to cover police staff costs. This was recorded as grant aid where occurring. Estimates were also produced of the time spent by officers evaluating and monitoring cameras and liaising with other agencies where appropriate. This was converted to an annual money cost using a ready reckoner.

Costs to the courts

Fixed costs

None identified

Recurrent costs

Recurrent costs identified for the courts break down into those related to:

Fixed Penalty Units: Camera generated fixed penalties (which involve a conditional offer of fixed penalty) were only one element of the workload of Fixed Penalty Units. These also have to deal with fixed penalties generated by other sources (e.g. from parking tickets). To estimate the cost of dealing with a camera generated fixed penalty, information was obtained on the number of such penalties, and the number of other sorts of penalties administered, from eight Fixed Penalty Units. Estimates on the relative effort spent in processing each type of penalty were also obtained from these units. By combining the volumetric information with the relative effort, it was possible to calculate camera activity as a proportion of total workload. This information was then combined with budget information to produce a total cost and an average cost to the Fixed Penalty Unit of dealing with conditional offers of fixed penalty.

Courts: The other main route for dealing with camera-detected offences is by way of summons. The magistrates' courts must undertake a number of activities to deal with a summons. One court listed these as follows:

- printing summons
- checking of summons by an officer of the court
- supplying summons back to police for issue
- entering appearance dates into the court diary and drawing up a court list
- annotating court lists to show Magistrates the nature of cases
- deciding how the court is split – e.g. which magistrates hear which cases
- court sittings (including Magistrates and clerks of court)
- adjournments and resorting of court lists
- resulting of cases and checking of resulted cases
- printing fine cards and sending out letters and fine cards
- endorsement of driving licences
- reminders to late payers
- issuing of distress and bail warrants for non-compliers

This indicates a complex and potentially resource intensive process. The investigation of associated costs was constrained by the complexity of the process and by the fact that most courts do not deal with camera cases separately, nor do

they collect detailed information specifically about them. The approach adopted was to use available Court management information from six courts in the study areas. Court management information does not distinguish camera generated summonses, but indicates the proportion of all workload accounted for by any type of summary motoring offence. Estimates were made of what proportion of the court budget – excluding Fixed Penalty Unit costs already considered above – were attributable to summary motoring offences. This enabled the average cost per summary motoring case to be calculated. The estimate of the courts costs for camera generated cases is based on this average cost multiplied by an estimate (provided by the police) of the number of camera generated summons dealt with.

Costs to the CPS

Fixed costs

None identified

Recurrent costs

The CPS has no involvement in the administration of fixed penalties. Nor has the CPS involvement in most summons cases, which are admitted by post in advance of any hearing and which are simply noted by the court. CPS involvement is greatest where:

- the offence is contested by the defendant
- the defendant does not plead and so the case is proved in his or her absence.

In each case, the CPS bear a cost in terms of reviewing the prosecution file prepared by the police, administering their own internal paper work and preparing and presenting the case to the court. A survey was conducted of 19 CPS branches to obtain their estimates of the average amount of time which they spent on each activity. These times were multiplied by a CPS ready reckoner for lawyer and administrative staff costs to obtain a measure of the average cost to the CPS for camera generated cases in which they have an involvement.

Whilst it was possible to obtain an estimate of average times for various activities, the CPS does not record information on the number of camera related cases it deals with, nor whether they are contested or proved in the defendants absence. One branch did, however, kindly conduct a review of its files to produce estimates of:

- proportion of camera-related cases where police file is received/reviewed by CPS
- proportion of contested cases

- proportion of cases proved in absence.

These proportions provided the basis for estimating the total costs of camera enforcement to the CPS i.e. it was assumed that the pattern of cases was broadly similar for most branches. It was recognised that different branches may differ in the pattern of cases to some extent, but given that the amounts of time devoted by the CPS are relatively small, any variation in the pattern across areas will not have a substantial impact on total camera related costs.

APPENDIX B

EXAMPLE CALCULATION:

THE COST BENEFIT EQUATION

A cost/benefit analysis of traffic camera technology must take account of the fact that the benefits and costs are realised over a period of time. The concept of Net Present Value is important to the assessment, because it recognises the fact that £100 of benefits (or alternatively costs) this year is worth more than £100 of benefits received in subsequent years.

In response to the question "would you rather have £100 this year or next year?", rational people would choose the former. This is because if they received £100 this year that sum could be invested (e.g. in a building society) and earn interest. For example, if a building society account gave interest at 6% per year, then the initial £100 would equal £106 by the end of the year. Therefore, if the individual deferred the £100 until a year later, they would be worse off by £6. If the individual deferred the benefit for two or more years, they would be even worse off, as there would have been a longer time for interest to be earned.

The measure of the difference of money values over time is captured by the concept of a discount factor. The discount factor allows a future cash value to be adjusted to express its worth in terms of a money amount received today. Obviously, the further one goes into the future, the more a cash amount must be discounted (i.e. the smaller the discount factor) to make it comparable to an amount received today. (Equivalently a cash value which occurs today has a discount factor of 1.) By multiplying a future cash amount by a discount factor, the Present Value of that amount can be calculated.

This principle must be applied to a decision to incur expenditure on cameras on the expectation that it will yield benefits in future years. Consider the case where the camera requires an initial investment of £1,000 and yields the following stream of costs and benefits for a further 4 years.

	start of first year	end of first year	end of second year	end of third year	end of fourth year
investment cost	(£1000)				
current costs (eg to police and courts)		(£100)	(£100)	(£100)	(£100)
current benefits (eg reduced accidents)		£500	£500	£500	£500
surplus deficit of benefits over costs	(£1000)	£400	£400	£400	£400
discount factor (eg 6%)		9434	8900	8396	7921
NPV of future benefit		£377	£356	£336	£317

In this example, there are £100 continuing costs each year after the investment and £500 benefits for the next four years. In cash terms, this is £400 surplus. However

£400 in one year's time must be adjusted to show its Present Value before it can be compared against the initial investment. Likewise, for the returns received in years 2, 3 and 4, although the effect of the adjustment will be progressively greater in each case.

If the Present Value of the return after one year is compared with the investment, it can be seen that there is still a net cost: £1000 – £377 = £623.

After two years that net cost is reduced £1000 – (£377+£356) = £267.

By the third year, the cumulative benefits just outweigh the costs because £377 + £356 + £336 = £1069.

By year four the benefits are significantly greater:

£377 + £356+ £336 + £317 = £1,386.

In essence, this is the approach taken within the current study in presenting the results to show when the cumulative benefits (at Present Value) exceed the initial investment (i.e. the first instance when there is a positive figure). In the example above, this occurs at the end of year 3.

Whilst this example shows the principles of the calculation when applying this approach, a number of assumptions have had to be made because costs and benefits are not normally realised at either the beginning or the end of financial years. Most importantly, it has been assumed that all the camera investments are made in a base year (at the start of the first year) and that recurrent costs and benefits are incurred in subsequent years. This is clearly not realistic since camera investments are made over time (as each new camera is purchased and installed) and recurrent costs and benefits increase as each new camera comes on stream. However, making this assumption makes it clear what the 'overall picture' is, even if it does not reflect perfectly the actual sequence of spending or the receipt of benefits.

A 6% real discount rate has been assumed. Note, however, that the overall findings – that cameras yield a substantial net surplus of benefits in the medium term – are relatively insensitive to the discount rate chosen. Some assumptions have also been made about when in the year costs are incurred and benefits realised. The discount factor is slightly different if one assumes that the benefits are received at the beginning, the middle or the end of the period. Again the overall results of the research are insensitive to this assumption.

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