

# Investigation into the interactions between closed circuit television and urban forest vegetation in Wales

## Abstract

In the past 20 years the UK has seen extraordinary growth in the use of CCTV (closed circuit television) to tackle crime and anti-social behaviour. The proliferation of open space CCTV cameras in the UK has led to concern that they are detrimentally affecting urban forest vegetation because of the desire to cut or fell vegetation to maximise the coverage provided by cameras and conversely that vegetation is reducing the effectiveness of CCTV. The guidance relating to the use of open space CCTV does not give meaningful advice regarding the deployment of CCTV in areas of existing urban forest vegetation. Results of this research found that the obstruction of cameras by vegetation was considered to be a major threat to CCTV and that CCTV was an issue of concern to urban forest managers. Despite the concerns expressed by stakeholders there has been minimal co-operation between CCTV managers and tree managers even though greater co-operation would be welcomed.

Results of this research have found that trees are the type of vegetation that most affects CCTV camera sightlines. The majority of vegetation affecting CCTV is situated in town squares, pedestrianised streets or other highway land. Where urban forest vegetation obstructs CCTV cameras the solution was to cut back or occasionally fell the obstruction. Installing more cameras or the relocation of obscured cameras was not undertaken as a solution. Despite concerns, the amount of cutting back and felling to address conflicts is relatively low. This elevated level of concern may be attributed to the significant amenity afforded by the affected trees and efforts to maximise the effectiveness of CCTV for public safety reasons.

## Introduction

### Closed circuit television growth

The growth of open space CCTV (closed circuit television) for use in public and quasi-public areas has been phenomenal with the UK recognised as a leading user of CCTV for community safety and crime investigation purposes (Fry, 2008). In its most basic form CCTV is simply a camera and monitor directly connected by a closed loop, most commonly with wires but also in some cases microwave or infrared beams. CCTV surveillance systems will include many cameras sending images back to a monitoring room, referred to as a CCTV suite, which can cover several towns or districts of a city.

Despite the rapid growth of CCTV there are no official figures for the total number of CCTV cameras in the UK. Based on research carried out by McCahill and Norris, (2002) the popular press have claimed that there are over 4 million CCTV cameras in the UK; however, this figure is not considered reliable because it is based on an extrapolated survey confined to two London streets. A more reliable figure for the number of CCTV cameras in the UK is provided by Fry (2008) who estimates that there are 1.5 million cameras surveying public and quasi-public areas including shopping malls, hospitals and universities.

Between 1994 and 1999 the Home Office awarded £38.5 million towards the cost of 585 CCTV schemes (Armitage, 2002) and under the Home Office's Crime Reduction Strategy (1999–2003) the amount of funding increased to £170 million which was sufficient to support the introduction of a further 680 CCTV schemes (Larsen, 2009). By 1995 CCTV funding

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equated to 78% of the Home Office budget for crime prevention (Goodwin *et al.*, 2000). In 2004 it was claimed that London had become the unrivalled CCTV capital of the world with 22 of the 32 boroughs having their own street systems utilising over 1000 cameras (Hemper and Topfer, 2004).

## CCTV, urban forest vegetation and crime

Notwithstanding the rapid growth and investment in open space CCTV, a study undertaken for the Home Office by Farrington and Welsh (2002) found that CCTV had no effect on violent crime (in five of the CCTV schemes studied) and only reduced overall crime by 4%. In another Home Office report (Gill *et al.*, 2005) studying the impact of CCTV on crime only two of the 14 case studies experienced a statistical difference in the level of crime due to CCTV. The report also acknowledged that it was unrealistic in the extreme to expect CCTV to counter complex social problems. Despite the research, most people's perception of open space CCTV is that it is very effective at detecting crime and effective at preventing crime (Charman and Honess, 1992). CCTV is now considered part of everyday life, with most members of the public willing to sacrifice personal privacy for safety and security (Webster, 2009).

Claims in the literature that CCTV is not a panacea for crime coincided with reports (CABE, 2004; ODPM, 2004) that the prevention of anti-social behaviour and crime in public spaces is better addressed by good urban design, promoting natural surveillance and better management. Research has found that criminals will use vegetation to aid concealment (Michael *et al.*, 2001) and that there is a greater fear of crime on sites which provide cover, escape or refuge for offenders (Talbot and Kaplan, 1984; Fisher and Nasar, 1992). It is not the case that all vegetation will block views, as research by Kuo and Sullivan (2001) found that high canopy trees did not encourage crime. Even where vegetation reduces natural surveillance, residents in poor districts have a higher sense of safety in areas of high density tree planting (Kuo, 1998). The reasons for this are that tree planting contributes to a sense of ownership and that this leads residents to care for the area. The benefits that trees provide to people's mental health and wellbeing have been widely researched. Patients that have a view of a natural setting recover more rapidly (Ulrich, 1984) and natural features reduce stress and aggression (Kuo and Sullivan, 2001).

## CCTV and urban forest interactions

Government-funded research (Britt and Johnston, 2008) has identified CCTV as an issue of concern amongst local authority tree officers with survey responses citing a lack of awareness of the problem and indicating poor public

support for the retention of trees where they obstruct camera sightlines. In addition, the popular press has highlighted the issue (*Lancashire Evening Post*, 2007; *Daily Mail*, 2008; *Luton Today*, 2008; Magill, 2008) with articles expressing public opinion both for and against the retention of urban forest vegetation where it affected open space CCTV. Significantly, some residents saw CCTV as the best means of improving their neighbourhood and demanded the removal of trees where they restricted visibility. There is an absence of research examining how the spread of open space CCTV has affected urban forest vegetation; nevertheless, it is the author's experience that CCTV camera sightlines and urban forest vegetation frequently conflict with each other.

## CCTV regulation and guidance

Specific powers to introduce public open space CCTV were granted to local authorities by the Government under Section 163 of the Criminal Justice and Public Order Act 1994 (HMSO, 1994). This Act is supplemented by the now updated version of the CCTV Code of Practice 2008 (ICO, 2008), which clarifies the general provisions for CCTV. The Code of Practice is mainly concerned with data protection, as it is this aspect of CCTV that is a legal requirement. As a result only a single page of the Code of Practice is devoted to the selection and siting of cameras. Within this page the only reference made to vegetation is by way of an example which states, 'Check that a fixed camera positioned in winter will not be obscured by the growth of spring and summer foliage'.

The current Code of Practice and the Crime and Disorder Act 1998 forms part of the Government's wider strategy (HMSO, 1998, 2002 and 2006) on crime prevention and community safety, which places a statutory duty on the police, local authorities and other agencies to work together to improve community safety. These partnerships heavily promoted the use of open space CCTV in their early strategic assessments.

Under the provisions of the Town and Country Planning Act 1990 (HMSO, 1990a) and related Acts (HMSO, 1995, 1990b) CCTV cameras mounted on poles over 4 m in height require planning permission. CCTV cameras fixed to the outside of buildings do not normally require planning permission unless the building is listed. In considering applications for pole-mounted CCTV cameras local planning authorities should consider visual impact.

## Urban forest vegetation

Urban forest vegetation comprises trees, shrubs, hedges and woody vines (Miller, 1997). Whilst open space CCTV has been a recent introduction trees have been an integral part

of city landscapes for centuries (Bradshaw *et al.*, 1995). Urban forest vegetation is an important asset which provides numerous and varied benefits (CABE, 2005; NUFU, 2005; Trees and Design Action Group, 2010) that are now becoming more widely appreciated.

## Materials and methods

The empirical research investigated the extent of open space CCTV provision in Wales, examined the interactions between CCTV and urban forest vegetation, and where conflicts occurred investigated how they were resolved. The research targeted local authority tree managers and CCTV managers because they are the respective professionals most directly involved with the issues under investigation.

In January 2010 all local authority CCTV managers in Wales were emailed and invited to participate in the research by following a link to a web-based questionnaire. The following month local authority tree managers were sent a link to a comparable questionnaire inviting participation in the research. As the management of trees within local authorities is often fragmented it was necessary to collect data from land managers who have responsibility for trees, as well as specialist tree officers. Both questionnaires were structured to enable comparison between the two strands of research. Reminder emails were sent out five days before each of the deadlines expired. This was followed by an extension of the initial deadline and personalised emails to non-respondents. Following the extended deadline non-respondents were contacted by telephone, which resulted in several additional responses. To augment the questionnaire research two open space CCTV case studies were also undertaken which involved an in-depth interview with managers of the system.

## Results

Just over 45% of local authorities provided at least one response to the tree manager questionnaire. The majority of responses (83%) were provided by specialist tree officers with the remainder provided by generic managers of local authority land. Slightly less than 70% of Welsh local authorities provided a response to the CCTV manager questionnaire indicating a high level of interest in the research. The most popular years for open space CCTV introduction were 1996 and 2001 with the sums invested ranging from less than £100 000 in one authority to over £800 000 in four authorities. The number of open space CCTV cameras in each local authority also varied

considerably from 23 to 360 (mean = 108) and showed a positive correlation to each authority's population.

## Urban forest and open space CCTV threats

CCTV managers identified the provision of budgets (long and short term) as the greatest threat to CCTV. This was followed by the obstruction of CCTV cameras by vegetation, with 46% of CCTV managers ranking it as the greatest or second greatest threat. This placed vegetation obstruction above other perceived threats to CCTV including rights to privacy, freedom of information, greater regulation and negative press coverage.

When asked to rate various obstructions to CCTV camera sightlines, trees were the most frequent obstruction followed by signs and other street furniture. All of the responses indicated that obstruction by trees was at least sometimes a problem. Shrubs were identified as being an occasional obstruction whilst hedges were considered to be a frequent obstruction in only two responses. Climbing plants were not identified as a cause for concern.

By contrast tree managers ranked the threat posed by CCTV as the seventh greatest risk to urban trees (Table 1), indicating that it is considered to be a moderately low issue of concern.

**Table 1** Ranked threats to urban trees according to tree managers.

Threat to urban trees	Nominal values	Rank
Development	81	1
Limited budgets	70	2
Highways requirements	67	3
Over-zealous risk management	59	4
Disease	55	5.5
Underground and overhead utilities	55	5.5
Open space CCTV	44	7
Climate change	41	8.5
Satellite television	41	8.5
Other, please rate and specify below	35	10
Tree-related subsidence	30	11

## CCTV and urban forest vegetation interactions

The research also showed that many requests to cut back trees over 10 m were repeat requests, where trees had been previously cut back within the past three years. The majority

of trees obstructing CCTV were situated 5–15 m from the affected camera and occasionally were less than 5 m away. One CCTV manager referred to a tree in excess of 50 m from the camera as causing an obstruction.

Trees were most likely to obstruct open space CCTV cameras when situated in town or city squares. This was closely followed by pedestrianised streets or precincts and highway verges. Trees in council-maintained parks and gardens, education campuses and council car parks were also likely to obstruct CCTV; however, the frequency of obstruction in these three areas was much less than the first three categories. Privately owned vegetation was not considered to be an issue or was possibly not addressed by CCTV managers.

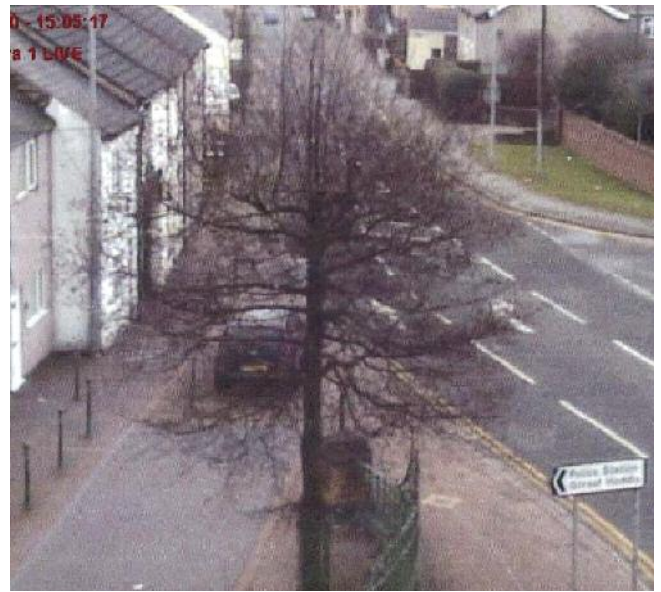
The majority of vegetation affecting CCTV was deciduous (87%) with maple (*Acer* spp.), oak (*Quercus* spp.) and plane (*Platanus* spp.) most frequently obstructing CCTV cameras. This was followed by lime (*Tilia* spp.), Italian alder (*Alnus cordata*), whitebeam (*Sorbus* spp.), poplar (*Populus* spp.) and ash (*Fraxinus* spp.).

To address CCTV obstruction, 70% of tree managers frequently used 'crown lifting' (i.e. the removal of lower branches) or reduction in branch spread. All tree managers stated that they had not undertaken the topping of trees to address CCTV obstruction which is incompatible with sympathetic arboricultural management. Window or notch cutting was not a favoured method of reducing CCTV obstruction. Six local authorities gave estimates for the cost of carrying out additional tree works (felling and pruning) in the past five years to address CCTV obstruction. The estimated costs ranged from £450 to £30 000 with funding to carry out additional work provided by CCTV and general land management budgets in addition to tree budgets.

An example of inappropriate tree work is shown in Figure 1. The photograph is an actual CCTV camera screenshot of a mature Italian alder (*Alnus cordata*) that is growing on a busy street. The tree has been 'topped' providing an unnatural shape and affecting its long-term viability. The work was sanctioned by the highways department at the request of the CCTV manager who considered it necessary to maintain a view along the road seen in the background. The work will need to be repeated every few years if visibility is to be maintained.

The short term (0–3 years) effects of cutting back to improve visibility were considered to be 'negative' by 70% of tree managers and 'very negative' by 10%. The long-term (more than 3 years) effect of cutting back trees was considered to be 'negative' in 90% of cases. Where trees were removed

**Figure 1** Winter CCTV screenshot of *Alnus cordata* 'topped' to increase CCTV visibility.



66% of tree managers stated that replacement planting 'nearly always' did not take place.

When CCTV managers were asked about possible solutions to CCTV obstruction by vegetation (Table 2) 80% considered that the most appropriate solution was to either carry out heavy pruning on a three-year cycle or lighter pruning every year. None of the CCTV manager responses considered that felling trees without replanting was the most appropriate solution and none considered additional CCTV cameras to be the most appropriate solution. The second and third most appropriate choices made by CCTV managers increasingly favoured felling on its own, felling with replacement planting and additional CCTV cameras.

In contrast tree managers favoured more CCTV or the relocation of cameras to a different position as the most appropriate and second most appropriate solutions when asked the same question. Other possible solutions put forward by tree managers were fewer CCTV cameras, more natural surveillance, better consultation and design.

CCTV managers were of the opinion that the amount of urban forest vegetation obstruction had increased in the past five years. Twenty per cent considered that the amount of obstruction had 'significantly increased' in the past five years whilst 60% stated that it had 'increased'. These responses can be compared with those made by tree managers where 45% stated that the number of requests to cut back or fell trees had remained the same, 33% stated that the requests had increased and 22% stated they had decreased over the same period.

Table 2 Solutions to camera obstruction chosen by CCTV managers and tree managers.

	Most appropriate		Second most appropriate		Third most appropriate	
	CCTV	Tree	CCTV	Tree	CCTV	Tree
Felling trees	0%	8%	7%	0	20%	12%
Felling trees and replacement with 'CCTV friendly' trees and shrubs	7%	0%	20%	0	33%	0%
Heavy tree pruning to ensure that no obstruction occurs for at least three years	40%	8%	33%	11%	0%	0%
A commitment to less drastic but more frequent annual tree pruning	40%	0%	20%	11%	13%	64%
The relocation of CCTV cameras to a different position	13%	25%	13%	56%	0%	0%
Additional CCTV cameras to provide coverage from different angles	0	33%	7%	22%	20%	12%
Other	0	25%	0	0	14%	12%

## Perspectives

CCTV managers consider that there is strong public support for CCTV and urban trees with a significant majority (87%) agreeing that the public is very supportive of open space CCTV. However, the majority of CCTV managers (73%) also agree that that the public is very supportive of urban trees and the benefits they provide. Tree managers have a similar awareness of the public's attitude towards urban trees with the majority (84%) agreeing that the public is very supportive of urban trees. However, tree managers are of the opinion that the public is much less supportive of open space CCTV (44%) when compared to urban trees.

Thirteen per cent of CCTV managers considered that, 'CCTV is the best means of combating crime and anti-social behaviour in town centres...', while nearly three-quarters (73%) agreed with the statement to some extent. One-fifth of CCTV managers disagreed with the statement, perhaps indicating an awareness of CCTV's limitations. Unsurprisingly, CCTV managers considered the police to be strong supporters of CCTV and considered that senior management, local councillors and residents/proprietors also tended to favour CCTV where it was obstructed by vegetation. The local press however were considered to have a slight bias towards favouring trees.

In their responses to the same question tree managers agreed that there was a strong bias for the police to favour CCTV but also felt that local councillors and residents/proprietors strongly favoured CCTV. Tree managers did not consider that the press had any bias. Additional comments were provided by tree managers in response to

this question. One stated that in many cases reasonable compromises were made and another felt that he usually won the argument with mature high amenity trees.

The research found a high level of dissatisfaction with the design of open space CCTV. The majority (61%) of CCTV managers and nearly all tree managers (90%) who expressed an opinion disagreed with a statement to the effect that the CCTV system in their area adequately considered existing trees when it was designed.

CCTV and tree managers were asked about how they thought the number of urban trees and CCTV cameras might change in the next 15 years. CCTV managers predicted that the number of both will increase, with 64% stating that the number of trees will increase and 78% stating that the number of CCTV cameras will increase. In comparison tree managers were more sceptical about the number of trees with only 39% predicting their number will increase and 31% predicting a decrease. Over three-quarters (77%) of tree managers predicted that the number of CCTV cameras will increase.

## Consultation and guidance

The responses from both questionnaires show that there is very little or no consultation between those who represent the interests of CCTV and those who represent the urban forest. Where CCTV had been installed by engineers in areas of existing tree cover three-quarters of tree managers stated that they had not been consulted. The same amount (75%) of CCTV managers had not been consulted over proposed schemes of tree planting in areas of open space CCTV. Even though there was very little consultation both CCTV

managers and tree managers felt strongly that there was a need for them to be consulted over proposals that might affect them. Concern over the potential for existing CCTV cameras to be obstructed meant that a small minority of CCTV managers did not want to see any new tree planting.

Fifty per cent of tree managers used recognised national guidelines on community safety (e.g. Secured by Design, Crime Prevention through Environmental Design) in the design of tree planting schemes. All tree managers were supportive of the idea of introducing spatial design guidance that specifically covered tree planting and methods to deter crime, such as natural surveillance and CCTV. Two-thirds of CCTV managers (67%) were also supportive of the idea.

### Case study 1 Flintshire County Council (FCC)

Open space CCTV surveillance was introduced in Flintshire at the end of 2002 with 11 cameras. The initial installation cost £180 000 with approximately half the funding from the Home Office and the remainder from FCC (£35 000), North Wales Police (£35 000) and the private sector (£25 000). Since 2002 the system has been extended to 94 cameras providing continuous coverage in town centres, industrial estates, residential areas and country parks. In addition a further 23 cameras have been installed in schools and are monitored by the CCTV suite under a service level agreement. The design and installation of the system was project managed by the Highways Department who undertook consultations with town councils and submitted 74 planning applications to the local planning authority between 1998 and 2004 to erect pole-mounted cameras.

The CCTV manager considered that the main factor affecting the operation of CCTV was the Council's policy of gradually phasing in new low energy street lighting which adversely affected the quality of night-time images. Secondary to this is the effects of trees, flags, banners and bunting (strings of small flags hung between buildings) obscuring cameras. It was considered that the obstruction of CCTV cameras by trees is a critical factor that limits its effectiveness and that the system's original design and subsequent extensions had failed to take into account vegetation. Reference was also made to tree planting carried out on landscaped mounds that screen factories on an industrial estate. The planting had been carried out after CCTV had been installed in the area. With time the trees had grown to a height where they obstructed pole-mounted cameras.

The CCTV manager considered that obstruction is most acute during the summer when deciduous trees are in leaf. During the winter obstruction by bare branches was tolerated

because cameras could see through the crowns. The position of one particularly high street camera was criticised by the CCTV manager. This camera had been planned and installed during the winter and was said to be rendered useless the following spring when a nearby tree came into leaf.

In response to the mainly seasonal nature of the obstruction the CCTV manager had resorted to writing to the departments and organisations responsible for trees obscuring CCTV cameras on an annual basis. During the summer of 2009 the CCTV manager sent a standard letter to tree managers who were responsible for trees affecting 23 CCTV cameras at various locations. All but one of the locations was managed by the local authority but because they were the responsibility of different departments the vegetation obstruction was difficult to resolve. The CCTV manager considered that the fragmented nature of local authority tree management resulted in inconsistent outcomes with only a quarter of requests for vegetation to be cut being resolved satisfactorily. To achieve more satisfactory outcomes the CCTV manager was willing to fund the cost of pruning works out of the CCTV budget.

Despite the CCTV manager's experience the preferred solution for dealing with vegetation obstruction was to commit to less drastic and more regular pruning rather than insist on its complete removal. Relocating cameras or installing additional cameras to overcome vegetation obstruction were not considered viable due to cost. The CCTV manager stated that open space CCTV was an important tool in combating crime and anti-social behaviour and was confident in its capabilities. It was acknowledged that vegetation was a feature of the urban environment and that CCTV and trees could coexist.

### Case study 2 Wrexham town centre

The first installation of open space CCTV in the town centre took place in 1996 with the deployment of 13 cameras. Camera positions were determined by senior police and council officers who assessed sites using a mobile platform. The initial installation was soon supplemented with a further 12 cameras that has now evolved to include 126 cameras in the town centre and elsewhere in the county.

The Security Client Manager considered that CCTV funding was a major cause for concern and was aware that criminal behaviour was being modified to avoid detection. The Security Client Manager stated that vegetation obstruction was not considered to be a critical issue but was a greater threat to CCTV than more regulation and public concern over privacy. The problem of vegetation obstruction was

again identified as being mainly confined to the summer months when deciduous trees are in leaf. During the winter cameras were said to be able to see through the bare branches of trees; however, it was stated that the autofocus mechanism on cameras would sometimes focus on a near branch rather than a distant object under surveillance. It was also claimed that the milder winters and wetter summers were leading to more luxuriant growth which remained on trees for longer periods of time.

The Security Client Manager estimated that five requests had been made to the tree officer in the past three years and that the majority of these had not resulted in any major work. All requests affected *Sorbus* spp. and it was admitted that vegetation obstructing cameras would occasionally be removed without consulting the relevant tree manager. It was claimed that high street trees planted in the 1980s were now becoming a problem and for this reason the frequency of obstruction by trees would increase.

Reference was made to an incident where a woman police officer had been assaulted and the crime had not been caught on camera because the incident had been obstructed by a tree. The incident led to a request for the tree to be felled. However, this was strongly opposed by the local councillor who is known to be a strong supporter of the environment. This was sufficient to ensure the tree's retention.

The Security Client Manager judged the town centre CCTV surveillance system to be a success and cited a local press article which claimed that it was one of the most successful schemes in Wales (Robinson, 2009). As the Security Client Manager had previously had a career advising about crime reduction he was aware of the role of good design and acknowledged that it was more important than CCTV.

## Discussion

Results of this research have found that 1993 was the earliest year for the introduction of open space CCTV by a local authority, thus illustrating how recently a concept which is now part of everyday life was introduced. In the 1990s CCTV was heavily promoted by the Government as *the* crime prevention method of choice and the public have largely agreed with its deployment. Despite being heavily promoted and accepted, the introduction of open space CCTV has not been accompanied by any meaningful guidance on how it should be sympathetically incorporated within the existing urban environment. It is also evident that the planning system has not acted as a safeguard either. The reasons for this are considered to be the lack of planning guidance for this

aspect of CCTV, the public support for CCTV and the fact that certain types of installation can be undertaken without planning permission.

In the majority of cases, open space CCTV will have been installed after any urban forest vegetation had been planted and allowance should have been factored into its design to ensure obstruction did not occur. In these cases it is considered that CCTV has been brought into conflict with urban forest vegetation. However, CCTV has not always been installed after urban forest vegetation has been planted and one case study referred to existing CCTV cameras being obscured by new tree planting. As the period of time that CCTV has been present increases this type of conflict is likely to become more common. A small minority of CCTV managers were so concerned about this eventuality that they wanted a moratorium on new tree planting in areas of existing open space CCTV. Tree managers also believe CCTV has reduced the opportunities for new planting. These findings will inevitably present additional challenges to landscape architects and tree officers wanting to plant in a crowded urban environment.

After its rapid introduction open space CCTV is now becoming a maturing technology that will continue to have a place in the urban environment. The withdrawal of generous grants and a more holistic approach to crime prevention mean that the growth of CCTV has slowed in recent years. This does not mean that the interactions between CCTV and urban forest vegetation will decrease for three reasons. Firstly, the CCTV industry still wishes to promote the further expansion of CCTV in public and quasi-public areas such as schools. Secondly, projects of regeneration will provide opportunities for new schemes of planting and also additional CCTV surveillance. Lastly, as trees are dynamic the incidence of obstruction will change even if the number of trees and CCTV cameras remains static.

Unfortunately, due to the fragmented nature of local authority tree management and limited responses to this aspect of the research, the degree to which CCTV affects urban forest vegetation in numerical terms is uncertain. Within the limited sampling that the tree manager survey provided, indications are that in the three years leading up to the survey there were 400 instances in Wales of tree felling or cutting back due to CCTV. Using data from six local authorities the cost of additional tree work in the past five years is estimated to be £10 000 for each Welsh local authority. The majority of remedial work was confined to cutting back trees or occasional tree removal, and this method was favoured much more where trees less than 10 m caused an obstruction. Shrubs and hedges were

affected much less indicating that CCTV is a problem affecting urban trees rather than urban forest vegetation generally. The trees affecting CCTV are nearly all deciduous and fairly evenly divided between small tree less than 10 m and larger trees greater than 10 m.

The relocation of existing cameras or new cameras was not considered an option for financial reasons with the cost of buying and installing an additional camera estimated to be £12 000 to £15 000 and the cost of relocating a camera being several thousand pounds. Tree managers are now increasingly using valuation methods (Nielan, 2010) to place a financial value on the amenity provided by trees and are able to calculate the loss in amenity that would result from cutting back and felling trees to accommodate CCTV. This approach is particularly relevant for open space CCTV as the trees which come into conflict with it are most likely to be prominently situated with high amenity value and where crown symmetry and other aesthetic aspects are important. The adoption of this approach and its acceptance by non-tree professionals will promote the retention of urban forest vegetation and encourage technological solutions.

The importance of good CCTV design is reflected in the two case studies. The CCTV system in Wrexham town centre had a considered approach with potential camera positions being checked in advance of installation using a lifting platform. This approach has resulted in fewer conflicts with trees to the extent that the CCTV manager considered that it is not a significant problem. By contrast, the open space CCTV system in Flintshire appears to have been designed without consideration of existing trees. This soon resulted in cameras being obstructed and requests for vegetation to be cut back for overriding public safety reasons. In the worst case a camera installed during the winter was rendered 'useless' the following summer by leaves on a nearby deciduous tree causing a severe obstruction to the camera's view. This is the result of very poor design. The failure of early CCTV systems to adequately consider tree growth may have been a genuine oversight due to the lack of meaningful guidance; however, it is also possible that CCTV designers assumed that vegetation would be managed to not impede cameras in the belief that CCTV should always take precedence.

Whilst the empirical research focused on the interaction between CCTV and urban forest vegetation, failure to consider why these respective elements are components of urban areas would have been a major omission. Urban forest vegetation and open space CCTV are considered to have a value to society which exceeds their net cost. CCTV is used as a method of promoting safer communities whilst urban forest vegetation is a fundamental part of greener and more

attractive urban environments. Both of these elements are key Government policies (ODPM, 2002) that promote sustainable and safer communities and aim to improve the quality of life for urban dwellers. At first the objectives of open space CCTV and those for planting urban forest vegetation appear to be mutually exclusive. However, the research demonstrates that vegetation and the creation of quality urban space can reduce crime and anti-social behaviour. This aspect of urban forest vegetation needs to be given greater emphasis by architects and town planners if a more integrated approach to good urban design is going to be achieved.

It is an inevitable conclusion that the benefits afforded by urban forest vegetation and open space CCTV are best achieved in conjunction with each other as part of good urban design, rather than allowing them to compete. Notwithstanding, it is apparent that there is very limited consultation between tree managers and CCTV managers and they often act independently. This is disappointing because the research also found that both stakeholders consider consultation essential and that, in the majority of cases, the views of tree officers and CCTV managers are not particularly polarised.

At the time of writing the London Tree Officer Association is preparing guidance for stakeholders regarding the interactions between open space CCTV and urban trees. It is expected that the guidance will address many of the stakeholders' concerns relating to poor planning and consultation that are discussed above as well as containing a protocol for the resolution of CCTV and vegetation conflicts.

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