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A model for managing Crime Scene Examiners

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Abstract

Police forces in the UK employ specially trained Crime Scene Examiners (CSEs) to provide forensic science support to the investigation of crime. Previous research (Bradbury and Feist 2005; Williams 2004) has shown wide variations in the management, deployment, and performance of this staff group and, as such, there is a need to develop performance indicators as a measure of effectiveness. This paper looks at the performance and management of CSEs in Durham Constabulary and discusses a model which focuses on the quality of the work of CSEs rather than the quantity of scenes visited, fingermarks lifted or DNA samples collected. Durham Constabulary focus on three main areas of performance to manage their crime scene examiners: level of activity, quality of materials collected, and the conversion of forensic materials into intelligence matches. In this paper we explore a model of performance management which demonstrates how activity measures and review processes can be implemented and utilised to provide insight into the effectiveness of forensic science. Performance management data collected from 24 CSEs over a one-year period (January to December 2011) is used to discuss the role of forensic performance measures in a scientific support unit, reflecting on the strengths and weaknesses of the measures collected.

Keywords

Crime scene examination, forensic science support, management processes, volume crime

Introduction

The forensic process starts at the crime scene with the collection of potential evidential materials which may be pertinent to an investigation. The importance of effective crime scene examination cannot be overestimated (Home Office 2007; Blakey 2000) and, even if crime scene examination is predominantly a means of information gathering, the assessment and interpretation of the scene is central to, rather than detached from, other forensic disciplines. Essentially, a crime scene examiner's (CSE) role is to "*retrieve, examine and investigate physical evidence*" from the scene of a crime (Robinson and Tilley 2009, pg. 212). CSEs are expected to assess and collect forensic evidence from the crime scene, prioritising that which is deemed significant in the early stages of the investigative process. For example, CSEs are often required to determine the best of a number of fingermarks to collect, so as to provide the highest chance of obtaining a good quality mark for analysis; which may, in turn, provide a the best chance of identification (Bond and Sheridan 2007; Adderley and Bond 2008). Crime scenes involve a variety of investigative opportunities and the identification of pertinent evidence often depends on the abilities and specialist technical skills of the crime scene examiner (Robertson 2012).

The decision to have CSEs attend a scene is dependent on crime type, availability of staff, specific force attendance policies and sometimes an assessment of the likelihood of recovering forensic materials. CSE deployment, management and performance have been shown to vary significantly throughout police forces in the UK (Robinson and Tilley 2009; Williams 2004). In some forces, Senior Investigating Officers (SIOs) or Scientific Support Managers (SSMs) have discretionary control over CSE attendance; in other jurisdictions attendance is determined by force policies (*e.g.* blanket attendance policies for certain crime types). It is also important to consider the priority given to some crimes types over others, *e.g.* crimes of violence versus property crime. Furthermore, the acceptance of CSEs by police investigative teams and their integration into police investigations hinges on the perceptions of their role as well as what they can contribute (Ludwig *et al.* 2012).

In the UK, CSEs receive extensive training to allow them to recover physical evidence and to develop the maximum amount of intelligence from a crime scene (College of Policing 2013). It is this training, and subsequent experience, which provides CSEs with the ability to recognise materials of evidential value and consider their potential usefulness for later analysis (Baber and Butler 2012). The increasing range and sensitivity of forensic technologies has also increased the complexity of the CSEs' professional practice.

CSEs must perform effectively alongside a number of different 'actors' in the criminal justice system, to support the investigation of crimes. The processing of scenes (the attendance, recording and recovery of forensic trace material) by CSEs is considered a crucial aspect of effective criminal investigations (Kelty 2011; Wyatt 2013). Therefore, ensuring CSEs are performing effectively and efficiently is important for the Scientific Support Unit. Forensic Managers within Scientific Support Units must develop and use performance indicators as a measure of the productivity of the CSEs.

Performance management

There have been a number of reports which have called for the use of performance indicators as a measure of effectiveness of forensic science. These measures have not always been readily available, as historically these services were restricted for use in investigating serious crime only (Home Office 2007; Touche Ross 1987; Ramsay 1987).

The need to introduce performance indicators was first considered in 1987, in an extensive review of scientific support to police in the UK (Touche Ross 1987). They recommended that "*performance assessment of personnel is developed*", and that members of the scientific support unit are regularly "tested" (Touche Ross 1987, pg. 2). The data available showed a large degree of variation in performance between forces and no correlation between force size and overall performance. Even where there was a "*reasonable supervisory structure*" of scientific support staff and some records of performance were kept, other work pressures prevented any review of this information or assessment of performance (Touche Ross 1987, pg. 9).

The 1996 Association of Chief Police Officers (ACPO) and the Forensic Science Service's (FSS) report 'Using Forensic Science Effectively' also stated that performance indicators were needed, in order to measure "*successful outcome*[s] *not just the level of activity*" (ACPO 1996, pg. 4). The importance of the quality, not just the quantity of evidential material recovered, was clearly stated for the first time. Performance indicators were considered as a means of measuring overall success and standards of work, to promote behaviours which provided investigative success.

In 2000, Her Majesty's Inspectorate of Constabulary's (HMIC) Thematic Inspection 'Under the Microscope' reviewed the use of forensic science in the investigation of volume crimes, and recommended that scientific support staff should be subjected to regular performance reviews in order to maintain and improve their professional competence (Blakey 2000). Performance measures could also be used to establish benchmarks to compare and judge the relative performance of individual scientific support staff, and the police force as a whole. HMIC mention, not only the use of performance indicators, but the introduction of targets as a means to improve performance. However, like many of the previous reports, they found that the small number and incomplete nature of the performance data on the use of forensic science in policing made it difficult for this review to reach any conclusions on the effectiveness of scientific support functions (Blakey 2000).

Not until 2006 were a set of official performance indicators created, in an attempt to measure the value of forensic science (Home Office and HMIC 2006). Measuring activity factors such as: the number of scenes attended, the amount of time spent at scenes, and the number of scenes from which fingermarks or DNA are recovered, were considered insufficient to evaluate forensic performance (Home Office and HMIC 2006). Such activity-based performance indicators focus on the quantity of samples, and not necessarily on its quality, or the impact on other forms of evidence, or the contribution to the investigation and the criminal justice system.

The 2007 Scientific Working Improvement Model (SWIM) report focused on crime scene examiners by recording and analysing measurable parameters such as: number of scenes attended per day, amount of time spent at scenes, number of evidential samples collected from a scene, and the amount of time spent carrying out other tasks not related to scene investigations (*e.g.* paperwork, travel time) (Home Office 2007). The SWIM report suggested that the evidence collection "*behaviour of individual CSEs is one of the biggest determinants of attrition (impacting productivity, recovery, identification and ultimately detection rates)*" (Home Office 2007, pg. 7). This report further stated that CSEs should be encouraged to collect high-levels of high-quality forensic evidence, and high-performers should be used as exemplars for lower performing CSEs.

Elsewhere, Australian researchers have begun to investigate the key core skills required to be a high-performing/proficient Crime Scene Examiner (Kelty *et al.* 2011). Top-performing CSEs were defined as "*CSEs who will achieve superior results in most or all aspects of their work compared with the majority of CSEs in the same role*" (Kelty 2011, pg. 199). This study took the cohort of the highest performing CSEs in a number of jurisdictions in Australia, and attempted to identify what traits exemplified their expertise. They wanted to provide an "*explanation of why some CSEs excel at crime scene work relative to their peers*" (Kelty *et al*., 2011, p.176).

Kelty and colleagues (2011) identified seven key attributes (or key performance indicators) of CSEs exhibiting outstanding performance, and included: cognitive abilities, knowledge base, experience, work orientation, communication skills, professional demeanour, and approach to life. These factors associated with high performance of CSEs, were considered important in order to reduce poor crime scene work, develop an "*excellence in the recognition, recovery and recording of high-quality evidence*" and to gain an understanding of the kind of impact a high-performing CSE could have on an investigation (Kelty *et al.* 2011, pg. 177).

Top performing CSES were found to produce high quality evidence leading to higher identification rates because they are more effective ("*collect the right things*") and efficient ("*collect them in the right way*"). Kelty and colleagues (2011) noted that high-performing CSEs did not process a scene more quickly nor collect less evidence than other CSEs, but were thought to utilise a more comprehensive decision making process in relation to how scenes were analysed and samples collected. This was also thought to save resources and staff time in the laboratory, as top performing CSEs have more confidence and technical knowledge to collect high-quality and case relevant materials.

One negative impact considered in this study was additional occupational stress to top performing CSEs if paired with lower performers. Lower (or average) performing CSEs were thought to place greater demands on high-performing colleagues; where the high performer not only managed a crime scene, but also supervised and managed the work of the lower performing CSE (Kelty *et al.* 2011). In this study, "*top-performing CSE*" were identified by Scientific Support Managers from each jurisdiction nominating their top performers using performance measures they had readily available. The criteria on which these selections were made may differ between police jurisdictions.

Performance indicators do not appear to follow any standard measure, although typical discussions regarding scene examinations focus on the technical or procedural role of CSEs which lend themselves more easily to measurement (Ludwig *et al.* 2012). Kelty (2011) asks the question "*even if procedures are properly documented, properly followed, and techniques properly applied, does this assure high-quality and highly effective outcomes at the crime scene*?" (Kelty *et al.* 2011, pg. 184). Scientific support is one of the most closely monitored areas of policing, and research into crime scene examinations and CSEs continue to interest scholars. However, data regarding measurement of performance figures are limited. In the Netherlands, the Dutch police introduced performance measure as a consequence of political pressure for improved accountability (Hoogenboezem and Hoogenboezem 2005). Practical professions (e.g. Police) ought to include regimented daily practice, in which goals, and behaviour are set, and sanctions are imposed in case of failure (Stol *et al.* 2004).

In this paper we consider a model of performance management being utilised in one police force which demonstrates how activity measures, and review processes, can be implemented and effectively utilised to manage and improve performance.

Durham Constabulary

This paper focuses on the work of crime scene examiners (CSEs) working for Durham Constabulary in the north-east of England, with a force area population of more than 600,000 people. Durham Constabulary has the responsibility for policing a geographic area of 860 square miles, including towns and cities such as Darlington, Durham and Bishop Auckland, as well as more rural areas such as Teesdale and Weardale. Durham Constabulary deals with approximately 23,000 crimes *per annum* and is made up of 1,381 warranted

Police Officers, and 980 civilian police staff (unsworn Police Staff) and Police Community Support Officers (PCSO). The service is led by the Chief Constable and his Executive Team. The work of the police service is carried out through a number of functional Commands: Neighbourhood and Partnerships, Response, Crime and Criminal Justice, Tasking and Coordinating, and Support Services; all of which are led by a Chief Superintendent. The Scientific Support function sits within the Crime and Justice Command at Durham Constabulary. The Scientific Support Unit is responsible for the following:

1. Crime scene examination of all crimes (serious and volume),
2. The provision of forensic expertise (to Senior Investigating Officers) in the investigation of serious crimes and (to Area Commanders) in devising tactical responses to volume crime problems,
3. The provision of a full fingerprint service from capture and enhancement through to final identification,
4. The administrative functions around the submission of prisoner samples and crime scene stains for DNA profiling,
5. The administrative functions surrounding the submission of all forensic exhibits for analysis and interpretation by external service providers,
6. The coordination of external services and specialist techniques by forensic service providers, and
7. Still image production and enhancement for the force (Durham Constabulary 2004).

Twenty-four Crime Scene Examiners (CSEs) are employed within the Scientific Support Unit (SSU) and their role is to attend crime scenes recorded and reported across the force area. They are based in four depots: Peterlee, Stanley, Bishop Auckland and Darlington and are responsible for scene attendance anywhere in the area. Durham Constabulary utilises a force-wide operational model of deployment rather than a Basic Command Unit (BCU) model in which CSEs would be restricted to certain areas within the police jurisdiction.

The management structure consists of a Scientific Support Manager and two Forensic Science Managers (Peterlee/Stanley depots and Bishop Auckland/Darlington depots) who oversee four Crime Scene Managers (one per depot), sixteen Crime Scene Examiners (four per depot) and four Volume Crime Scene Examiners (one per depot). The role of Volume

Crime Scene Examiners was introduced under funding provided by the DNA Expansion Programme (2005) and these members of staff are mainly responsible for the attendance at burglary and motor vehicle crime scenes. Unlike CSEs, VCSEs cannot be redeployed to attend a major crime incident but may be required to cover the work of their colleagues who do attend a major incident at short notice. The organisational structure of Durham Constabulary Scientific Support Unit can be seen in figure 1.

Figure 1: Organisational structure of SSU

Durham Constabulary carried out a number of reviews of its scientific support functions in the early 2000s (Williams 2001; Durham Constabulary 2004). A 'Best Value Review' (BVR) was carried out in 2004, which found that at the time there was no monitoring of performance indicators (by team or individual), nor were performance targets generally used (Durham Constabulary 2004). Since this review, Durham Constabulary have implemented and utilised performance measurements, in order to move the focus from measuring quantities only. Previously, CSEs would evidence their workload by the number of jobs they logged on the forensic management system (LOCARD). However, closer inspection identified that staff were logging a new entry (with a different LOCARD reference number) on the system every time an action was taken on a specific job number (*e.g.* scene attended, exhibit collected). This resulted in multiple LOCARD numbers being linked on one Crime Reference or job number. Policy was introduced so that all actions/tasks were logged under one Crime Reference Number (CRN) and one LOCARD number only.

When the decision was made to monitor the performance of CSEs within the SSU at Durham Constabulary, no targets were set initially. Performance psychology explains that the simple introduction of the process of performance monitoring causes a natural improvement in performance of an individual (Burton and Weiss 2008; Locke *et al.* 1981). This is based on the idea that individuals now become accountable for their own actions, rather than blending in with the performance of a group (VandeWalle *et al.* 2001). The recording of performance occurred for a number of months in order to establish the baseline, or natural performance level, of the CSEs before specific targets were set at the mean level of performance of the group as a whole. It was quickly established that the initial performance targets were set too low as they were met easily by the CSEs. As a consequence the performance targets were increased gradually and have remained stable for a number of years, based on national benchmarks against which performance is measured. This was to provide guidance for the minimum level of expected performance, as determined by the Forensic Managers and the SSM. There continue to be individuals who easily exceed these expectations every quarter, but there will also be others who cannot (for various reasons) maintain this level of performance consistently and constantly.

The process of performance management involves managing employee efforts based on *measured* performance outcomes. Thus, determining what constitutes good performance and how the different aspects of high performance can be measured is critical to the design of an effective performance management process (Hartog *et al.* 2004). The use of targets or goals as a means to encourage uniform performance is well documented, and it is known to improve performance (Bryan and Locke 1967; VandeWalle *et al.* 2001). Specific goal setting, even if the goal is difficult to achieve, will drive a greater level of performance than asking individuals simply to 'do their best' (Locke and Latham 1990). Such individual 'do-your-best' goals are define idiosyncratically and have no external measuring point (Locke and Latham 2002). This leads to a wide range of 'acceptable' performance levels varying from individual to individual. Goal specificity reduces variation in performance by reducing the ambiguity of what is to be obtained (VandeWalle *et al.* 2001; Bryan and Locke 1967). Targets or goals are known to affect performance in a number of ways: they focus attention toward goal relevant activities and away from non-relevant activities, they can have an energising function leading to more effort, and they can affect the persistence of an individual to try to achieve their goal (Locke and Latham 2002).

At Durham Constabulary, performance measures are recorded for each Scientific Officer on a monthly basis, and are reviewed quarterly in accordance with set targets and performance averages (see table 1). A simple 'traffic light' system of performance has been implemented:

- Green - targets are being met
- Amber - the individual is performing above the set targets but below the average of their colleagues

- Red - targets have not been met.

This information is used to provide indicators of staff activity levels, individual and collective unit workloads, and management information to the Scientific Support Manager (SSM) and Forensic Managers. Although these indicators are only able to measure fairly simple aspects of performance, the information available is considered important for monitoring staff performance, and identifying areas of improvement or ineffectiveness (Williams 2001).

Table 1: Example of quarterly performance analysis of Crime Scene Examiners evidence conversion rates (target rate 12%)

Individual performance is reviewed on a quarterly basis by the Scientific Support Manager (SSM). Individuals performing below the average of the rest of the unit are identified and this is highlighted to the relevant Forensic Manager. The low performance level of the CSE is shown to the individual and discussed with the Forensic Manager. This is often sufficient to improve the performance of the CSE in the next quarter; the process of identifying low performance often causes the individual to naturally increase their effort (Matsui *et al.* 1983). This is a similar natural effect as observed when performance monitoring is introduced initially (VandeWalle *et al.* 2001). Poor performance in a second consecutive quarter leads to a discussion between the individual CSE and the SSM, where the lower than expected performance is questioned. The individual is given the opportunity to explain or justify their poor performance, as for example, external (and often personal) factors may have affected their job performance (Kelty 2011). This gives the SSM opportunity to assess whether the individual may be suffering from stress or struggling with situations outside of their control, whether the types and numbers of scenes the CSE has been attending has contributed to the low performance figures, or whether the CSE is struggling with their workload (or any number of other factors) (Kelty 2011).

Unsatisfactory performance in a third consecutive quarter is taken seriously and results in an ‘Action Plan’ being developed with the individual. This considers the needs of the individual, and may involve re-training or mentoring from the Forensic Manager. Action plans last no more than six months and involve constant scrutiny and review. If the performance of the CSE was still considered to be unsatisfactory at the end of the Action Plan, steps for re-deployment or dismissal would be initiated (an Unsatisfactory Performance Process begun). The performance management process is illustrated as a flowchart in figure2.

Figure 2: Flowchart of CSE performance management process

Scrutiny of performance figures has been useful for managing staffing, budget and resource issues at Durham Constabulary. The monitoring of productivity and effectiveness of CSE and other scientific support staff (*e.g.* fingerprint examiners), has provided information on individual staff performance, as well as a summary of the units performance as a whole. Comparing performance over time, and across crime types, has been used to change policy and practice within Durham Constabulary.

There are a number of performance measures which are recorded and measured in the Durham Constabulary Scientific Support Unit, that are considered important in determining how effectively CSEs are deployed and operating. These include: 1) scene attendance and number of tasks per day, 2) evidence conversion rates (successful identification of a suspect from trace material recovered from the scene – mainly DNA and fingerprints) and 3) the quality of evidence collected. These factors will be discussed in detail in the next sections.

1) <u>Scene attendance</u>

A commonly used indicator of crime scene examiner productivity is the average number of scenes attended per day. The SWIM report found that this differed considerably between the 41 police forces samples; a median level of attendance was calculated at 2.4 scenes per day (Home Office 2007). Durham Constabulary calculates performance as a measure of tasks per day rather than scenes. Tasks are split between operational and non-operation. Operational tasks, which are number of scenes attended, take up 70% of CSEs working time.

Non-operational tasks include paper work, evidence submission and other administrative tasks and make up the remaining 30% of a CSEs average working day.

The measure of tasks per day is calculated by dividing the number of tasks (operational or all) by the number of days worked. Durham Constabulary Scientific Support employs 22 full-time CSEs (and 2 part-time) CSEs who work 10 hour shifts, in patterns of 4 days on, 3 days off. The necessity for shift patterns to coincide with crime patterns was identified by the Best Value Review in 2004 and nationally by SWIM in 2007. Durham Constabulary has implemented a shift which ensures adequate resources are available during peak hours. Ten hour shifts run from 8am to 6pm or from 12pm to 10pm. A 24 hour on-call system is in place to cover any major crimes that occur outside the 8am-10pm working day.

On average, Durham Constabulary CSEs operate at 2.8 operational tasks per day (an increase of 0.5 tasks per day since 2004). The term 'operational tasks' is used by the SSU at Durham Constabulary to mean the number of scenes attended, and is used to distinguish them from other tasks ('non-operational' tasks) which CSEs also carry out (*e.g.* paper work, evidence submissions). CSE performance of operational tasks per day ranges from 4.1 (CSE 21) to 1.8 (CSE 17). This is also measured against non-operational tasks (see table 2). Therefore, a low number of operational and/or non-operational tasks could identify struggling CSE to the Scientific Support Manager.

SWIM stated that variance in number of scenes per day (productivity) could not solely be attributed to demographics of the police force; a similar caveat must be implemented for the data from this single police force (Home Office 2007). It is well known that a number of external factors can affect productivity and performance (Dale and Becker 2004; Porter and Steers 1973). Kelty *et al.* (2012) identified that factors such as home life, stress management, and job security affect the performance of CSEs. Therefore, awareness that such factors may influence the performance of CSEs are considered and are discussed during quarterly performance reviews.

Table 2: Number of tasks (operational and other) per day (January –December 2011)

By measuring operational tasks and non-operational tasks, it is possible to measure overall activity of CSEs including 'non value-adding activities'. Identifying areas where CSEs may lose time can help improve overall performance. Superfluous activities previously identified by SWIM (2007) have been addressed (*e.g.* IT system improvements to reduce queuing time and the need to re-key information into multiple systems) to free-up CSEs to carry out operational tasks, as required.

In order to focus CSEs on productive scene examinations, trained call handlers assess the likelihood of a scene to provide value to an investigation. Durham Constabulary telephone operators (or call handlers) carry out 'forensic assessments' when receiving incoming calls. The individual reporting a crime is asked a number of set questions which allow the call handler to make an initial assessment of nature of the scene/scenario, in order to evaluate attendance requirements of scene examiners. Used as a form of scene screening, these call handlers may determine that a particular offence has been committed in a way that severely limits the deposition of forensic material and is considered 'unproductive' (due to a number factors, e.g. weather, location, or the nature of crime). This not only minimises the attendance of CSEs at 'unproductive' scenes but theoretically, increases the number of scenes CSEs attend which are considered forensically viable and consequently is considered to maximise the (cost-) effectiveness of scene examinations.

The importance of balancing the workload of CSEs to obtain optimum performance has previously been discussed (Williams 2004; Home Office 2007). Assessing workloads of CSEs ensures that staff resources are sufficient for CSEs to effectively carry out their jobs. For example, too high a workload may result in substandard scene investigations as CSEs are rushing to get to the next job. The close management of CSE provision, activity and productivity may reduce the variation in outputs and outcomes of scene investigations (Williams 2004).

2) <u>Forensic conversion rates</u>

The most important performance indicators are evidence collection, submission rates and conversion rates. Recovery rates are defined as "*the percentage of the scenes attended from* *which at least one item of DNA or fingerprint evidence was submitted*" for analysis (Home Office 2007, pg. 31). Previous studies (Home Office 2007; ANZPAA and NIFS 2012) identified the median evidence submission rates as 10% for DNA and 28% for fingerprint evidence. Durham constabulary measured evidence submission levels at 40% fingerprint evidence and 7% DNA evidence for volume crimes (burglary dwelling, theft of vehicles, and theft from vehicles) in 2011.

CSE effectiveness can be measured using evidence conversion rates. This is the percentage of evidence samples collected which result in an identification of an individual and provides a useful measure of productivity of scene attendance (Williams 2004). Conversion rates are useful for measuring productivity and effectiveness of CSEs as it combines the results of the "*production of evidential artefacts by CSEs and their successful matching to records held on relevant databases*" (Williams 2004, pg. 33).

Most frequently, this focuses on DNA samples or fingerprint lifts which produce a DNA match or a fingerprint identification (see table 3). This changes the focus of measurement from just the *number of samples collected*, such that it includes a consideration of the quality of the evidence being collected. This requires the CSE to utilise their skills and knowledge to provide the 'best' possible evidence for analysis. The highest performing CSE (CSE 4) at Durham Constabulary for the period of data analysis (calendar year of 2011) demonstrates a conversion rate of 18.1%. The annual data collated demonstrates a range of conversion rates, averaging at 12.1% (see table 3).

Table 3: Conversion rates, fingerprint identification rates, DNA identifications and footwear yield rates

Calculating the number of scenes attended against the number of hits achieved (DNA and fingerprint) allows the Scientific Support Manager to identify the productivity of the CSEs. This quickly identifies the high performing CSEs (15 of the 24, 63%), and those whose performance failed to meet the required standard (7 CSEs 29%). However, when this was analysed further, it was found that individual conversion rates of fingerprint and DNA evidence varied. For example, although CSE 4 has the highest overall conversation rate (18.1%), this can mostly be attributed to the percentage of fingerprint identifications (84%), rather than DNA (16%).

In the Durham Constabulary data for 2011, fifty-six percent of forensic materials collected from crime scenes are fingermarks, twenty-one percent are footwear marks, and eighteen percent are DNA-containing materials. Individually each CSE collects more fingerprint marks from crime scenes than any other evidence type. This correlates with international studies that have looked at collection rates of forensic materials from crime scenes (Peterson *et al.* 2010; Home Office 2007; Roman *et al.* 2008).

Analysis of individuals in relation to collection rates and rates of identification (a DNA match or fingerprint identification) is illustrated in figure 3. This shows the divide between individuals who are high collectors of material from crimes scenes (restricted for this case to fingermarks, sources of DNA and footwear marks) and who also achieve a high identification rate. Eleven out of 24 CSEs appear in the top quadrant of performance, high collector and high identification rates. CSE 16 is the highest attending, highest collector and has the highest identification rate in this sample.

Figure 3: Scatter graph of performance of CSEs calculating collection rates and identification rates.

The remaining 13 CSEs are performing outside of the top quartile, with a cluster of 7 CSEs around the 'mean' performance mark. CSEs 2, 17 and 20 appear to be particularly low performers, with low collection and identification rates. CSE 2 is one of the two members of staff that work part-time at Durham Constabulary, therefore it may be expected that they attend less scenes and collect less forensic material. However, this does not explain their low conversion rate. CSEs 17 and 20 attend an average number of scenes within this sample.

Although collection and recovery rates cannot be used to demonstrate a complete picture encompassing all factors, it can be useful as an intermediate measure of performance. Recovery of poor quality material, not only leads to low conversion rates, but can also "*bring about low downstream inefficiencies as resources*" are used up to test forensic material (Bradbury and Feist 2005, pg. 34). Low rates of identification may indicate that CSEs are collecting poor quality forensic material from scenes and reasons for this should be established to avoid depletion of resources – time, staff and money.

3) <u>Quality of evidence</u>

The previous section has identified the importance of the quality of forensic evidence collected from scenes to achieve high rates of forensic detections. At Durham Constabulary, fingermark evidence is analysed further to consider not only number of identifications, but also to consider the percentage of fingerprint lifts which were of poor quality and therefore were considered insufficient for comparison.

Table 4 illustrates quality on a sliding scale of value. The most important column in this table in for monitoring CSE performance is 'insufficient detail for comparison'. CSEs are monitored for their quality of fingermarks recovered to identify or eliminate individuals or to provide good quality fingerprint lifts which can be uploaded to the fingerprint database for comparison. Ideally, CSEs want to collect good-quality and clearly observable fingerprint lifts for analysis in the Fingerprint Bureaux. However, the judgement of the quality of fingermarks collected from scenes for uploading and comparison on the national fingerprint database (Ident1), are not made by the CSEs themselves.

CSEs are trained to collect any mark that they consider to be a fingerprint and which contains some friction ridge detail. The quality assessment and expert interpretation does not occur until the fingerprint lift is received in the Fingerprint Bureaux and is examined by a Fingerprint Expert. Therefore, CSEs may collect fingerprint lifts which will eventually be determined 'insufficient detail for comparison' by the Fingerprint Bureaux. It is the Fingerprint Expert who will determine whether an identification can be made from the lift submitted to the Fingerprint Bureaux by the CSE, not the CSE.

The SSM and the Forensic Managers review fingerprint performance and identify those collecting a high-percentage of poor-quality fingermarks on a regular basis. Standard operating procedures within the Fingerprint Bureaux will be followed in order to ascertain the quality of the print and the likelihood of it being submitted for comparison on the national fingerprint system. Fingerprint Experts will come to the decision on the quality of the print whether or not it is good enough to be sent to the national fingerprint system, or whether it is stored on the local system within the SSU if the quality measures are not met.

If an individual consistently recovers a high-percentage of poor-quality fingermarks, these will be reviewed and if deemed necessary he/she will be encouraged to spend a day in the fingerprint bureaux to gain some insight into the quality process of fingermark comparison from the Fingerprint Experts. Some examples of threshold expectations of quality will be communicated to the CSE by the fingerprint expert and it is expected that performance improvements will occur.

Table 4: Fingerprint lift status (percentage of the exhibits submitted)

Table 4 reviews CSE performance not only on the number of positive identifications they have achieved, (from the total percentage of fingerprint lifts recovered) but also recognises quality not just quantity is important. Unlike table 3, which focuses on a comparison of number of scenes attended and number of hits/identifications achieved, without considering the number of negative results obtained due to poor-quality of materials collected? This is far more useful for managers as it helps to identify weaknesses, knowledge gaps or poor working practices of specific individuals. Individuals with low percentages of poor-quality evidence collection may be able to provide guidance to individuals who are collecting a high-percentage of poor-quality materials. However, as not all DNA materials recovered from scenes are sent for analysis to forensic service providers it is more difficult to determine poor-quality collection rate patterns for this evidence type.

Discussion

Performance indicators (PIs) throughout all stages of the investigative process can be useful for evaluating whether forensic science has contributed to the criminal justice system.

Measuring outputs and outcomes in terms of identifications is seen as a major performance measure for CSEs, who work within a small section of the greater criminal justice system. Performance measures in terms of the uses and effects of forensic science evidence in terms of outcomes in the criminal justice system are limited (Ludwig and Fraser 2013).

Activity based PIs do not necessarily identify behaviour which may contribute to investigative success, however they are useful for SSMs to monitor and manage internal efficiency of the department. PIs based on activity and outcomes could be used to monitor effectiveness, encourage improvements in professional behaviours, establish areas that need improvement and estimate the overall level of success (ACPO & FSS 1996).

The performance management of CSEs has been discussed for a number of years. However, the implementation of measures to assess CSE productivity and performance have been sparsely recorded and discussed in the literature. This paper seeks to illustrate one force's model of performance management of its Scientific Support Unit and discusses the benefits of utilising such methods for managing overall productivity. The data in this paper illustrate the variation in success of individual CSEs at attending forensically viable scenes, recovering material and converting this into fingerprint identifications and DNA hits from all types of crime scenes. The most successful CSEs had at least three times as many identifications and DNA hits than the least successful CSE. However, the results are complex and differences in comparative performance are difficult to summarise. Assessing CSE performance against conversion rates into detections (both primary and TICs) may also provide a more detailed analysis of performance and quality of work (Home Office 2007).

It is important to consider that CSEs may not excel (or perform poorly) in all areas of performance currently measured within Durham Constabulary. For example, CSE 21 completes the highest number of tasks per day (operational and non-operational) but has the lowest conversion rate for DNA and fingerprint hits (5.6%). However, 16% of fingerprint lifts are identified and 21% are recorded as having insufficient detail by the Fingerprint Bureaux staff. Therefore, this CSE attends a lot of scenes but does not collect high quality evidence. Other members of staff also show a variety of performance and productivity.

CSE 4 is meeting targets for tasks per day (operational and non-operational), has the highest overall conversion rates of DNA and fingerprint hits (18.1%) and is one of the highest performers of fingerprint identifications. The performance analysis shows that this CSE is attending an average number of scenes per day but is collecting good quality forensic evidence. CSE 5 was found to attend the lowest number of scenes per day but the data shows that CSE 5 is meeting his targets relating to DNA and fingerprint conversion rates. Further breakdown of the data indicates that CSE 5 also produced a high- percentage of fingerprint lifts classified as insufficient detail (42%).

Overall performance of CSEs therefore requires a more comprehensive assessment of activity and productivity. A mixture of activity and outcome based indicators must be used to identify effective procedures geared towards investigative successes, as well as establishing areas for improvement and assessing the overall success rate and forensic contribution (ACPO & FSS 1996). Although this is currently not done within the Scientific Support Unit, it may be useful track performance further and investigate the outcomes of the cases involving forensic evidence. The conversion rate from identification into detections and other outcome based measures (e.g. no further action, taken into consideration) may would provide a greater understanding of the 'value' of forensic evidence to the Criminal Justice System.

The role of forensic material as intelligence in crime investigations can be difficult to measure. Therefore, the contribution forensic material makes to an investigation, other than identifying or eliminating an individual, may not be clearly identifiable. The contribution of intelligence may progress an investigation in more subtle ways (e.g. narrow the field of potential suspects) is not easily recognised using performance measures (Williams 2004).

It has previously been stated that performance measures are used to ensure that the effectiveness of forensic science can be accurately explored (ACPO & FSS 1996). Performance indicators were thought to be useful for police to measure their use of forensic science contributions to a criminal investigation. However, SSUs like those at Durham Constabulary do not measure success beyond a certain point in the instigative process.

Although some information is provided in terms of the positive identification rate, DNA match rate, and footwear hit rate, which are recorded and credited to each individual CSE, feedback on the outcomes of investigations are not easily obtainable. This is related to the multiplicity of management systems in use by different actors in the Criminal Justice System. Monitoring of performance and attribution of 'success' are only recorded to a certain point in the CJS chain. Scientific Support Managers focus on their immediate responsibilities, which at Durham Constabulary include investigative processes as far as the confirmation of an identification. The responsibility of the SSU within the investigative process stops at this stage and other stages of the process such as detections, arrests, and prosecutions are recorded elsewhere and feedback of case progression is not provided back to the SSU. It appears that the performance measures utilised provide more data on the efficiencies of internal departments, rather than the effectiveness of investigative outcomes.

Outputs are tracked to determine their value in terms of the outcome and the investigative value of evidence. More work is required to determine the 'value added' of forensic evidence to an investigation, however this requires a holistic view of the various stages of the processes involved as well as access to a number of different systems in order to do this. Forensic science does not always add value to an investigation; identifications can be made using a number of different (non-scientific) methods.

Performance measures can provide a means of identifying a gap between expected and actual performance by using a range of indicators to measure the effectiveness and efficiency of a range of individuals (in forensic science and crime scene investigation) within the criminal justice system. Performance indicators can be used as objective measures of performance (of police and scientific support), as long as they reflect measures of meaningful and appropriate activities (e.g. scene attendance rate). It is important for managers to consider measuring what is important, not just what is easy to measure.

The performance indicators used for CSEs have historically recorded daily activities, focusing on the number of scenes attended and the number of items collected and submitted, and less on the value of the evidence for furthering investigations and the overall investigative outcomes (Tilley and Ford 1996; Williams 2004; Adderley *et al.* 2007). This is partly due to the fact that there is limited available information which indicates how forensic evidence is used in investigations and therefore how the work of CSEs influences the investigative process (Green 2002; Home Office 2007).

Conclusion

The data described in this paper highlight the key features of one model of measuring performance and overall productivity of Scientific Support Units, particularly the performance of the Crime Scene Examiners. We have discussed the role and utility of forensic performance measures in the Scientific Support Unit, which has looked at the strengths and weaknesses of the measures already in place. These measures not only collate the volume of work individual CSEs deal with, but also consider how effectively there are providing information and intelligence to the criminal justice system.

Most Scientific Support Managers can easily identify high and low performing CSE, if basic data on their performance are collected. This information can quickly identify those individual CSEs that are highly productive and effective in evidence collection of good quality samples, as well as those "*CSEs who perform more poorly, either collecting low volumes or collecting evidence which does not yield identifications*" (Home Office 2007, pg. 32). The focus of this paper is on the measurable outcomes of various performance indicators in terms of actual numbers, percentages, and the cut-off measure of these indicators. Although these numbers are not the answer themselves, they are "indicators" that point towards the actual answer

Measuring evidence collection behaviour of high and low performing CSEs can help identify performance improvements on an individual, as well as at Constabulary level. Performance standards can be used as a means of identifying and explaining where there might be a gap between expected and actual performance. However, it is important that individual staff members do not treat the performance criteria (targets) simply as a guide to their actions but take pride in their work and strive to achieve high levels of performance.

Performance assessment and judgements have been made on absolute and comparative assessments of performance. Whilst it provides a measure of performance, which determines positive aspects as well as those requiring improvement, it does not provide detailed analysis of the processes underpinning that performance. Analysis of the cognitive processes and decision-making procedures used by CSEs to carry out their tasks, and a comparison of the difference between high-performing CSEs and low-performing CSEs based on these factors, may provide insight into why some CSEs are consistently high performers and other less so. As has previously been found, there is very little research which addresses the quality of the initial actions or the decision-making of CSEs at a scene, therefore distinguishing activities from accomplishments is difficult (Jansson 2005).

Performance metrics are used as a means of assessing the contribution of forensic support to the number of offences detected using forensic methods both in terms of primary detections and offences taken into consideration. Further work by the authors builds on this article taking into consideration a more 'outcome' based analysis of the contribution of forensic evidence to the investigative process.

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Figure 1: Organisational structure of the Scientific Support Unit

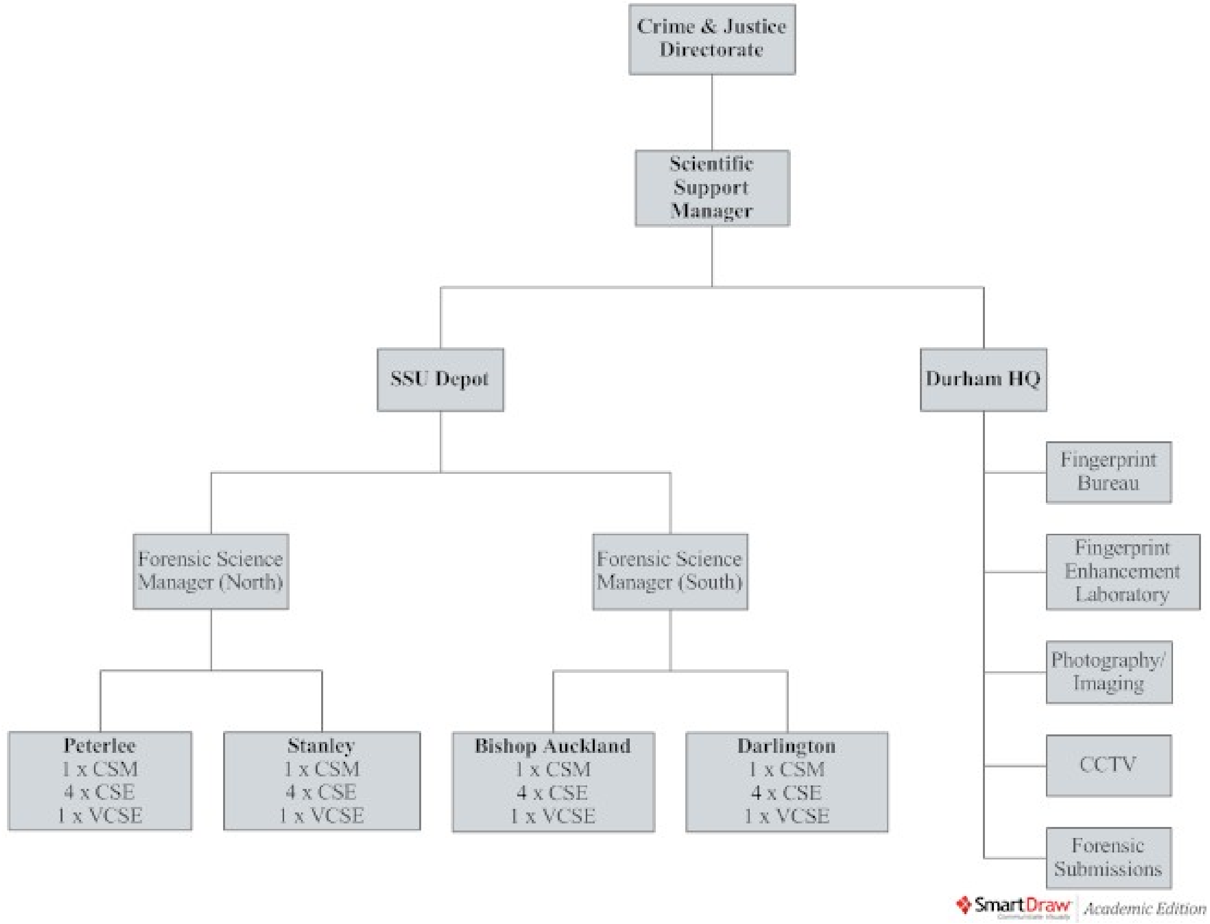

Figure 2: Flowchart of CSE performance management process

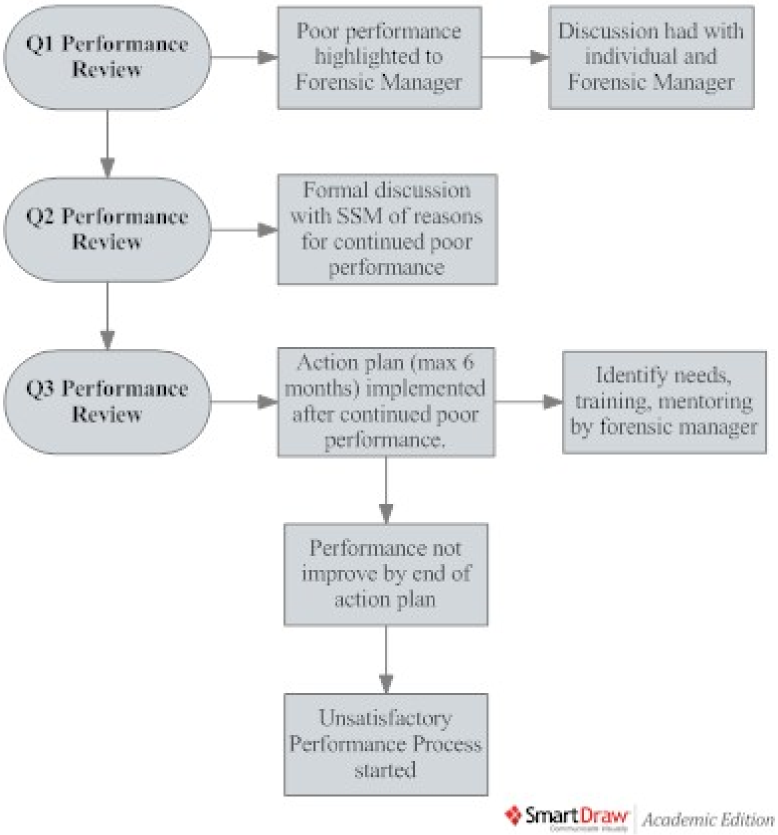

Figure 3: Scatter graph of performance of CSEs calculating collection rates and identification rates.

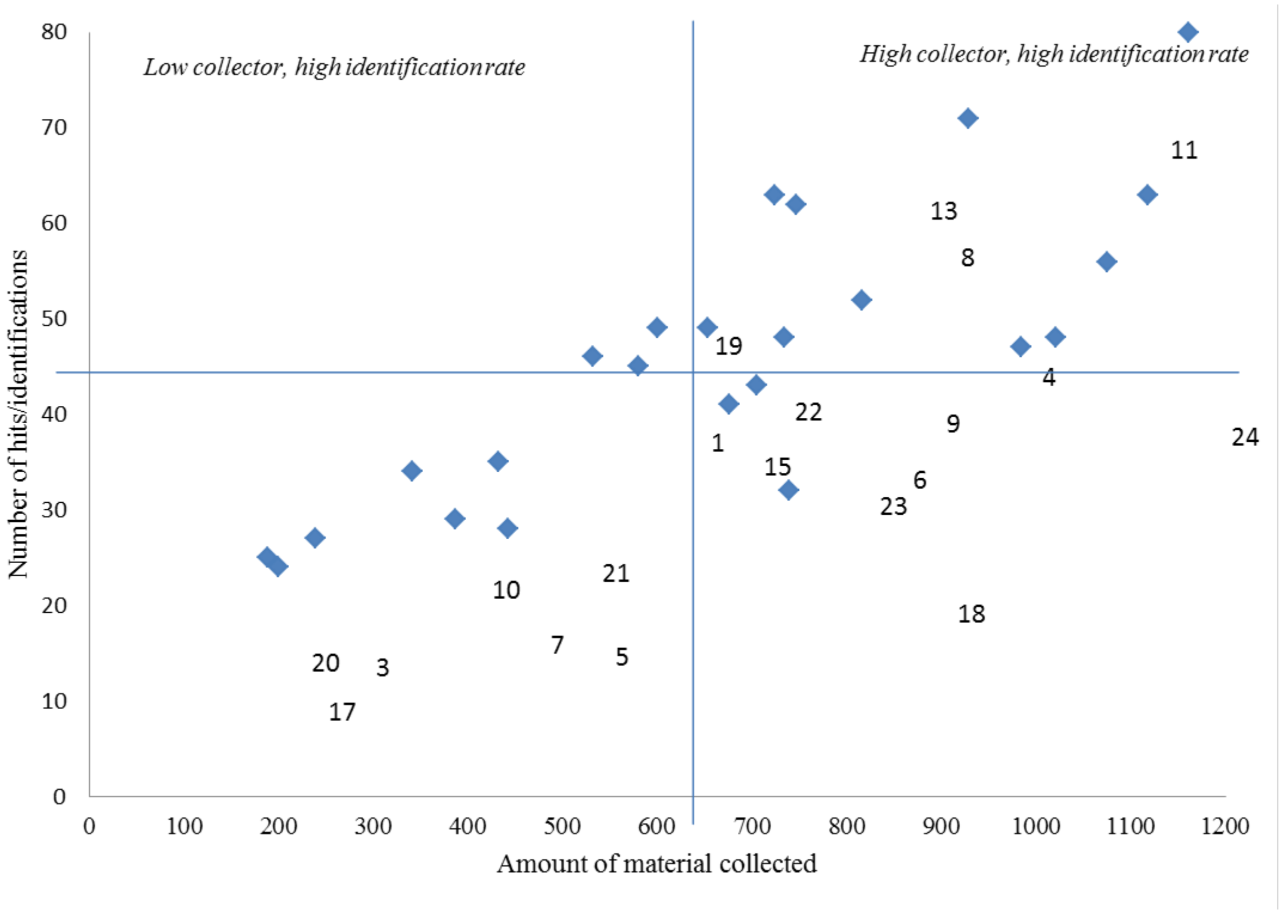

Table 1: Example of quarterly performance analysis of crime scene examiners evidence conversion rates (target rate 12%)

CSE	Conversion rate			
	Q1	Q2	Q3	Q4
3	13.5%	16.7%	15.6%	15.6%
5	11.0%	10.3%	5.7%	60.0%
6	14.8%	13.4%	11.7%	11.0%
8	8.1%	12.6%	20.2%	9.1%
11	15.3%	13.5%	21.0%	9.9%
12	9.3%	21.8%	12.0%	12.0%
15	15.9%	10.6%	20.0%	8.7%
17	12.1%	5.9%	6.3%	14.8%
19	6.1%	11.9%	16.7%	13.2%
24	10.6%	9.1%	14.4%	9.7%

N.B. The low occurrence of amber in this table indicates that individuals are performing above average and within targets. Where averages are higher than targets set, individuals will either be classified as 'green' or 'red'.

Key	KPI's	CSE's
(green)	Meeting target	Above average and/or meeting targets
(amber)	Above average but below target	Has met at least one target but room for improvement in other areas
(red)	Below average	Has not met any targets

Table 2: Number of tasks (operational and other) per day (January –December 2011)

CSE	Op Tasks	All Tasks	Days Worked	Op Tasks/ Day	All Tasks per Day
21	738	1037	180	4.1	5.8
16	557	836	174	3.2	4.8
9	556	802	173	3.2	4.6
13	565	792	180	3.1	4.4
24	512	831	171	3.0	4.9
8	463	628	155	3.0	4.1
12	505	762	177	2.9	4.3
19	486	711	167	2.9	4.3
2	469	699	163	2.9	4.3
11	504	730	174	2.9	4.2
14	504	733	176	2.9	4.2
4	325	480	118	2.8	4.1
Average				**2.8**	**4.1**
1	470	629	170	2.8	3.7
23	455	668	166	2.7	4.0
7	452	668	165	2.7	4.0
6	424	604	155	2.7	3.9
10	444	613	162	2.7	3.8
3	210	326	82	2.6	4.0
15	427	655	166	2.6	3.9
22	364	653	144	2.5	4.5
20	184	294	76	2.4	3.9
18	333	551	158	2.1	3.5
5	285	415	133	2.1	3.1
17	267	420	149	1.8	2.8

Table 3: Conversion rates, fingerprint identification rates, DNA identifications and footwear yield rates

CSE	Scenes attended	Total Hits	Conversion rate	No. of FP Idents	No. of DNA hits	% Idents (Fingerprint)	% Hits (DNA)	Footwear Yield
4	288	52	18.1%	44	8	15.3%	2.8%	38.8%
15	273	45	16.5%	36	9	13.2%	3.3%	46.4%
16	493	80	16.2%	61	19	12.4%	3.9%	41.3%
3	176	27	15.3%	19	8	10.8%	4.5%	30.5%
11	463	71	15.3%	51	20	11.0%	4.3%	31.3%
22	323	49	15.2%	36	13	11.1%	4.0%	41.5%
20	167	25	15.0%	14	11	8.4%	6.6%	19.7%
14	435	63	14.5%	47	16	10.8%	3.7%	42.8%
12	424	56	13.2%	42	14	9.9%	3.3%	40.6%
8	470	62	13.2%	44	18	9.4%	3.8%	21.8%
6	341	43	12.6%	33	10	9.7%	2.9%	34.6%
13	502	63	12.5%	45	18	9.0%	3.6%	34.9%
5	234	28	12.0%	21	8	9.0%	3.4%	35.1%
19	410	49	12.0%	36	13	8.8%	3.2%	32.2%
2	407	48	11.8%	39	9	9.6%	2.2%	42.8%
9	413	48	11.6%	33	15	8.0%	3.6%	40.9%
1	413	46	11.1%	38	8	9.2%	1.9%	31.9%
24	430	47	10.9%	35	12	8.1%	2.8%	51.7%
18	307	32	10.4%	25	7	8.1%	2.3%	48.8%
23	395	41	10.4%	27	14	6.8%	3.5%	33.9%
17	241	24	10.0%	15	9	6.2%	3.7%	20.5%
10	434	34	7.8%	25	9	5.8%	2.1%	34.0%
7	384	29	7.6%	17	12	4.4%	3.1%	33.9%
21	628	35	5.6%	27	8	4.3%	1.3%	18.7%
Average			**12.1%**			**8.9%**	**3.2%**	**35.7%**
Target			**12%**			**8.5%**	**3.5%**	**25%**

Key	KPI's	CSE's
(green)	Meeting target	Above average and/or meeting targets
(amber)	Above average but below target	Has met at least one target but room for improvement in other areas
(red)	Below average	Has not met any targets

Table 4: Fingerprint lift status (percentage of the exhibits submitted)

CSE	Identified	No action taken	Filed database	Checkable against suspects	Insufficient detail for comparison	Eliminated
4	27%	0%	12%	22%	23%	16%
3	27%	0%	14%	36%	16%	8%
10	24%	7%	17%	27%	19%	5%
20	21%	8%	13%	17%	35%	5%
8	21%	0%	13%	25%	23%	18%
22	21%	5%	16%	36%	13%	9%
15	20%	1%	12%	30%	28%	9%
6	19%	2%	16%	34%	12%	17%
1	19%	0%	22%	28%	23%	8%
2	18%	0%	14%	29%	25%	14%
11	18%	0%	11%	26%	31%	15%
13	18%	1%	10%	21%	35%	16%
17	17%	0%	12%	27%	28%	16%
14	17%	2%	15%	30%	20%	16%
21	16%	0%	20%	37%	21%	6%
16	16%	0%	20%	28%	12%	23%
12	16%	2%	8%	21%	28%	26%
7	13%	0%	10%	26%	39%	12%
18	13%	0%	7%	22%	38%	20%
9	12%	0%	8%	25%	43%	12%
5	12%	0%	11%	27%	42%	7%
19	10%	0%	19%	29%	17%	24%
24	10%	2%	8%	24%	44%	11%
23	10%	0%	4%	22%	51%	13%
Average	**17%**	**1%**	**13%**	**27%**	**28%**	**14%**