

Use of data mining techniques to model crime scene investigator performance

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Received 10 October 2006; accepted 16 November 2006

Available online 13 December 2006

Abstract

This paper examines how data mining techniques can assist the monitoring of Crime Scene Investigator performance. The findings show that Investigators can be placed in one of four groups according to their ability to recover DNA and fingerprints from crime scenes. They also show that their ability to predict which crime scenes will yield the best opportunity of recovering forensic samples has no correlation to their actual ability to recover those samples.

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Keywords: Data mining; Crime scene investigators; Performance monitoring; K-Means

1. Introduction

The importance of forensic intelligence (principally fingerprint or DNA identifications) as a standard forensic technique for the investigation and detection of a wide spectrum of crime types from volume crime (burglary dwelling, burglary of commercial buildings, theft of motor vehicles and theft from motor vehicles) to serious and major crime such as rape and murder is now well established. Some ten years ago an evaluation of the UK police service's use of forensic science revealed a lack of awareness by police officers of forensic science and there is a wide variation between forces in the number of crime scene investigators (CSIs) relative to the numbers of police officers or the number of reported crimes [19]. In the same year, a joint report by the Association of Chief Police Officers and the UK Forensic Science Service [2] noted that, for

most UK police forces with a limited number of CSIs, a 'selective attendance' policy is most appropriate. The report also noted that performance indicators for CSIs were almost exclusively activity based (i.e. the number of scenes visited) and not outcome based (i.e. did the scene visit assist in the detection of the crime). Despite this, little actual research has been carried out to examine the role played by the CSIs in the forensic process and how this resource can be best utilised.

Notwithstanding the need for proper control over CSI activity, there is still a wide variation amongst UK police forces in terms of the percentage of volume crime attended by a CSI. Only six of the 43 UK police forces attend more than 95% of reported domestic burglaries and, for theft of motor vehicle offences, only 19 forces attend more than half of the reported offences. One force attended less than three percent of reported theft of motor vehicle incidents [15] although tackling acquisitive crime is a high priority for both the UK Home Office and police forces [10].

More recent work [20] has considered the management of police forensic resources, CSIs, in the context of the relationship between management practice and service delivery

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and noted that ‘a number of forces concede that current scientific support performance indicators need further development’. He also recommended that police forces should consider the relationship between the workload and performance of individual CSIs and also the effect that this relationship has on overall performance. The introduction of computer based systems for tracking CSI activity was viewed as a step forward to better understanding this relationship.

In this paper we consider a novel approach to assessing CSI performance. The main aim of which was to ascertain whether CSI performance could be quantified in a systematic way using a computer based unsupervised learning algorithm. The secondary aim was to ascertain the feasibility of automating the process.

2. Current CSI activity and assessment

All Northamptonshire Police CSIs are deployed centrally which is unusual as many UK forces direct them from an Area base. This enables the most effective resource (in terms of location, skill, etc.) to be deployed for the task in hand. Between the hours of 08:00 and 17:00, Monday to Friday personnel are deployed from staff within the CSI FHQ base but out of those hours, deployment is direct from the incident management centre (IMC) at force headquarters (FHQ). A white board at FHQ gives a ‘snapshot’ of all CSI deployment, current and outstanding jobs at any point in time. Due to the process of central deployment, CSIs cannot choose to attend particular crimes which means that the data will not contain groups of crimes that have been attended by an individual due to his/her preferences.

Northamptonshire Police have three levels of CSI which are equivalent to:

Level 1 – Basic Volume Crime Scene Examiner. This person has received sufficient training within the force to enable the proficient recovery of forensics at volume crime scenes such as burglary dwelling, burglary of commercial buildings, theft of motor vehicles and theft from motor vehicles.

Level 2 – Volume Crime Scene Examiner who, in addition to Level 1, has passed the national Foundation Course in Crime Scene Examination at the training centre in Durham.

Level 3 – CSI who, in addition to Level 2, has passed or is working towards the Diploma in Crime Examination Skills and has passed the conversion course for the crime scene examination of major crime at the training centre in Durham. Major crime can be considered as murder, rape, serious assaults, etc.

All levels described above receive on-going training which is delivered within the force by the Senior Training CSI and attend external courses.

Each time that an individual CSI attends a crime scene it is recorded as an “activity” on the Trak-X computer system and is allocated a unique reference number. Trak-X

is a computer system that has been designed for use within Northamptonshire Police to record and monitor crime scene activities. There can be many activities associated to a single crime meaning that a single CSI can attend many times, several CSIs can attend the same scene or a combination of the two. An activity record comprises the following:

- Time, day and date attended
- Time, day and date completed
- Forensic samples retrieved
- Results of forensic examination

On returning to their base, the CSIs submit the recovered samples, which are grouped by ‘type’, for example, fingerprints, DNA and footwear marks, for analysis. Footwear and fingerprints are examined by force experts and DNA is submitted to the Forensic Science Department for profiling. The analysis results, when known, are entered onto Trak-X.

In Northamptonshire Police, CSIs are currently assessed using Trak-X data as a means to analyse their activity. They do not have to complete additional forms or paperwork as their performance data is derived as a consequence of them entering details of their activities onto the computer system. Each CSI has, on a monthly basis, a one-page sheet that shows in graphical form their performance for key evidence types (DNA, fingerprints and footwear) against the rest of the staff. This ‘performance’ includes not only recovery but also success in terms of identifications and detections. It is possible to identify good practice where one individual is performing to a consistently high standard. All of this is achieved by conducting SQL type queries and manually comparing the results which is a time consuming process.

3. Methodology

Data mining encompasses a range of techniques each designed to interpret data to provide additional information to assist in its understanding. This reveals insights into a range of functions in an organisation which can assist in the areas of decision support, prediction, resource handling, forecasting and estimation. The techniques trawl systems which often contain voluminous amounts of data items which has limited value and difficult to examine in its original format, finding hidden information producing benefits to the organisation.

Data mining embraces a range of techniques such as neural networks, statistics, rule induction, data visualisation, etc., examining data within current computer systems with a view to identifying operational issues by uncovering useful, previously unknown information. Today computers are pervasive in all areas of organisational activities which has enabled the recording of all workplace operations making it possible not only to deal with record keeping and information for performance management but also, via

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