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Intelligence-led crime scene processing. Part II: Intelligence and crime scene examination

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ABSTRACT

A better integration of the information conveyed by traces within intelligence-led framework would allow forensic science to participate more intensively to security assessments through forensic intelligence (part I). In this view, the collection of data by examining crime scenes is an entire part of intelligence processes. This conception frames our proposal for a model that promotes to better use knowledge available in the organisation for driving and supporting crime scene examination. The suggested model also clarifies the uncomfortable situation of crime scene examiners who must simultaneously comply with justice needs and expectations, and serve organisations that are mostly driven by broader security objectives. It also opens new perspective for forensic science and crime scene investigation, by the proposal to follow other directions than the traditional path suggested by dominant movements in these fields.

1. Introduction

In part I, we defined the trace as the singular building block of pertinent information about a crime and crime series and we described an important role that forensic science has to play besides its end product as court evidence: as an integral part of an intelligence-led managerial philosophy. The potential of traces in this perspective has been demonstrated, at the very least, for linking entities, which itself is a basic function of crime intelligence.

In this second part, we will consider crime scene processing within this framework. This activity consists in collecting data that feed different processes. The collection of data is the object of great attention in typical intelligence processes: it must be selective, timely, and planned according to the relevancy and accessibility of data, as well as the availability of resources. The collection plan is systematically updated in function of new knowledge and needs. Crime intelligence is thus fed by this data. It then drives the system by influencing priorities and deployment of resources as well as determining new informational needs according to a variety of security objectives. As a corollary, crime scene processing should be directly influenced by such processes.

This view contrasts with how crime scene examination is considered in the traditional justice-oriented conception. In most jurisdictions around the world, crime scene examination is carried out under police responsibility and resources are limited. The actual task of crime scene examination or processing is undertaken by crime scene examiners, who themselves are sworn or non-sworn police officers.[1] They are generally trained to follow very normative quality assurance procedures in order to detect, recognise and, if necessary, collect the "best" quality and quantity of traces. However, performance indicators seem to show very disparate outcomes between crime scene investigators across different institutions or even within the same crime scene unit [1–7]. Despite frequently defined standard operating procedures,

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[1] The term 'sworn' is used here to characterise a police employee who has police powers; *i.e.* an officer who can, amongst other things, apprehend criminals, prevent and detect crime and maintain public order along with community interaction. This term is commonly used because police officers are generally sworn to an oath. In most jurisdictions, sworn officers have typically attended a Police Academy or specific Police School to acquire general and specific policing skills. In contrast, to 'sworn', the term 'non sworn' or 'civilian' is applied here to a police employee who does not have police powers, but is crucially contributing to police functions through his or her skills specific to a specialised area, *e.g.* crime scene examination.

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most of the work at the scene, qualitatively and quantitatively, seems to be mainly influenced by individual attitudes. Beyond workload, factors such as personal knowledge and interests, individual ability to recognise relevant traces, as well as confidence between partners and awareness are assumed to play a predominant role [2,4–6,8,9]. Part of the explanation may be related to the fact that procedures are rarely if ever, focussed on intelligence or investigation but remain within a narrow individualisation and court oriented paradigm. There is a confusion resulting from a lack of mutual comprehension between police searching to meet, often implicitly, their needs in terms of investigation and security through policing models and intelligence processes (mainly security-oriented), and how the forensic science community conceives its role (mainly court/justice-oriented). This confusion is crystallised by the fact that procedures for investigating crime scenes do not clearly separate factors that serve security objectives or investigation, and basic principles oriented towards more traditional views of forensic science (*i.e.* mainly gathering evidence for court purposes). This is particularly evident when considering manuals dedicated to non-forensic personnel (*e.g.* [10]) that prescribe how to view a crime scene without considering, more holistically, the constraints faced by actors of a policing model.

This paper starts by clarifying the uncomfortable position of the crime scene examiner operating within an often implicit complex dual situation delineated by justice and security objectives. An example relates the actual treatment of a specific series of burglaries which has developed in Switzerland. It illustrates how intelligence aspects have been effectively used, ignored or have not reached crime scene investigators in the follow-up of the case. From this basis, the forensic science literature and recommendations resulting from a number of reports and research projects will be mentioned in order to explain how crime scene investigation is now conceived within the forensic science community, and what it considers as desirable progresses.

From this background, we discuss why we consider that the path suggested by the forensic science community for improving the current situation is misleading, at least from a security perspective. In order to propose an intelligence-based conception, crucial points of decisions will be identified. They explicit the diversity of factors that influence how the police process crime scenes. This leads us to propose a possible general framework based on crime and forensic intelligence. This new framework takes into account intelligence factors and consideration of the immediate social and physical environment to lead to an efficient but modified view of forensic science and crime scene investigation.

2. Example

Let's consider an example of a series of burglaries that occurred between 2006 and 2008 in a specific region in Switzerland. Links between many cases came to light as the same DNA profile was reported in a number of cases. This DNA profile remained unidentified because its source was not in the national database (CODIS system). At the time, no specific measure nor any *crime analysis* was deemed necessary, especially since no intelligence-led structure or intelligence policy was in place in that particular law enforcement agency. The information was simply passed on to field investigators in case someone is apprehended and his or her DNA would become available for comparison (*reactive* attitude).

Because of the lack of knowledge of the *criminal and immediate environments*, each burglary was treated as an isolated case and crime scene processing was usually processed routinely. This went on despite the fact that the modus operandi of this series was relatively specific (same targets, night time, specific locations, etc., *i.e.* considerations on *the immediate environment*). Knowledge of the *physical environment* nevertheless led to the systematic DNA swabbing of the extracted door lock cylinders (when left on the scene) or around the door lock (when taken away). This was supported by the fact that there is a high detection rate of DNA in such circumstances and it was confirmed by the number of cases in this series that were ultimately linked through DNA profiles.

A year later (2007), this series was still active. In one burglary, the victim disturbed the burglars and a chase and fight followed (considerations on the *immediate environment*). The victim stated that the burglars were three. Later on, the DNA profile revealed on the door lock was found to be the same as in the previous cases belonging to this series (let's call it profile burglar no. 1). This was the first indication that this series of burglaries was committed not by a single burglar but probably by a group of three. Despite this new information, subsequent cases belonging to this series were still treated as individual events (lack of *crime analysis*). In some cases, scenes were not even attended (*strategic* considerations). In early 2008, the series continued and, once again, the same DNA profile was retrieved from door locks. But no forensic traces of the other two burglars were found, mainly because they were never looked for (lack of *intelligence* used at the scene). In one case, a partial DNA profile was retrieved on a door lock but quality criteria did not allow its introduction into the national database (insufficient number of loci to be introduced in CODIS), although it could have been used for pointing to potential suspects: DNA comparisons were asked between this DNA trace and the DNA profiles of other known burglars that were active at the time. But no matching DNA profile could be found. These known specific burglars had indeed nothing to do with this series (lack of *knowledge of the criminal environment*). Much later, once the series was identified and thoroughly studied, a DNA comparison was asked between the partial profile and the profile of burglar no. 1 and it was found to be a match (use of *intelligence*).

This highlights that *knowledge of the criminal environment* is not only useful in the decision for attending the scene and how to process it, but it can provide valuable information regarding the exploitation of traces usually processed for identification purposes as a linkage agent.

Finally, in one of the cases, a jewel box which had probably been moved by one of the burglars was searched for fingerprints and an identifiable fingermark was detected (*situational* and *physical* considerations). A name provided by the national fingerprint database (AFIS system) associated the mark to a finger of a man previously charged with burglaries. Following investigation, this led to the arrest of this known burglar and two accomplices who included burglar no. 1. This brought the series to an end. The case is summarised in Fig. 1.

This example shows many possible uses of forensic case data for investigation and crime analysis, as well as how contextual information can be used in order to detect traces.

It also highlights how difficult it is to detect and identify series of burglaries or other types of high volume crimes when they are perpetrated over a long period of time. Indeed, they get diluted in the cloud of all other cases and without a dedicated crime analysis unit, the risk is high that they will remain undetected. On the other hand, if the series is committed during a very short period of time, then the higher the chances that it will be detected, even if the policy and structure of the police force is not intelligence-led.

It appears that DNA linking integrated into crime analysis would have helped to select relevant crime scene work in the context of this series. The case actually made significant advances because of tacit information exchanges and individual initiatives. This kind of reasoning generally does not appear in standard operating procedures, neither for crime scene examination, nor for crime analysis.

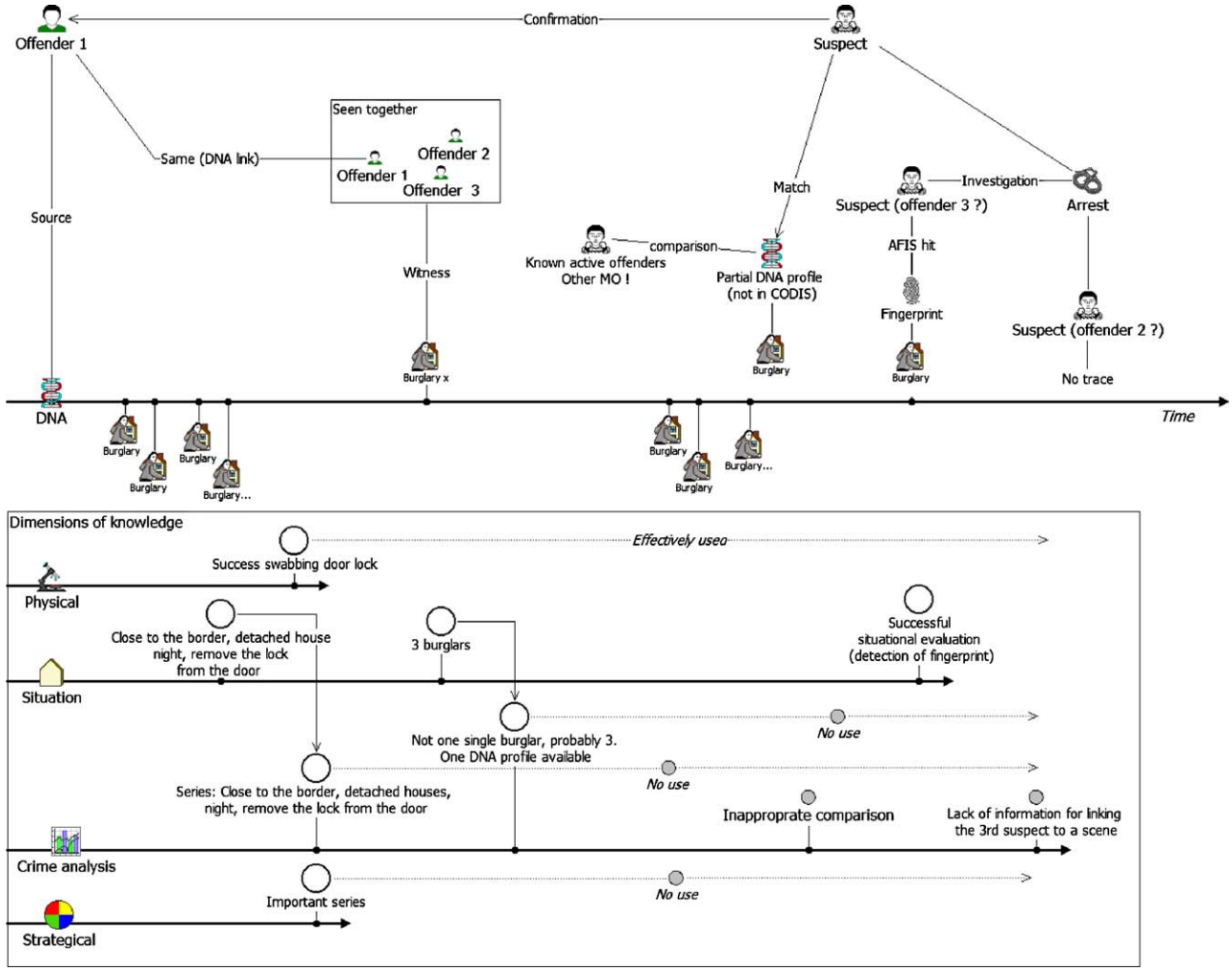

Fig. 1. Chronological development of the series. This is a very traditional treatment of series by strictly following standard operating procedures. It is clearly noticeable that very early, beyond the use of successes obtained by swabbing doors locks, knowledge was available (pieces of knowledge are represented by circles) for improving awareness on the series, improving its treatment and targeting the effort. These weaknesses are represented by grey circles. The example also illustrates how forensic intelligence considerations (door lock, situational perspective and forensic links), more often than not, suffer from information silos created by the organisation.

This is however a very traditional way of dealing with such series. There is generally a very limited view on the relative importance of crime series. Linkage blindness of many forms [11,12] hampers obtaining the global view necessary for making decisions and anticipating informational needs. Similar treatments seem repetitive, and largely across organisations [9,13]. In this example, we have already sketched some more general notions that will ground our further proposition. However, before presenting a general model, we must consider if current evolutions in the field of crime scene examination follow a path that will tend to correct these evident weaknesses.

3. Main tendencies

Crime scene processing is at the crux of the forensic science pioneers' works of the early parts of the 20th Century [14–16]. Since then, and for the largest part of the last Century, the forensic science focus moved on to technology and laboratory processes despite calls by Kirk already in 1963 that major innovations will not come from technology, but science.[2] However, there has been recently a resurgence of interest in crime scene and many authors have revisited this topic along with some of the fundamental concepts such as Locard's exchange principle [4,5].

Beside this theoretical background, the practice itself renewed its focus on crime scene. The main reason can be understood by examining the current major overlapping trends in this area. These trends are described below.

3.1. Increased efforts for measuring the efficiency of crime scene examination

Whether or not crime scene examination is carried out within a police environment, there is an increasing interest to quantify the quality and efficiency of the work, as well as promoting more targeted crime attendance. These managerial pressures impact on training and recruitment strategies, as well as decision making at various levels. But police and forensic laboratories may differ in their objectives, which explains why their practices may be diverse.

As a result, the scientific support for dealing with crime scene performance is still unsatisfactory. When they exist, indicators often focus on activity (*e.g.* number of crime scenes attended) rather than on outcomes (*e.g.* number of crimes detected) [1]. This emphasises the confusion that exists as to what the real outcome of crime scene examiners should be. This appears through the variety of poorly formalised objectives forensic case data may serve.

[2] "In short, there exists in the field of criminalistics a serious deficiency in basic theory and principles, as constrasted with the large assortment of effective technical procedures" Kirk, P.L., *The Ontogeny of Criminalistics.* The Journal of Criminal Law, Criminology and Police Science 54 (1963) 235.

3.2. Significant changes in recruiting models

In recent years, a number of police services around the world have moved towards civilianisation for some of their most specialised units, including crime scene. In general, in this model university graduates are recruited and fast-tracked in their training so they can undertake crime scene work without the requirement to undertake extensive traditional police training (*e.g.* Police Academy). This solution often results from a cost–benefit analysis. In some jurisdictions, like in the Australian State of New South Wales, crime scenes are processed by sworn or non-sworn officers, depending on whether the scene relates to serious or high volume crime. From both training and operational viewpoints, these changes have prompted the need for a more formalised approach to crime scene, but mainly oriented towards the process of providing evidence for courts.

3.3. Development and generalisation of quality assurance systems

Over the last 15 years, the forensic science profession shifted towards the development of more standardised protocols generated by a more structured framework. This trend is currently further developed through personnel certification. If formal quality management and accreditation are now widely accepted in forensic science laboratories around the world, the question remains as to how best they can be applied to crime scene work. In a number of countries, the tendency has been so far to accredit laboratories for tests with ISO/IEC 17025 without considering crime scene units. However, a recent trend to address this issue is currently emerging. For example, in Australia, crime scene units are now accredited to ISO 17025, whereas within the European Network of Forensic Science Institutes (ENFSI), there is an initiative to establish guidelines for crime scene based on ISO/IEC 17020 [17]. Creating specific actual standards for crime scene accreditation still remains a possibility, but levels of generality of formal procedures is the object of a hot debate, because, when the formalisation is exaggerated, they may lead to routine applications that hamper to considerate the singular nature of each scene as such. This situation creates a fertile ground to review the way crime scene's work is approached.

However, accreditation raises also many issues about the cost and the generated business of certification, the legitimacy for private companies to control State procedures, and the way procedures take into account (or ignore) intelligence and investigative aspects.

3.4. Scientific and technological developments

The emergence of new technology (*e.g.* DNA) and the strong development of advanced analytical techniques over the last 20 years provided increased opportunities for traces collected from crime scene to be exploited. This situation catalysed the famous 'laboratory backlog' which actually would be best defined as 'triage backlog'. More importantly, this situation also highlights the importance of being selective in the collection and exploitation of traces and that of using techniques that are 'fit for purpose'. For example, some authors have clearly stated that more field-based testing, with a better selection of samples for full laboratory analysis, will go a long way towards addressing this backlog [18,19]. In this respect, knowledge of possibilities and limitations of working selectively on scenes (this implies specific scientific competencies) should allow to highlight the range of information content that can be gained from the scene. The study of inference structures drawn at the scene is critical in this perspective [20]. Moreover, better review processes within investigative agencies would help prioritise laboratory operations or remove useless treatments from the queue, for instance when cases have already been detected through other substantive evidence.

3.5. Occurrence of large scale incidents and the need for fast forensic responses

In the last decade, a number of large scale incidents and/or acts of terrorism occurred around the world, September 11, 2001, the two Bali bombings (2002–2005) and the Indian Ocean tsunami (2004) being dramatic examples of such incidents. These incidents highlighted the existence of a tension between the need to provide fast information leads and the somewhat slower traditional forensic response that is mainly designed for court purposes. Accepting the premise that late information is useless, the concept that a trade off may exist between completeness (precision, accuracy, value of rough but quality information) and timeliness started to emerge. These ideas were presented by Almog at Interpol conferences at least from 1989, and supported by other authors, for example Robertson [19].

This is not only true for serious crime and salient events. Rapid reporting is seen as a key aspect for the efficient treatment of manifold types of crime. Traces such as fingerprints or DNA transfer traces are rapidly searched, collected, analysed and compared with reference material collated in national databases, for exclusion purposes, or directly with suspects. Their analyses are generally expected to point to the identity of the person at the source of any of the traces and thus give rapidly a new direction for the investigation.

Rapid response time is typically a sign that there is a need for using forensic case data in the early stages of an investigation. It may also be the case that the dramatic rise and even change of scale of the number of people controlled by biometric systems will generate a new demand for a rapid elimination of false positives. This is compounded also by the evolution in criminal law procedures that increasingly require more rapid decisions in relation to cases when individuals are deprived of their civil rights (*e.g.* individuals under arrest). The relevance of this dimension is also illustrated by the apparent increasing demand from police investigators and/or public prosecutors for fast information in order to help them take informed decisions, such as to pursue the investigation or not.

For example, in one drug-related case, the investigators observed an inconsistency between the amount of drug delivered and the price paid, the latter being too high. Therefore, two alternative hypotheses were formulated by the investigators: either the buyers were expecting another delivery or the purity of the drug was very high which would explain the price difference. Thus, the investigators needed an immediate result of the chemical analysis in order to determine if they would have to target another delivery or not. If yes, additional investments in resources (phone tappings, surveillance, etc.) would be required. This particular example shows the importance of a rapid, almost immediate forensic response which allows the chief investigator to make a timely informed decision. It is thus more important to obtain a result in a matter of 1 or 2 days, even if rough but relevant and dependable, than a very precise, may be too detailed in regards with the question asked and the decision to be taken, and accurate result in a formal report after many weeks or months.

Another example comes from DNA profiling which is now used routinely for most types of crime. In Switzerland, the maximum delay set for the laboratory to obtain a DNA profile from a trace is set by legislation.[3] However, there is no legally required timeframe for reporting the result. Thus, for high volume crimes, such as

[3] 12 days, in accordance with Ordinance of the Federal Department of Justice and Police on DNA laboratories of June 29, 2005, art. 2, al. 4c, RS 363.11.

burglaries, where samples are gathered together for a certain time period and results are collated into one general report, the delay can be as long as 2 months. This delay is too long for some cases and informal results are communicated at an earlier stage in order to assist with the investigation. In these two examples, traces, as relevant information, are used in a completely different decision making process compared to what is required for court purposes. As it stands, this aspect remains very poorly formalised and poorly understood within the criminal justice system, if not sometimes hidden behind the formal needs and contradictory procedures that belong to the judicial process. Consequently, it may occur that results of traces evaluations in these immediate circumstances are transmitted as evidence in court; when in fact, the latter follows a different decision making process. This may lead to great confusions, and technology, by itself, will not help to clarify this situation.

This fundamental gap is epitomised by strategies and agendas which favour technology as the ultimate solution, like, for example, the development of technological forensic toolbox that has been prioritised in European security research programs.[4]

3.6. Reaction to the relative isolation of forensic science laboratories

Over the years, forensic science laboratory processes became increasingly more specialised and more complex. As a result, the laboratories themselves became increasingly more isolated from the crime scene and from the investigation. To address this issue, many jurisdictions have introduced the position of crime scene coordinators who generally are laboratory scientists attending the crime scene in the more serious cases. By this approach, laboratories should also extend their services: there is an increased recognition that, on each incident, physical traces, by their presence or absence can be of a crucial importance already in the early phase of the investigation. Many of these uses are unlikely to lead to actual evidence, but they may clarify what happened, help determine priorities, and significantly contribute to the detection process. Proximity between investigators and forensic scientist is recognised to be crucial in this perspective, but difficult to implement in the current dominant paradigm.

Occasionally, these new "specialists" are working within a police environment or act in close collaboration with the police who request such support. Such crime scene coordinators assist with the holistic management of the case. Although the creation of such a position can be seen as a move towards some kind of intelligence framework, it is fair to say that it is essentially a reactive solution to the "scene vs. laboratory" fragmentation and remains mostly oriented towards the specific needs of the laboratories. Conversely, the distance between forensic laboratories and the police is also often seen as desirable by some in order to avoid the influence of the police context when criminal cases are scientifically processed [21]. The whole system seems to hesitate between organisational separation, connexion or integration of tasks between different communities, each solution showing pros and cons in relation to the diversity of tasks to be carried out and to the variety of existing decision making processes. There is clearly a need to separate consideration about information system, the logical nature of processes, and the way they are organised to address the confusion that currently prevails.

4. Attending and processing the scene: the diversity

From the introduction, it is understood that the approach to crime scene work and its actual delivery are very diverse. This has been stated by many empirical studies [1,3–7,9,13]. In general, serious crime (*e.g.* homicide) results in the systematic and often exhaustive deployment of major police resources, while intervention in the context of high volume crime (*e.g.* break and enter) shows a greater variety of, often tacit, strategies and practices. This variety can be identified before, during and after crime scene processing. In other words, at least three levels of diversity can be distinguished, namely:

Strategy applied: original decision to attend the scene or not, case prioritisation, human and institutional resources allocated will depend on the case. For instance, influential factors can be the extent and nature of the territory covered (*e.g.* metropolitan vs. country areas), and time needed to attend crime scenes; style of policing: response to public expectations, the promotion of the image of the police or the decision to intensify the fight against certain types of crimes.

Crime scene processing: a variety of methods and procedures for crime scene searching and recording (from selective to complete) exist, as well as for delineating the levels of use of technologies (from cutting-edge to simple technology).

Information gathered and exploited: traces are collected, examined, and compared for immediate use or stored for future comparisons. They are examined in order to feed different processes.

These types of decision making processes occur in every system. But, in the forensic science context, they are implemented under a great variety of models of organisations and management. The latter ranges from small to big organisations; from an integration of most forensic science services within one police service to their separation; from an integration of laboratories and crime scene examination units to a strict separation; from the separation of specialised crime scene units to the integration of all kinds of crime scene examinations, from basic police training to specialised scientific education. All these forms of organisation will influence the proximity of parts of the activities to some specific exploitation process: everyday formal or informal meetings between scene of crime specialists and investigators will implicitly or explicitly favour investigative-led strategies, while external forensic science laboratories will be more concerned by delivering services to customers in a more distant and formalised way. This evidently results to other forms of decision making processes to cover the three levels mentioned above.

5. Crime scene examination within its environment

We have shown that managerial, organisational, methodological and technological dimensions influence crime scene examination. Moreover, a great diversity exists in the way such models are implemented (investigation colliding with court's needs, sworn vs. civilian, centralisation vs. decentralisation, laboratory divide, etc.). Finally, the search for the ideal model seems to be confronted to a series of basic, often implicit, contradictions that cause the pendulum to balance according to the solution of short terms preoccupations, instead of being identified in line with a long-term and coherent strategy.

The model we propose capitalises on the view presented in part I and is resolutely connected to an intelligence-led strategy. It makes explicit that a specific policing model influences crime scene examination and it is crucial to recognise the impact of this influence.

At this point, it is valid to ask the question whether such a model may introduce a bias in the scientist's judgements. This critical point has motivated most of the recommendations for

[4] European commission, seventh framework program: http://cordis.europa.eu/fp7/ (last access 12th October 2009).

separating forensic activities from the influence of police organisations, so far. For this reason, it is discussed further below.

5.1. A priori knowledge and critical thinking

When envisaging using intelligence in order to guide decision making for crime scene examination, *a priori* knowledge is necessarily at the core of the suggested process. It must be accepted that it provokes a context effect that may channel reasoning processes. It is now well recognised that an inappropriate attitude can lead to a skewed process (*e.g.* one only sees what one expects to see).[5] This tension, when processing a crime scene, should be controlled by a framework based on a hypothetico-deductive reasoning process such as we advocate for, which implicitly includes abduction by imagining potential causes to observations under accepted general rules or laws (see Fig. 2).

Contextual elements must be used in the selection process on the scene of the investigation. Detection and observations highlight the presence of traces whose significance may be tested through alternative hypotheses at different levels. The assessment of hypotheses, and possibilities to predict what should be observed if one hypothesis is true, lead to reject, obtain more confidence in the hypothesis or to the need to recover new specimens. This creates a cycle that lasts until hypotheses are discriminated by successive series of tests. Eventually hypotheses are aggregated to form a list of probable scenarios or causes. It is not always the more "probable" hypothesis that guides priorities: when attending a scene that is presented as a suicide, the hypothesis of the homicide should be systematically the most carefully envisaged.

This is a proposal for minimising the undesirable effects of *a priori* knowledge that channels reasoning processes. This is only a specific illustration of how critical thinking should form the core of intelligence and investigative reasoning processes [22]. This means adopting an attitude of awareness that encourages the examiner to go beyond a preconception or common sense. But, at the same time, it also accepts the proper integration of available knowledge that exists in relation to the case. This is a subtle combination. In fact, a key aspect of crime scene examination is the detection and recognition of relevant traces [23]. The detection process itself, and the recognition of relevant traces, by definition, requires *a priori* knowledge of different natures. Ignoring a forensic technique, or how to apply it may lead the examiner to miss a latent trace: when an object is retrieved under water, common sense will wrongly orient to the idea that potential traces have been irremediably washed. At another end, having hypotheses of criminal activities in mind may help to undertake a selective search at the early stage of crime scene processing, the end result being that it becomes easier to recognise what is relevant.

This discussion supports that the different inference modes are of a scientific nature akin to scientific research and discovery [5,20,24–27]. It deserves high intellectual grade training, intensive research and explicit modelling. This recognition is necessary if we wish to appropriately integrate contextual knowledge of various natures, and control its potentially undesirable side effects. Controlling structures and preserving scientists from contextual effects are in contradiction with the global aim of detecting and recognising high quality and quantity of relevant traces. Therefore desirable control should rely on demonstrable critical thinking and the necessity to process crime scene with a scientific attitude. This goes against "on the job" technical training of non-scientific personnel.

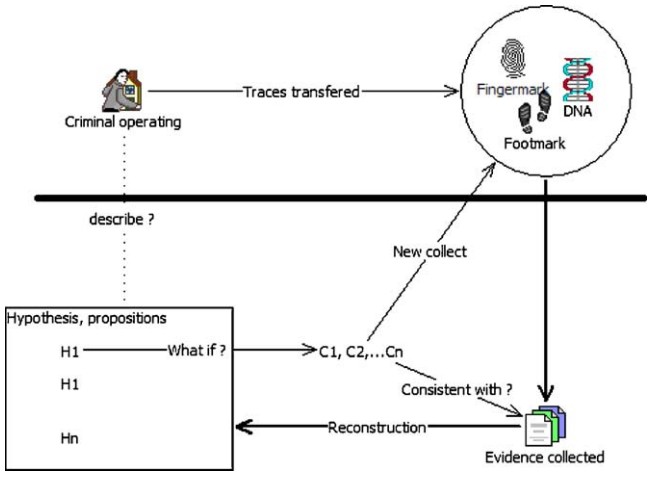

Fig. 2. Description of the whole reconstruction process through hypothetico-deductive reasoning process. A criminal transfers traces that are detected and recognised by scene of crime investigators. From evidence collected alternative hypotheses and propositions are drawn. They are then tested.

6. Proposition: the four dimensions of knowledge

We propose a formalisation of management and crime scene processing methodologies with an architecture that decomposes knowledge used into four dimensions. For illustration purposes, we consider a case that has been reported to the police. We assume two different levels of decisions where knowledge of the current environment can be used to guide crime scene examiners activities, whatever the organisation: the decision to attend or not a particular scene for searching traces (1) and actual decisions made for processing the scene itself (2).

6.1. The decision to attend the scene—first case assessment

We assume that, when deciding whether attending the crime scene, or the extent of the intervention, the crime scene investigator will interpret the case in the context of (1) the strategic environment, (2) the criminal environment, (3) the immediate environment and (4) the physical environment (see Fig. 3).

Two criteria are assessed in the decision making process from a forensic perspective: the relative *importance* of the case and the *chance* to detect traces. Main decision points can be described independently of specific organisations, but obviously, the way the intervention is organised and the subsequent background of the deciders, can greatly influence *what* is decided in function of specific situations.

The so-called *strategic environment* is constituted by the organisation, available resources in terms of available technology and knowledge, a set of management rules, priorities and strategies devised by the management following an intelligence-led philosophy. The *importance* of the case becomes relative to the policy and is mainly assessed at this level. For instance, to increase credibility, to improve the police image, or to impact on the security feeling, it may be decided to increase the attendance levels at certain types of scenes of high volume crime. In this sense, each case of this type is given a high *importance*. The legal dimensions appear here for instance when the security strategy consists of filling the judicial gap. It is first seen in this model as a means rather than an end. But forensic science remains an aid to manage

[5] Laurence Sterne wrote it 250 years ago: "It is the nature of an hypothesis, when once a man has conceived it, that it assimilates everything to itself, as proper nourishment; and, from the first moment of your begetting it, it generally grows the stronger by every thing you see, hear, read, or understand." Laurence Sterne, *The Life and Opinion of Tristram Shandy, Gentleman* vol. II, ch. 19, cited at: http://www.tristramshandyweb.it/ (last access 12th October 2009).

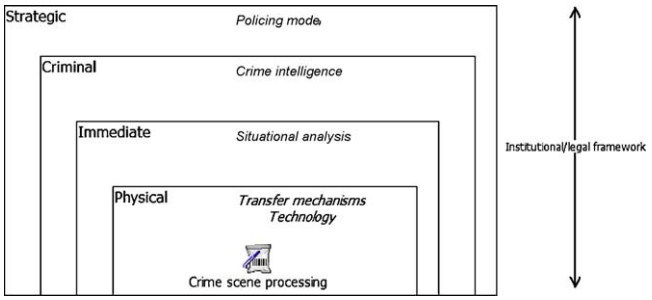

Fig. 3. Boxes represent the different environments to take into consideration. In italic, the different disciplines and theories which the activity relies upon. Finally, the institutional and legal frameworks intervenes at each levels, as they impose constraints on how to carry out the task, and may also motivate some activity when they are considered as a means in a security strategy.

evidence including to confirm the strategic objectives, and ultimately to determine imputability. The collection of data also must follow increasingly formalised rules with respect to civil liberties. This particular aspect becomes increasingly important with the proliferation of electronic traces.

Another typical strategy consists of targeting prolific criminals or managing hot-spots. This is done in accordance to knowledge about the *criminal environment* which, itself, informs about the current structure of the criminality and about current criminogenic hot-spots. Are prolific criminals active? If the involvement of specific prolific offenders is detected, there may be signs that a new case is the result of their activities, and this must influence the decision to attend the scene.

These signs can result from the evaluation of the *immediate environment*: what type of house has been burgled, in which street, when, how, what was removed? Together, the *chance* of detecting traces can also be integrated into factors of decision by evaluating traces collected in relation to other cases of the same series: does the burglar operate in a way that direct the collection of new traces? One may also consider that traces collected in this specific series are already sufficient as potential evidence in court, if the burglar is subsequently arrested. This judicial attitude may contradict the processing of intelligence-led strategies, if it is not integrated as a whole, by considering punishment as an efficient mean of disrupting criminal activities.

Forensic scientists are more familiar with the last dimension: *the physical environment*. Studies regularly report information about the chance to detect traces on given supports, according to knowledge about traces, transfer mechanisms or persistence: for instance, what are surfaces offering the best chance of successful trace recovery according to the supposed activity of the offender and the assumed conditions of preservation? If the environment of the case opens good opportunities for detecting traces, this may influence the decision. This actual processing represents a particular thorough technical assessment of the case itself, while participating to the decision to attend the scene.

6.2. Detection and collection

A valid approach to crime scene must also consider a series of additional specific and specialised pieces of knowledge that may be highly variable. The nature of this relevant knowledge should be clearly distinguished and coherently organised within a framework. The proposed model decomposing crime scene into strategic, criminal, immediate and physical dimensions enables to connect intelligence to crime scene processing, while still integrating other relevant crime theories and forensic science background into the task.

The strategic environment informs about how much resources are available to effectively process the scene. For instance how much time can be dedicated to this specific scene and subsequently how detailed the processing should be. This evaluation also concerns what techniques should reasonably be used, according to their portability, simplicity, or cost. This continuous assessment should be adapted in relation to what is observed at the scene.

The current environment can potentially help classify the case into an already known activity. For instance, if a case is recognised as the plausible result of the activity of a serial offender, all the knowledge available about the activity of that offender may be important to process the case. Difficult to see or detect, poor quality traces may be observed just because one knows what to look for.

The reconstruction process must also rely upon careful interpretation of the immediate environment where the crime took place. A set of approaches developed in criminology can help interpret this environment: the so-called situational approaches. These approaches were originally aimed at crime prevention by considering crime as the product of the immediate environment. They converge towards the idea that the conditions for a crime to occur are very specific and strongly depend on the motivation and abilities of the offender (perceived risks, expected gain, effort, knowledge or resources), as well as the characteristics of the victims within a specific poorly protected environment that make the victim vulnerable and his or her values attractive. Changing this immediate environment would remove opportunities for crime to occur.

Based on postulates such as "whatever one's criminal inclinations, one cannot commit a crime without overcoming its physical requirements" [28], these approaches have also proven to be relevant for detecting and analysing crime problems [29]. In fact, this "chemistry" or opportunities can be helpfully studied in order to look for concentration of crimes in time and place, as well as for explaining the existence and developments of these clusters [28].

Generally, manual for crime scene processing stress that scene of crime specialists should "think thief" or "take the place of the offender" when they process the scene. This is typically an attitude that situational approaches have successfully developed and for which a powerful framework takes into account four constitutive elements: the immediate environment, the offender, the target (victim), and the capable guardians. The specificity of possible situations where crime occurs, limit possibilities to develop *modi operandi*. As a result, situational approaches are very promising for imagining offenders activities at the scene, typically through a selective search such as: how was the environment configured at the time of the crime? what are the guardians (neighbour surveillance, technical alarms, lock protections, etc.)? and what are the vulnerabilities of the target at the time of the crime?

The different dimensions of the contextual knowledge that make the connection of crime scene intervention and processing with intelligence-led style of policing are summarised in Table 1 and Fig. 4.

From this analysis, a useful additional concept makes the links with the physical level: the focus on "contact points" between offender, the scene and victims. It is particularly useful in uncovering the specific physical interactions, when the obvious (footwear/fingermarks/DNA) have not been found.[6] At this point, crime scene examiners use their knowledge of the physical nature of traces, transfer mechanisms, persistence of traces under the known circumstances of the case, and available technologies.

[6] The concept of "contact point" has been coined by one of the anonymous reviewer of this paper. It was probably formalised at National Crime Faculty in UK from around 1998 onwards.

Table 1
Knowledge dimensions for the first (most often than not "remote") assessment of the case and for supporting the processing of the scene itself. From the assessment, the intensity and nature of the intervention will be decided. The knowledge gained will also support the detection and collection of traces.

	First case assessment		Actual processing
	Importance of the case	Chance to collect traces	Detection and collection
Physical	Assessment of physical damages	Assessing potential supports for traces, technology and knowledge needed	Identifying supports for traces
Situational	Assessment of the seriousness	Imagining paths and modus operandi	Targeting the search through reconstruction of the path and modus operandi
Intelligence	The case relative to the criminal situation	Existence of previous similar cases and results obtained	Using knowledge of previous similar cases and successes obtained
Strategic	Degree of priority in relation to policing strategies	Availability of technology and knowledge	Using available resources (time, technologies, knowledge, human)

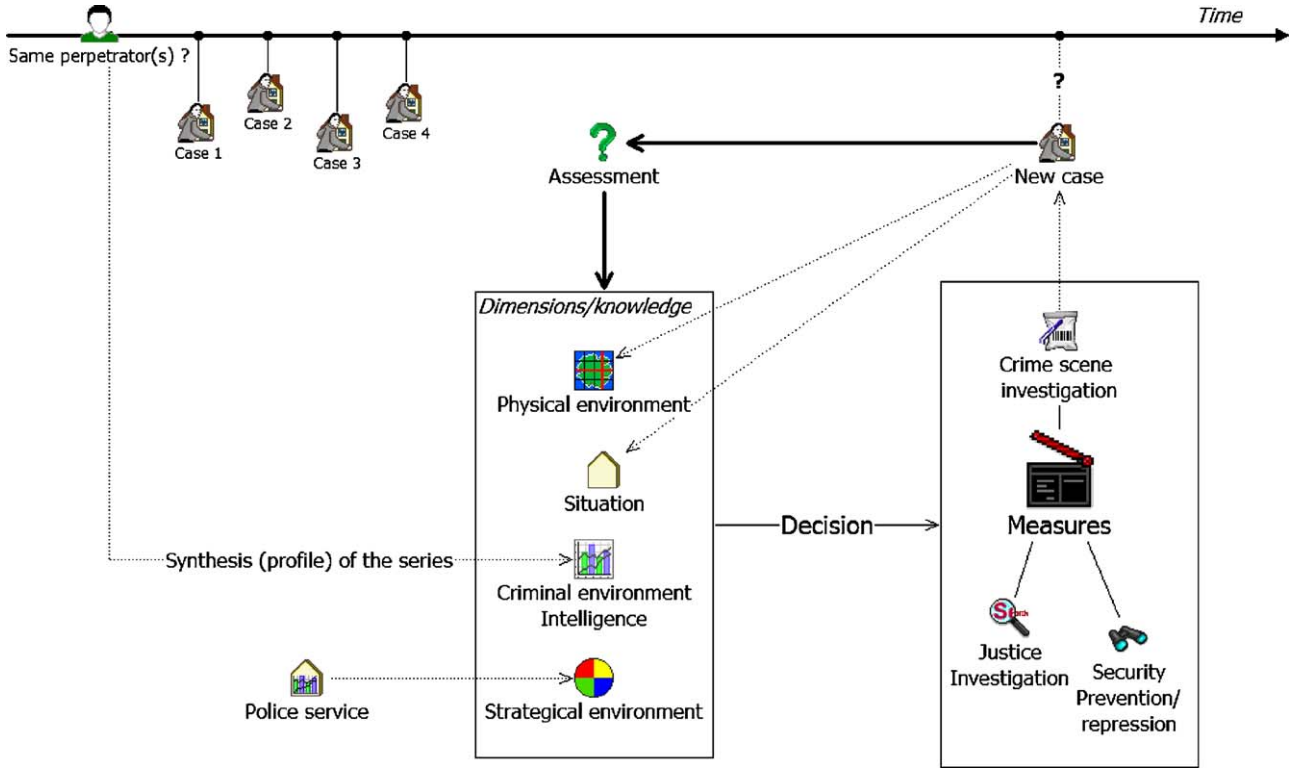

Fig. 4. Intelligence is central to decision making. In our model, a new case is assessed according to an evaluation of the physical environment and an analysis of the situation (circumstances) where the crime was perpetrated. At a next level, the new case is interpreted according to the current knowledge about the criminal environment. Finally, this assessment is completed by strategic considerations. This global reasoning process supports the decisions of determining the intensity and nature of the intervention (from none to extensive crime scene investigation). More generally, within an intelligence-led framework, this process supports the decision of the response to give to the situation, from strategies to concrete operational repressive or preventive measures. Bringing criminals to justice is one amongst other possible measures.

6.3. Examples

Illustrations of the combined use of the four levels are already manifold in the implicit or explicit practice. The interpretation of the series of burglaries presented at the beginning of this paper in the perspective of this integrative approach highlights evident ruptures in the reasoning process.

Another typical example illustrates how the proposed decomposition formalise implicit practices. When stolen cars are recovered, most often than not, standard operating procedures tell that they must not be investigated by crime scene examiners. However, when intelligence suggests a connection between the car stolen and, for instance, a serious crime or an important crime series, standard operating procedures are overruled and eventually the car recovered will be the object of an examination. This typically often leads to the collection of relevant traces belonging to the whole criminal activity, because cars form a very favourable environment for traces transfers and preservation.

These kinds of examples are collected in several research projects [30,31]. In [31] we presented the case of a series of burglaries in detached houses perpetrated during the night. The detection of the series by the crime intelligence unit has stimulated the management to give priority to the case by allocating more resources. On their side, crime scene examiners reconsidered their procedures of intervention at the scene for such cases. They analysed situational factors and imagined possible physical contacts resulting from the specific *modus operandi* of the burglar. These considerations changed the approach of similar cases and improved quality and quantity of traces collected. As a corollary, the global information available on the series brought by crime and forensic intelligence supported investigative efforts and led to the resolution of the case. In similar circumstances, the quality and quantity of traces collected, and consequently the understanding of the series are also solid arguments when delicate decisions are taken in the course of the investigation.

These are typical contribution of forensic intelligence within a whole system that intends to detect problems and make informed decision at every level of the organisation.

7. Conclusion

From the first part of this paper, we derived that there is a necessity for the forensic science community to take into account the various constraints imposed both by security and justice tasks. These constraints increase the complexity of the forensic science position, and drive the forensic science community to accept to take more responsibility in a security perspective. In our opinion, this realisation infers that important challenges are around the corner; and addressing these challenges will require from the forensic science community to go far beyond recent recommendations for a simple better control of forensic procedures.

The proposed framework intends to make a step towards integrating and structuring intelligence aspects in the methodology and make explicit what is today exploited by individuals implicitly using environmental knowledge. In this perspective, the strategic, crime intelligence, situational and physical dimensions delineate this logic of crime scene investigation.

This model belongs to a long-term formalisation project that relates to the use of forensic case data in a truly intelligence and security perspective, as well as the manifold potential use of forensic case data in specific investigations [6,31–35]. It extends recent empirical studies investigating a better understanding of the logical mechanisms of crime scene examination [4,5,36,37]. Current research is ongoing in order to go beyond successful examples and should empirically test the proposed model [30].

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