

DEVELOPING A QUALITY STANDARD FOR FINGERPRINT EXAMINATION

1. Introduction

- 1.1. The principal role of the Forensic Science Regulator is to set and monitor quality standards for forensic science used in the criminal justice system in England and Wales. The Regulator is supported in this role by the Forensic Science Advisory Council which includes representatives from Scotland, Northern Ireland and experts who advise on the many different aspects of forensic science. The Regulator has agreements with the authorities in Scotland and Northern Ireland to collaborate on the development of UK-wide common quality standards. In the context of regulation forensic science includes all fingerprint examinations; at crime scenes, in laboratories and in fingerprint bureaux. The Regulator established a fingerprint quality standards specialist group to advise on standards for fingerprint examinations. The group is chaired by Gary Pugh, Director of Forensic Services, Metropolitan Police Service.
- 1.2. The Regulator and chair of the specialist group both gave evidence to the Fingerprint Inquiry Scotland – a Public Judicial Inquiry set up by Scottish Ministers under the Inquiries Act 2005¹. They are also familiar with the fingerprint issues and comments made in the Court of Appeal judgement in the case of R v Smith² which identified a real need in fingerprint examination “*to ensure that there are common quality standards enforced through a robust and accountable system*”. It is clear from these proceedings and other enquiries notably the US National Academy of Sciences report “Strengthening Forensic Science in the United States: A Path Forward” that there needs to be a fundamental shift to delivery of fingerprint examination within an accountable, effective and robust quality standards framework. In this paper the authors set out some initial views on what the quality framework for fingerprint examination should be composed of and invite comment from all stakeholders and interested parties.

¹ Details are available at www.thefingerprintinquiryscotland.org.uk

² [2011] EWCA Crim 1296 Case No. 2009/03393/C1

2. Basis for Fingerprint Examination

- 2.1. The use of fingerprint examination in the investigation of crime and the prosecution of offenders provides valuable and essential information and evidence. The criminal justice systems in the UK rightly demand that such evidence is reliable and subject to the robust quality standards that apply to other areas of forensic science. In order to set standards in fingerprint examination it is necessary to understand the basis for fingerprint examination, the risks of providing unreliable or incorrect results and the structures that need to be put in place to mitigate risk and provide confidence to the courts and public at large.
- 2.2. Uniqueness and persistence are often put forward as the underlying basis for the reliability of fingerprint examination in that the individuality of each and every person's finger and palm prints provides a basis for a fingerprint examiner giving a definitive opinion. For this to hold true it would be necessary to prove that among the total population that lives or has ever lived, no two people share the same fingerprints. This cannot be proved but can be inferred through empirical observations and data, the theory of friction ridge skin (the morphology of friction ridges), and fingerprint individuality models based on probability and statistics^{3 4}. While these concepts are important it is the accuracy of fingerprint examiners rather than uniqueness or persistence of fingerprints that is the foundational issue in the reliable provision of fingerprint evidence.
- 2.3. Fingerprint examination is not a science in that it is derived from a theory or coherent set of principles and the result of a fingerprint examination is an opinion and not a fact. It is no less valuable than the results of scientific analysis but it does underscore the absolute need for any process of fingerprint examination to recognise and manage the risk of human error. This requires clear levels of individual competence to be set and complied with, within a system that is owned

³ Scientific Research Supporting the Foundations of Friction Ridge Examinations. Glenn Langenburg, Chapter 14, The Fingerprint Sourcebook, US National Institute of Justice, March 2011

⁴ Is Fingerprint Identification Valid? Rhetorics of Reliability in Fingerprint Proponents' Discourse. Simon Cole. Law & Policy, Vol 28, No. 1, January 2006

and operated by organisations that provide fingerprint examination to the criminal justice system. It also requires evidence that fingerprint methods are valid and that fingerprint evidence is objective and impartial. These are the key elements we see as the basis for setting and maintaining quality standards in fingerprint examination.

- 2.4. Fingerprint examination is best described as a cognitive process which relies on the ability of a competent individual to analyse and compare areas of friction ridge detail, and arrive at a decision as to whether they originate from the same person or not. In arriving at this decision fingerprint examiners will assess the pattern, ridge flow features and characteristic minutiae. It is the convention in fingerprint examination to consider in a strict hierarchical manner first, second and third level detail. These can be described as overall pattern (first level), characteristics such as ridge endings or bifurcations in ridges (second level) and detail within the ridge structure such as pores and ridge shape (third level). Each level of detail is considered in succession from first to third level detail, it follows that if a difference is found at first or second level detail then further levels of detail would not be considered and could not be used to make an identification. To arrive at a definitive decision a fingerprint examiner should be able to demonstrate that the match or identification shows a coincident sequence of characteristics and that there are no unexplained differences.
- 2.5. A methodology referred to as ACE-V (Analysis, Comparison, Evaluation and Verification) has been widely adopted in many countries including the UK for fingerprint examination. This provides a broad structured approach to fingerprint examination, a basis for developing technical procedures. If the ACE-V methodology is followed, particularly in relation to analysis and verification, it provides some degree of safeguard against errors and incorrect results.
- 2.6. Within the current processes in the criminal justice system where a fingerprint examiner makes a definitive decision it is usual to have a verification process involving at least two further competent fingerprint examiners who must also make a definitive decision.

3. Quality Standards Framework

- 3.1. BS/EN ISO 17025 is the standard for testing and calibration laboratories, and is endorsed by the Regulator as the basis of a quality standards framework for UK forensic science laboratory activities. It is adapted for the forensic science context by joint agreement through the International Laboratory Accreditation Cooperation (ILAC) paper 'ILAC G19 2002 Guidelines for Forensic Science Laboratories' and latterly in the UK through the Regulator's Codes of Practice and Conduct. The standard is designed, and works well in the forensic laboratory context, to assess laboratory activities at four essential levels: organisational competence (does the organisation managing the laboratory have effective quality systems), individual practitioner competence, validity of methods and impartiality.
- 3.2. The UK, as with other EU member states, is already on the path to adopting accreditation against BS/EN ISO 17025 for a central aspect of fingerprint methodology – the laboratory enhancement of fingerprints⁵. Plans are already in place for fingerprint enhancement laboratories across the UK to become accredited against BS/EN ISO 17025 by November 2015. The enhancement laboratories use a range of physical and chemical methods to raise latent marks on different substrates. As fingerprint laboratories become accredited it is entirely logical for the scope of such accreditation to be extended to cover the comparison of fingerprints carried out by fingerprint examiners.
- 3.3. The following sections set out in more detail the basis for a quality standards framework in fingerprint examination; they include: organisational competence, practitioner competence, method validation and impartiality. Taken together we believe these form the basis for a modern quality standards framework for fingerprint examination and are consistent with the approach taken for other forensic science laboratory methods in the Regulator's Codes of Practice and Conduct.

⁵ A requirement under EU Council Framework Decision 2009/905/JHA.

4. Organisational Competence

- 4.1. Fingerprint examination and the evidence produced is largely the product of fingerprint examiners working within organisations (primarily police forces) that are currently required to achieve certification to the ISO 9001 standard. However, ISO 9001 is a generic standard for a management system and does not include the rigorous requirement to demonstrate the technical competence that is covered by ISO 17025. The first four elements of the ISO 17025 standard incorporate the generic quality management requirements of ISO 9001 giving organisations who have achieved this standard a basis for building a more robust technical quality system for fingerprint examination.
- 4.2. It is a core and fundamental requirement that the most senior leaders of an organisation demonstrate visible commitment to a quality management system. This requirement combined with the requirements of the criminal justice system and the impact of unreliable fingerprint evidence strongly argues for every organisation that provides fingerprint evidence to have a named Senior Accountable Person. The Senior Accountable Person, member of ACPO or Chief Executive Officer, will be accountable for ensuring that the provision of fingerprint examination meets the quality standards requirements set out in this paper and the requirements of the criminal justice system. This is the level of accountability expected in an ISO 17025 accredited laboratory where the senior leadership is expected to understand quality issues and to drive a corporate approach to achieving the necessary quality standards. It is an accepted and established principle in the broader forensic science community, and the accreditation process, that the consistent and acceptable quality of results is a product of organisational quality systems, with senior management accountability, that cannot be delegated to individual practitioners or assumed to be a natural consequence of individual expertise and responsibility.
- 4.3. For the purposes of setting fingerprint standards we believe it is important to recognise the different types of fingerprint examination undertaken and the challenges and risks inherent in the examination of “complex marks”, we therefore

Type 1: the comparison of fingerprints taken from an individual at different points in time to establish identity.

Type 2: the comparison of an unknown or latent area of ridge details left on a substrate with a fingerprint from an individual. Within this type, two sub types are recognised: simple and complex (in a complex mark the amount of ridge detail is small and/or may be subject to movement, superimposition or other factors that affect the quality of information and therefore the complexity of the comparison, requiring a greater degree of interpretation and risk of error).

4.4. Any organisation that undertakes fingerprint examination should have at least two competent practitioners. Each organisation should declare which types of fingerprint identification are undertaken as set out in Section 4.3 and have at least two competent practitioners in each type of examination.

4.5. An organisation that undertakes fingerprint examination is expected to meet the following organisational requirements:

- Where staff are recruited and achieve competence as fingerprint examiners within the organisation there must be a system in place that allows competence to be acquired and demonstrated.
- A list of staff who are designated as competent by the Senior Accountable Person or their nominee must be maintained and where required made available to Forensic Science Regulator.
- There must be a process in place that provides for all fingerprint evidence to be the product of at least two independent examinations by competent practitioners and the organisation must have a process for dealing with any errors that are found in the process, or differences in opinion.
- There must be a management system in place that is subject to external audit and contains documented and controlled standard operating

4.6. The examination of complex marks should be covered by separate technical procedures to ensure that complex marks are identified and that additional measures are in place to mitigate the risk of error. These should be incorporated into the procedures and used as the basis for BS/EN ISO 17025 accreditation and the following elements should be considered:

- Notes should be taken at each stage of the process by every examiner involved in the examination of complex marks. These notes should record the features identified at analysis and those relied upon by each examiner in reaching his or her conclusion.
- No examiner should disclose his or her conclusion to another examiner until all three examiners have reached their independent conclusions.

4.7. Differences of opinion between fingerprint examiners should also be the subject of a technical procedure; further investigation should be conducted by a panel of at least three members. The members of the panel should each examine the mark independently without any contextual information about the case or knowledge of the conclusions of the other panel members. Once the panel members have reached their own conclusions they should, as a panel, look at the reasoning of the earlier examiners. An outcome of the review should be that examiners understand why they came to different views. If the panel members are unanimous then the result can be reported, if not the conclusion of identification would not be safely relied upon.

5. Individual Competence

5.1. Fingerprint examination has at its core the ability of a competent practitioner to:-

- Understand the structure of skin friction ridge detail and its deposition on a range of substrates.
- Interpret and compare areas of friction ridge detail taking account of the features present and their spatial relationship to each other.

- Make a definitive decision as to whether two areas of friction ridge detail originate from the same person or not.
- Determine that two areas of friction ridge detail contain insufficient detail to make a decision.

5.2. In setting out this core basis it is recognised that fingerprint examination is a decision making process relying on the human brain to recognise complex visual detail and to compare this detail to arrive at a definitive decision. Regardless of the certainty in the mind of a fingerprint examiner once a conclusion is reached, the evidence is always an opinion, not fact.

5.3. Competence in fingerprint examinations can be achieved through a process of learning and developing skills, some of which can quite properly be achieved through external training. However, the management of practitioner competence rests firmly with the ISO 17025 accredited organisation and cannot be delegated or assumed to be achieved through external processes. Use of the National Occupational Standards as part of an integrated competency framework provides one tried and tested framework for managing all aspects of staff competence and development.

5.4. A person from initial selection through to competence must be monitored at all stages and build up a portfolio of evidence that will demonstrate that they have achieved the necessary competence. All practitioners who achieve competence will be required to demonstrate that their competence is being maintained and undertake a proficiency test on at least an annual basis. This should be underpinned by audits and dip sampling meeting the requirements of ISO 17025 accreditation.

6. Validation

6.1. Method validation is a central requirement to accreditation against ISO 17025 for every method within an organisation's scope of accreditation. The Forensic Science Regulator's Codes of Practice and Conduct - December 2011, set out the requirements for validation and methods at section 20.2 i.e.:

20.2 Validation of methods (ISO 17025:2005 ref. 5.4.5)

- 20.2.1. Validation should be conducted prior to implementation of the method. This may be performed by the provider, manufacturer or another provider.
- 20.2.2. Where the validation has not been conducted at the laboratory site that will be using the method, the provider must still verify the scope of the validation with the required steps, scaled according to the adequacy and relevant of the available existing validation study. The provider's own competent staff shall demonstrate such adopted methods perform reliably at the given location following the validation process.
- 20.2.3. The validation policy or procedure shall set out roles and responsibilities of staff involved in conducting validation, authorisation of key stages and reviewing outcomes.
- 20.2.4. To ensure validation studies are conducted on the final method, there should be a clear boundary between development and validation. This should include consideration of how to prevent inadvertent re-entering of the development process once validation has started.
- 20.2.5. The validation procedure shall include where relevant, but is not limited to:
 - a. determining the end user's requirements and specification;
 - b. risk assessment of the method;
 - c. a review of the end-user's requirements and specification;
 - d. the acceptance criteria;
 - e. the validation plan;
 - f. the outcomes of the validation exercise;
 - g. assessment of acceptance criteria compliance;
 - h. validation report;

- i. statement of validation completion; and
 - j. implementation plan.
- 20.2.6. In certain circumstances implemented methods will require revalidation, e.g. when:
 - a. quality control indicates that an established method, is changing with time;
 - b. equipment which was not validated to be mobile or portable is moved to a new location;
 - c. deficiencies have becomes apparent after the method has been implemented; or
 - d. the end-user identifies a change in requirement.

7. Impartiality

7.1 The Senior Accountable Person within an organisation and individual fingerprint examiners who undertake fingerprint examination must formally acknowledge that they accept their duty to the court as an expert witness as described in the Criminal Procedure Rules 2010, Part 33.2 i.e.:

Rule 33.2 Expert's duty to the court

- (1) An expert must help the court to achieve the overriding objective by giving objective, unbiased opinion on matters within his expertise.
- (2) This duty overrides any obligation to the person from whom he received instructions or by whom he is paid.
- (3) This duty includes an obligation to inform all parties and the court if the expert's opinion changes from that contained in a report served as evidence or given in a statement.

8. Other Considerations

8.1. Production of Images of Latent Marks: The photography and image processing of latent finger marks is a critical and important part of fingerprint examination and

- 8.2. Modern digital imaging provides valuable opportunities for the recording, transmission and development of latent marks, all of which should be encompassed within the fingerprint quality standards framework set out in this paper. This requires further work and the Regulator will be developing new quality standards for forensic imaging incorporating fingerprint images.
- 8.3. Use of Statistics and Probabilities in Fingerprint Examination: Probability models for fingerprints have existed for some time, but have yet to be validated. They demonstrate that fingerprint minutiae/characteristics are highly discriminating and indicate that there are “staggeringly low probabilities that two individuals will share an arrangement of minutiae”⁶. As research continues, alongside the ever increasing AFIS databases and computing power available to researchers, we can expect that there will be the means to properly model and test hypotheses regarding the variability of fingerprints⁷.
- 8.4. The sole use of a probabilistic approach to the interpretation, evaluation and reporting of expert opinion is some considerable way off, if it is possible at all. However, probabilistic models may well have a role in supplementing the analysis and evaluation of the fingerprint examiner but the crucial step in the fingerprint process of identifying characteristics argues for caution in the light of the R v T⁸ case which exposed flaws in this approach when applied to footwear examination.
- 8.5. Independent review of fingerprint examinations and defence access to fingerprint examiners: The Court of Appeal in the case of R v Smith highlighted the lack of

⁶ Scientific Research Supporting the Foundations of Friction Ridge Examinations. Glenn Langenburg, Chapter 14, The Fingerprint Sourcebook, US National Institute of Justice, March 2011

⁷ Stoney, D.A. Measurement of Fingerprint Individuality. In Advances in Fingerprint Technology, Lee.h.c.,Gaensslen, R.E.'Eds.;CRC Oress: New York, 2001;pp327-387 (quoted in 7 above).

⁸ R v. T [2010] EWCA Crim. 2439

availability of fingerprint examiners to conduct independent examinations and to advise the defence in criminal case. It cannot be healthy for the criminal justice system or for the fingerprint profession to only support the prosecution. The establishment of a quality standards framework for fingerprint examination would allow competent fingerprint examiners within accredited organisations to act for both the prosecution and the defence in criminal cases, with the necessary practical safeguard that an organisation cannot act for both in the same case.

- 8.6. Culture, Bias and Peer Pressure: At the UK Forensic Science Advisory Council meeting on 6 July 2011 it concluded that cognitive bias (also referred to as contextual bias or observer effects) is an issue that is relevant to forensic science, including the fingerprint domain. The issue is well set out in the NIJ Fingerprint Sourcebook⁹.
- 8.7. Organisations who undertake fingerprint examination should demonstrate within their accredited quality management system that they understand the potential for cognitive bias and build into their technical procedures safeguards to minimise the risk of bias and peer pressure.
- 8.8. Admissibility in the Criminal Justice System: In describing the core basis of fingerprint examination it is recognised that it should meet the requirements of admissibility of expert opinion evidence, in particular the factors summarised by King C J in the Australian case of Bonython. These factors which are also part of common law in England and Wales are:
- Whether the subject matter of the opinion is such that a person without instruction or experience in the area of knowledge or human experience would be able to form a sound judgement on the matter without the assistance of a witness possessing special knowledge or experience in the area.

⁹ Special Abilities and Vulnerabilities in Forensic Expertise. Thomas A. Busey and Itiel Dror. Chapter 15, The Fingerprint Sourcebook, US National Institute of Justice, March 2011

- Whether the subject matter of the opinion forms part of a body of knowledge or experience which is sufficiently organized or recognized to be accepted as a reliable body of knowledge or experience, a special acquaintance with which by the witness would render his opinion of assistance to the court; and
- Whether the witness has acquired by study or experience sufficient knowledge of the subject to render his opinion of value in resolving the issues before the court.

9. Concluding Remarks

- 9.1. This paper sets out the initial views of the Regulator and the chair of fingerprint quality standards specialist group, and gives a clear indication of the quality standards that must be developed in order to bring fingerprint examination within the quality standards framework found in other forensic disciplines.
- 9.2. The Regulator's intention now is to commission work to develop these views in light of the report and recommendations of the Fingerprint Inquiry Scotland with a view to public consultation in 2012.

Andrew Rennison Forensic Science Regulator

Gary Pugh Chair of the Fingerprint Quality Standards Specialist Group

20 December 2011