

‘MARKETISED FORENSIC DNA- PROFILING IN ENGLAND & WALES’

A thesis submitted
for the degree of
Doctor of Philosophy
in the School of Law
at the University of
Strathclyde

To my family - May Richmond, Gordon Richmond, and Christina Brooks

Table of Contents

List of Tables	vi
List of Abbreviations	vii
Preface and Acknowledgements	viii
Declaration	ix
Declaration of Prior Publications	x
Forthcoming Publications	xi
Abstract	xii
Introduction	1
Chapter One: Forensic Science Provision, DNA Profiling, and Marketisation	8
Part One: Forensic Science Provision.....	8
Part Two: DNA Profiling.....	15
Standardisation through probabilistic evidence techniques.....	16
The ‘hierarchy of propositions’	22
The Case Assessment and Interpretation (CAI) Method	25
Part Three: Marketisation of Forensic Science Provision.....	33
Research questions	40
Central research question:.....	40
Secondary Research Questions	40
Chapter Two: Thematic Literature Review	42
Part One: Standardisation	43
Standards and Regulations.....	44
Formal and Informal Standards	45
Informal Standards.....	46
Non-marketised Standardisation in the Forensic Science Sector	47
Standardisation and Marketised Forensic Science: The Forensic Science Regulator	51
Part Two: Expertise.....	54
Epistemological privileging of knowledge claims derived from DNA-profiling techniques.	62
Theories of Expertise	68
Science and Technology Studies and Studies of Expertise and Experience.....	68

The common origins of law and science.....	69
The taxonomy of expertises	72
The ‘Third Wave’ of Science and Technology Studies	76
Law, science, and expertise across disciplinary boundaries: macro-sociological theories and governmentality	80
Part Three: Efficiency	84
Economic rationalisation and efficiency in forensic science.....	84
Efficiency and forensic science: overview	86
Efficiency and Forensic Science Policy.....	86
Efficiency through privatization: global perspectives	90
Part Four: Regulation	97
The NAS/NRC and PCAST reports.....	97
The Runciman Report and UK Government Committees	104
Mertonian norms, scientific-realism and the ‘forensic imaginary’	107
Chapter Three: Methodology	111
Introduction.....	111
Method Selection	112
Participant Selection and Recruitment.....	113
Interview Setting.....	115
Semi-structured Interview Schedule: Design and Implementation	119
Chapter Four: Standardisation	133
Chapter Summary	133
Introduction.....	134
Forensic science provision in England and Wales.....	135
Economic Rationalisation in the United Kingdom	136
The Forensic Science Service: Transition and Closure	138
Restructuring and DNA Analysis	139
The Forensic Science Market.....	143
Procurement and the NFFA	144
The NPIA/NFFA.....	147
Forensic productisation - Implementation and Resistance	148
Triaging of forensic investigations	151
Conclusion	155
Chapter Five: Expertise	158
Chapter Summary	158

Pre-codification forensic analyses within the public sector.....	159
Triaging, and the privileging of DNA profiling techniques	160
Case Fragmentation and quoting	165
Mixtures and Low Template DNA	167
Commercialisation and the restructuring of forensic expertise	171
Triaging and Forensic Science Provision in the public sector	177
The Contest and Communication Narrative – silos and transfer of expertise	186
Interdisciplinary theories of expertise.....	188
Chapter Six: Efficiency.....	194
SFR and Abbreviated (or ‘Staged’) Forensic Reporting.....	195
Background: The Ministry of Justice Efficiency Program	197
Criminal Procedure Rules	200
Supporting Case Law	202
Streamlined Forensic Reporting - Outline	203
Conclusion	223
Chapter Seven: Regulation	224
The Forensic Science Regulator	225
FSR’s Regulatory Responsibilities	226
International Standards	226
Accreditation.....	227
Professional and commercial Standards	227
Forensics Procurement Framework	227
Investigation of Complaints.....	228
Forensic Regulator’s Code of Practice and Conduct	228
Quality Assurance and <i>Daubert</i> criteria	229
Regulation and the ‘Enhanced <i>Daubert</i> ’ Criteria	233
Accreditation and DNA Profiling	234
DNA Profiling and the Declaration of ‘non-compliance’	235
Regulatory Objectivity.....	237
The Normative Basis of Forensic Science	244
Chapter Eight: Conclusions	246
Standardisation.....	248
Expertise	249
Efficiency	251

Regulation and Autonomy	253
Contribution of this study to the literature	255
Implications	256
Reference List.....	262
Books	262
Articles.....	268
Internet Resources.....	285
Reports	287
Appendix I : Interview Schedule and Questions.....	288
Appendix II: Example Codified Forensic Product	291

List of Tables

Table 1 : Collins and Evans’ ‘Periodic Table of Expertises’	73
Table 2 : Research Interview Participants & Designation.....	118
Table 3 : Employment Categories of Research Participants	119
Table 5 : FSNI Case Types.....	180

List of Abbreviations

CAI	Case Assessment and Interpretation
CJS	Criminal Justice System
DNA	Deoxyribonucleic Acid
EGP	Early Guilty Plea Scheme
ERU	Evidence Recovery Unit
FSP	Forensic Science Provider
FSR	Forensic Science Regulator
FSS	Forensic Science Service
LCN-DNA	Low Copy Number DNA
NDNAD	National DNA Database
RMP	Random Match Probability
RQ	Research Question
SFR	Streamlined Forensic Reporting

Preface and Acknowledgements

Completion of this thesis would not have been possible without the financial support of the University of Strathclyde, delivered by way of a Dean's Award, and a John Anderson Research Excellence Award. Thanks are also due to the trustees, and administrative staff, of the Leverhulme Trade Trust, the Glasgow Mitchell Educational Trust, the Fran Educational Trust, and the Gilchrist Educational Trust, for their support.

Special thanks are due to Professor Jane Ireland for her help and experience, to Dr. Carole McCartney of Northumbria University, and to Professor Corinna Kruse of Linköping University, for sharing their experiences in the forensic science field. And not least to colleagues at Edinburgh University, and Cardiff University, for their encouragement.

For their interest - and enthusiastic participation - in my research, I am grateful to: the Royal Society, The Royal Society of Edinburgh, Her Majesty's Inspectorate of Constabulary, the United Kingdom Accreditation Service, the Crown Prosecution Service, the Metropolitan Police, and the Office for the Forensic Regulator. Thanks also to the Scottish Police Authority, Scottish Institute for Policing Research, and the Faculty of Advocates. Greatest thanks are due to the staff of the Forensic Science Providers in all four corners of the United Kingdom for sharing so freely of their time and knowledge.

The supervisory, academic, and administrative, staff of Strathclyde University Law School, and The Graduate School of Humanities and Social Sciences, deserve my sincere thanks (in particular each and every one of my supervisors). I am likewise grateful to fellow students and academics for the encouragement and engagement they offered, having enlisted their help in reading - and commenting on - early drafts. Thanks also to the Institute for Advanced Legal Studies, the Law and Society Association, the Socio-Legal Studies Association, the Chartered Society of Forensic Sciences, and the Society of Legal Scholars, for helping me to disseminate my research. And I owe a special debt to all those who took an interest in this project and who came along to workshops and conferences to hear me speak about the results of my research.

Declaration

I am the author of this PhD thesis and the results presented here are from investigations conducted by myself. Work other than my own, consulted by me, is clearly identified with references to the authors, and their publications. I hereby declare that the work presented here, in two volumes, is my own, and has not been submitted - in any form - for any other degree at this, or another, university.

Karen M Richmond

Declaration of Prior Publications

Sections of this thesis have appeared in peer-reviewed journals and edited collections:

Richmond, K. *DNA Profiling: Transfer and Persistence R v Tsekiri [2017] EWCA Crim 40* (2017), *Journal of Criminal Law*, Volume: 81 issue: 4, page(s): 275-277

Richmond, K. *Streamlined Forensic Reporting: Swift and Sure Justice* (2018), *Journal of Criminal Law*, Volume 82, Issue 2, April 2018 ¹

Richmond, K., 3 Sep 2018, *Interdisciplinary Research in Law and Forensic Science: From 'silos' to systems*. In *Critical Issues in Science, Technology and Society Studies: Conference Proceedings of the 17th STS Conference Graz 2018, 7th - 8th May 2018*. Getzinger, G. (ed.). Graz, Austria: Technischen Universität Graz, p. 166 - 175 10 p.

Richmond, K., *Streamlined Forensic Reporting: 'Swift and sure justice'?* (2018) : *Journal of Criminal Law*. 82, 2, p. 156-177 22 p.

Written Evidence submitted to House of Lords Science & Technology Committee Enquiry into Forensic Science. This evidence was requested, reviewed, accepted by the Committee, and published by the House of Lords;

Karen Richmond, University of Dundee – Written evidence (FRS0101) 9. What role for should the Forensic Science Regulator have? If the Forensic Science Regulator is to have statutory powers, what should these be? Richmond, K., 18 Dec 2018, 4 pages.²

¹ This article was also cited by multiple sources in written evidence to The House of Commons Justice Committee Inquiry into the disclosure of evidence in criminal cases.

² See <http://data.parliament.uk/writtenevidence/committeeevidence.svc/evidencedocument/science-and-technology-committee-lords/forensic-science/written/93850.html> A version of this submission was submitted to the House of Lords Science & Technology Committee Enquiry into Biometrics Strategy and the role of the Forensic Science Regulator on 12th March 2018

Richmond, K 'Customer-Driven Standardisation in the Forensic Science Market in England and Wales' in Kai Jacobs (Ed.) *Managing Corporate Standardisation and Meeting Economic Demands* (2019) (IGI Global: Pennsylvania)

Forthcoming Publications

Richmond, K 'Marketised Re-structuring of Forensic DNA Profiling in England & Wales' (2019) *Oxford Journal of Legal Studies* (Oxford University Press: Oxford)

Richmond, K. *DNA Evidence Alone as a Case to Answer; Bech, R v Court of Appeal [2018] EWCA Crim 448*, *Journal of Criminal Law*

Richmond, K (2020) *Marketised Forensic Science Provision in England & Wales* (Emerald Publishing: London)

Richmond, K *Articulating 'Scientific Method' in the Forensic Market (2020)* *Journal of Forensic and Legal Medicine* (Special Issue, eds. McCartney, C., & Machado, H.)

Abstract

Forensic science provision in the United Kingdom has undergone significant, though uneven, development during the past decade. In England and Wales, forensic expertise is now delivered by way of a commercial market, whilst similar provision in Scotland, and Northern Ireland, remains within the public sector. As a result of marketisation, police forces (and other forensic ‘customers’) have become increasingly concerned with measuring economic value, whilst forensic science providers have been required to maintain an efficient, high-quality service that conforms to the overarching regulations. Early studies suggest that these structural, and regulatory, developments have had a marked impact upon the field of forensic DNA analysis, and may affect the way in which expert DNA evidence is constructed.

This empirical research project seeks to assess the impact that these public policy, and organizational, developments, have had on the perspectives of forensic DNA-profiling experts.³ The project focuses on the perceived links between governance structures, and the performance of forensic expertise, through the construction of analytical, and evaluative, reports. The study also considers the reported impacts of overarching regulatory incursions. The purpose of this unique study is to gain a clearer understanding of the ways in which forensic DNA profilers have responded to policy-driven structural changes, and to assess the perceived effects of resulting adaptations.

The project has uncovered valuable data, demonstrating that respondents regard DNA reporting and evaluation in relation to serious crime as conforming to the highest scientific standards. However, the ways in which ‘volume’ crime cases are perceived to have been dealt with may raise more pressing questions. Indeed, certain trends are identified within the respondent’s

³ Black, S & Daeid, NN 2015, *Time to think differently: catalysing a paradigm shift in forensic science* Philosophical Transactions of the Royal Society B - Biological Sciences, vol 370, no. 1674.

testimony, based upon their experiences of the forensic market, which may raise concerns. Particular developments (such as the perception of case fragmentation and de-skilling, and concerns relating to the production of streamlined reports) could – if accurate - impact on the quality of expert opinion, and may potentially subvert the courts’ ability to arrive at sound determinations on questions of fact.

Introduction

This empirical qualitative study seeks to understand the ways in which forensic experts in England and Wales perceive DNA profiling under marketisation. However, it is not concerned with the physical examination of DNA samples within the laboratory. Rather, it explores the experiences of bio-medical experts, and reveals their understandings of the influence of marketisation, and regulation, on the evaluation, interpretation, and reporting, of DNA profiling evidence. Therefore, it encompasses the expert's understandings of the entire trajectory of DNA evidence within the criminal justice system: from the collection of material samples, to their stabilisation within the laboratory, their evaluation, the careful assimilation of contextual information, and their translation into probabilistic outputs for consumption within the courtroom.

The first chapter begins with a comprehensive account of the essential subject matter of the study; forensic science provision, DNA profiling, and marketisation. Using academic literature, and original sources (such as contracts, tenders, reports, and the transcripts of government committees), it builds a detailed historical, and socio-legal, account of the contingent factors which have influenced the reconstruction of forensic science provision (and the reformation of forensic expertise and employment) in the forensic market. Central to this account (and to the focus of this doctoral research project) is the emergence - from a publicly-funded Forensic Science Service - of a system of marketised forensic DNA profiling provision.

The critical analysis moves on to review in detail the existing literature relating to the uses of probabilistic evidence in criminal proceedings, focusing on the standardisation of probabilistic evidential techniques through the Case Assessment and Interpretation (CAI) method. In order to better comprehend these processes and the institutional logics which structure them - in addition to the influences which shape them - particular attention is devoted to the harnessing of Bayesian statistical methods as a primary means through which to interpret DNA profiling evidence. It considers the utilisation of Bayesian methods as an 'inference engine': an evaluative tool which exhibits the flexibility necessary in order

to facilitate the diverse requirements of progressive, abductive reasoning, and the power to model successive hypotheses introduced through the assimilation of contextual information. It demonstrates the ways in which the employment of Bayesian probabilistic methods may be perceived as making the forensic scientist more reliant on interdisciplinary communication with the corresponding investigatory agencies - and vulnerable to forces which shape the investigatory context - whilst simultaneously promoting a more pronounced role for the expert forensic scientist within the legal process.

This chapter serves to further demonstrate the degree to which these phenomena may be perceived to have been shaped by attempts to standardise DNA profiling, and to render it more efficient, whilst remaining consonant with the requirements of rational adjudication. The chapter also demonstrates that probabilistic techniques (and attendant normative representations) are not applied in respect of all iterations of forensic DNA profiling. Rather, 'serious crimes', and so-called 'volume crimes', have become subject to different processes.

The third chapter of introductory material aims to provide a definition of marketisation, as distinct from both commercialization, and privatization. The study reviews the literature and concludes that these distinct terms are neither synonymous, nor interchangeable. Marketisation is defined as a change in transactions, through the introduction or intensification of price-based competition. However, this definition is not limited to economics. Rather, it is defined by a small number of specific social and political elements, which correspond to both the research questions, and to the following data analysis chapters. These key dimensions are; commodification through standardisation, commodification of labour and expertise, a restructuring of processes to maximize efficiency, and a restructuring of democratic accountability through regulation.

Having offered a detailed account of these topics – and differentiated marketisation from privatization, and commercialization – the study proceeds to a thematic review of the academic literature closely related to the research topic. This review focusses on the major themes which emerged from the researcher's general reading, specifically; standardisation, expertise, efficiency, and regulation. The review covers a range of empirical and theoretical material commencing with a review of general material, followed by a focus on academic

literature in the forensic scientific field (where available). The purpose of each part of the review is to determine the research gap relative to each theme. Each part of the review thus closes with an account of the contribution which this study could make to the literature.

The thematic review, and analysis, considers the ways in which external factors which may shape the routine practices of forensic DNA profiling, with a particular focus on England & Wales. With reference to the academic literature, the review demonstrates the ways in which forensic-scientific knowledge claims are translated into a consistent product, and shaped to conform to the expectations of the criminal justice system. It shows how this process of translation serves to open up the forensic analytical protocol to the external gaze, and thereby invites the external structuring of forensic-scientific knowledge claims through the influence of exogenous political, economic, regulatory, and managerial forces. It illustrates the ways in which those who shape forensic-scientific policy, often find themselves in struggles for control, and continuing relevance, during the negotiations that bind forensic science to other domains. Further, it highlights the ways in which such contests, and negotiations, may serve to obscure the nuance and intuition, the conceptual diversity, and the distribution of skills and knowledge, which together form the reality of expert practice.

The thematic review considers theoretical accounts alongside empirical studies. It provides a thorough review, and critique, of the conceptual, and theoretical, perspectives, which underpin this inquiry. It will be clear from the foregoing sections that the co-production of forensic-scientific knowledge claims within England and Wales is conducted, and managed, by a diverse collection of institutions and actors (scientific, investigatory, legal and governmental), representing heterogeneous epistemic communities. At the heart of the process lies the practice of forensic-scientific expertise: its mediation, its standardisation, and the subsequent elicitation of expert knowledge claims across disciplinary boundaries. Since forensic knowledge claims are required to communicate expert insight, and understanding, in terms that non-experts may understand, this entails that interdisciplinary expert judgment must be exercised according to specific analytical norms which retain their relevance to the intended audience, and which may serve the needs of other epistemic communities. This requires a rigorous theoretical account of professional expertise, and an

assessment of the ability of subsisting accounts to explain the exercise of expertise as a driver of interdisciplinary professional collaboration.

Crucially, the literature review identifies a gap in the existing research, and demonstrates the need for an empirical study focusing on the perceived effects of marketisation on the evaluation of DNA profiles in England and Wales. The discussion then turns to methodology. The methodology chapter provides a detailed account of the way in which an appropriate research strategy was shaped, in order to answer the research questions. The methodology chapter is rendered in sufficient detail and clarity to facilitate reproducibility. It considers the problem of engagement with a heterogeneous group of experts representing a range of institutions and functions within the criminal justice system. The chapter offers a reflexive account of the way in which scope of the study was delineated; the rationale for participant selection; the method of recruitment; the chosen method of data capture; and the process of data analysis. The foregoing elements are placed in the context of an effective research strategy, designed to provide a solution to the research problem. This section provides details of research participants, and interview themes, as well as addressing a series of subsidiary questions relating to data management, funding, consent, risk assessment, and dissemination. The methodology chapter is supplemented by an appendix providing an account of the methodological narrative; discussion of the challenges of interdisciplinary study, and their resolution.

The following section comprises an extended discussion, and critical analysis, of the results of empirical research. These four chapters focus on emergent themes, drawn from the empirical data. These chapters are separate, but closely related: thus, each chapter in this section builds on the foregoing analysis in order to develop a comprehensive account of the ways in which marketisation has shaped forensic DNA-profiling.

The initial chapter addresses the issue of standardisation and perceptions related to the implementation of standards. This chapter aims to contribute further to the nascent, but expanding, body of literature concerned with sociologies of standards, and standardisation. Through contributing to this field, it aims to answer Timmerman and Epstein's call 'for careful empirical analyses of the specific and unintended consequences of different sorts of

standards operating in distinct social domains.’⁴ Thus, the chapter sets out to critically examine the standard-making process, emphasising the complex negotiations required. Further, it exposes the material, historical, and organisational contingencies, which led to the creation of standardised forensic products, surveys their implementation, and explores the ways in which these standards became subverted in site-specific contexts.

The subsequent chapter addresses the issue of expertise, and the problems associated with practitioner’s perceptions of the marketisation of forensic science, from a novel perspective. Rather than focusing on the economic efficiencies and priorities which structure customer needs, this discussion takes the obverse perspective, examining efficiency from the perspective of time. This approach enables a more appropriate examination of this field of expert practice, and aligns with the views of lead forensic scientists, drawn from the empirical data:

“In practice, the police have budgets and scientists have turnarounds. You need thinking time...or experience [to carry out a thorough analysis]. So, when time is short, the tendency is just to do what the police ask. You have targets to meet. You have to complete a number of allocations.”

The chapter begins with an examination of the processes of productisation, and of ‘triaging’, which combine to set material samples on a particular evidential trajectory, and which structure the resulting analysis in terms of depth, level of expertise, and the examiner’s ability to take account of contextual factors. It explores the effect of overarching governance structures on the work of expert practitioners, and considers the degree to which these may affect the ability of forensic scientists to carry out an exhaustive – contextually rich – evaluation, which conforms to the requirements of the Case Assessment and Interpretation process. It also explores the process of market restructuring and ‘de-skilling’, demonstrating that restructuring has resulted in a loss of expertise.

⁴ Timmermans, S. & Epstein, S. A World of Standards but not a Standard World: Toward a Sociology of Standards and Standardization (2010) *Annual Review of Sociology*. 2010. 36:69–89

The third chapter to discuss the empirical data explores the introduction of novel forms of forensic reporting, introduced through the Criminal Justice System Efficiency Program (which aims to deal ‘promptly and efficiently’ with ‘low-level, straightforward cases’, in order to dispense ‘swift and sure justice’). Particular attention is paid to the rise of Streamlined Forensic Reporting, and the ways in which it serves to restructure expertise within the marketised forensic science sector. It also raises concerns over the potential for these forms of reporting to contribute to miscarriages of justice.

The final chapter in this section focusses on the regulation of forensic-scientific practice. It begins with a consideration of the ways in which DNA profiling experts interact with a regulatory regime: a regime, which demands institutional transparency and openness in the formulation of policies, and the management of perceived risks. Using empirical data, it demonstrates how the proliferating regulatory regime attempts to hold experts accountable to the public. It goes on to consider how regulation relates to the proper functioning of expertise, its efficient mobilisation, and its limits. It demonstrates how institutional agents negotiate with experts and how they justify their decision-making processes to the public. It also demonstrates how the apprehension of risk, and demands for quality assurance, serve to stifle the growth of emergent technologies, affecting the DNA profiling expert’s ability to meet new challenges, and to exploit fresh opportunities. These questions are considered in light of the unifying concept of ‘objectivity’. The discussion considers what role the concept of ‘objectivity’ plays in the resolution of these tensions, and how it helps the forensic-scientific community to justify policy decisions. The discussion leads to a consideration of whether, and to what extent, the reduction in DNA profiling expertise, and concomitant rise in ‘regulatory objectivity’ is predicated on ideal representations of law and science.

This chapter further demonstrates the centrality of normative accounts of scientific method to laws understanding of forensic science. It uses the empirical data to illustrate the ways in which such normative representations correspond to similar representations of legal fact-finding, both of which are characterised as exercises in rational adjudication. The discussion highlights that both fields share similar epistemic perspectives, founded upon

their approaches to inferential reasoning. The rationale, and utility, of such ideal constructions is questioned.

The thesis then concludes, by drawing together the conclusions and implications of the empirical and theoretical research and the foregoing discussion. It also offers a candid and reflexive assessment of the limitations of the study as well as highlighting the contribution which this study makes to the field.

Chapter One: Forensic Science Provision, DNA Profiling, and Marketisation

Part One: Forensic Science Provision

The forensic science industry operates through a network of agencies and actors, including government, regulatory bodies, professional associations, academia, product suppliers, the civil and criminal justice systems, the media and the general public. The market in forensic science provision extends to every corner of the United Kingdom. It is concentrated in England and Wales, where the provision of forensic science services by commercial organisations dates from the mid-1990s. The closure of the Forensic Science Service in 2010 has since led to the creation of the world's only marketised system of provision in forensic services.

The sector is dominated by four large companies, who together account for the largest share of the market. They are Key Forensic Services⁵, Cellmark⁶, Environmental Scientifics Group⁷, and LGC Forensics⁸. These four companies are the founding commercial members of the Association of Forensic Service Providers⁹, which aims to promote the interests of the forensic services industry. These firms offer a large range of forensic services. In some, forensic science provision only accounts for one part of their business. The remainder of the market consists of medium-sized and niche organisations, such as ROAR, Principal Forensic Services¹⁰, Manlove Forensics¹¹, Randox, and Hayward

⁵ <http://www.keyforensic.co.uk> (in insolvency as of 2018).

⁶ <http://www.cellmarkforensics.co.uk>

⁷ <http://www.esg.co.uk/services/forensic-services-overview/>

⁸ <http://www.lgcgroup.com/sectors/forensic-science/> (rebranded EuroFins as of 2017)

⁹ <http://www.afsp.org.uk/node/33/>

The non-commercial members are Scottish Police Authority Forensic Services and Forensic Science Northern Ireland.

¹⁰ <http://www.principalforensicservices.com/>

This company is noteworthy as it employs the incoming UK Forensic Science Regulator, Dr. Gill Tully.

¹¹ Now ArroGen Forensics, merging with Forensic Access in 2018.

Associates Forensic Science (which provides only DNA-profiling services and specialises in criminal defence work).¹²

A single forensic service provider may provide services to various police forces. Contracts are generally arranged on a large-scale 'volume' basis - normally in terms of tens of thousands of units, each unit corresponding to a forensic product - and the open market structure allows forces to change providers with relative ease. Police forces may have contracts with a variety of providers to provide different services. One provider may provide DNA-profiling information, another may do work relating to the analysis of footwear impressions, and another may provide computer and telecommunications services. Thus, different elements of a complex case may go to different providers. Since the market structure actively precludes communication between rival companies, and the articulation of the contextual detail that is essential to providing accurate results, CAI may be affected (see below). In addition, companies may specialise in different types of work. Routine work on high-volume crime may throw up the same complexities and difficulties as those relating to serious crime, but the decision to fully investigate these anomalies may be determined by budgetary constraints.

Forensic science providers will typically offer a range of services related to analytical biochemistry, including serology - the screening of evidence for bodily fluids – and DNA technologies, often with a prioritisation of the latter, though staff may be cross-trained to cover both disciplines.

The DNA-profiling process begins with the collection of samples at the crime-scene, a task that is performed by specially trained Scene-Of-Crime Officers (SOCOs). Alternatively, samples may be taken by police doctors, or by police officers taking samples from suspects at a police station. The samples themselves commonly include sexual assault kits, complainant clothing, bedding, suspect clothing, swabbings, weapons, or any items on which bodily fluids may have been deposited. Items may be put into sterile consumables intact, pieces may be removed from larger items or samples may be loaded onto a cotton swab for submission.

¹² <http://www.haywardforensics.co.uk/>

Samples arrive at the laboratory accompanied by a chain-of-custody document. This gives information relating to the source of the sample and the work to be undertaken by the laboratory. It is signed by the originating police officer, and is countersigned by the laboratory when they receive it, and any subsequent transfers must also be logged on the document.

Most commercial laboratories follow the 'casework' method of DNA-profiling and analysis. Casework involves careful planning and determination of 'customer' needs. Essentially, the laboratory director or a similarly qualified member of the laboratory management staff, will decide which items of evidence should be processed and the most effective way in which to process them. This plan may be based on knowledge of the contextual circumstances of the case, and may require further liaison with the investigating authorities. The laboratory manager, who has a budgetary responsibility, will arrive at a determination by weighing economic and evidentiary factors. Increasingly, the investigating authorities put a ceiling on the amount that of funds that they are willing to devote to a particular case, thus imposing a constraint on the work which can be done and the determinations which may be reached in respect of the collection of samples.

In some cases, the determination may be relatively straightforward. For instance, in a case of alleged rape, the presence of seminal fluid on swabs in a sexual assault kit may be highly probative of the *actus reus* of the alleged offence (but only the *actus reus*). Although this is an over-simplification, it is straightforward in comparison with other cases, especially those involving so-called 'touch DNA' or mixed samples. In these cases, a full appreciation of the surrounding facts will have to be made in order to plan an analysis. This plan may change as new details become available and may the CAI process thus allows for plans and hypotheses to undergo significant revision(s).

Homicide cases are comparatively complex, if only because the victim cannot verbally relate the details of the offence. Multiple items are generally submitted, and important case details are provided in order that an analysis can proceed in the most logical manner. In such cases the laboratory manager will determine whether items require serological screening or whether they can be sent directly for DNA analysis.

The actual process of DNA analysis involves various stages. First, the DNA has to be extracted from the sample. The extracted DNA is then 'amplified'. Essentially, the sample DNA is copied tens of millions of times using a technique known as PCR amplification. It is this 'analogue' DNA, literally constructed in the laboratory, which undergoes analysis. Using a system called a 'multiplex' the DNA analyst looks at a number of specially chosen sites on the genome. The genome consists of two types of material; genes - whose function is to pass on hereditary information - and extra-genetic material, known as 'junk DNA'. Junk DNA serves no currently discernable biological purpose. However, it is notable for containing repeated sequences of base-pairs, known as Short Tandem Repeats.¹³ The number of STRs at any given site varies from individual to individual. By counting the number of STRs at a number of particular sites, an analyst may construct a 'DNA profile' that is unique to a particular individual. In addition, sites containing extra-genetic material are independent from each other, whereas genes are linked. This feature is important for the purposes of statistical measurement.

The majority of the evidence processing and note-taking occurs during this initial biochemical analysis, as this is usually the first time that the evidence is opened in the laboratory. Laboratory analysts are responsible for documenting the type, quantity, and packaging of the evidence received. In addition, a description of the evidence - complete with notes, diagrams or pictures regarding the types of stains present and their location on each item - is placed into the case file. Serologists are also required to take detailed notes of their testing and outcomes. This documentation will be referenced during an analyst's testimony during criminal proceedings. Analysts are encouraged to take precise and thorough notes, especially given the fact that there may be a substantial gap between the completion of case analysis and an analyst's appearance in court to provide testimony. It is also important in circumstances where a different analyst must interpret the case notes.

Reports are written copies of an analyst's findings, and these should comprise an accurate representation of the results as they would be testified to during criminal proceedings. Results should be conservatively stated and should take into account guidelines established

¹³ An STR-site containing five short-tandem repeats may take the form ATCAATCAATCAATCAATCA.

by the forensic community and accrediting agencies. Reporting statements should also take into account the individuals who will be receiving the results. Police officers, lawyers for both parties, and jurors may find the scientific principles behind serology and DNA analyses difficult to interpret. For this reason, reporting statements should be clearly written and in layman's terms whenever possible. However, the scientist must be careful not to allow overtly subjective language to pollute her evaluations, even if subjectivity is present at every point in the process when a decision is required.

As previously stated, casework is a recursive process. The laboratory manager may hold meetings with analysts, seek advice from colleagues, offer advice on the correct interpretation of results, and seek further information and guidance from the investigative authorities, in order to factor in new information, perform further tests, and provide a more accurately represented output. At each and every stage, informed decisions have to be made, based on the analyst's experience, expertise, and communication with colleagues and the investigating authorities.

The laboratory manager may also be responsible for quality assurance. Alternatively, a dedicated quality assurance manager may be appointed, whose responsibilities are to ensure that the laboratory, staff and procedures reach agreed standards and comply with legislative and regulatory requirements. The forensic laboratory is now the subject of many of the same forms of governmental regulation that have been applied to other sectors and areas of social life. All forensic laboratories, whether commercially run, operated by police forces, or within the public sector, must be accredited by the United Kingdom Accreditation Agency (UKAS). According to UKAS, 'accreditation under ISO/IEC 17020 and 17025:2005¹⁴ is the only mechanism that determines the technical competence and integrity of the organisations offering forensic testing and inspection services.'¹⁵ UKAS also provide certification under ISO 9001:2008, a generic quality management system standard, which is applicable to many different organisations, including forensic science laboratories. While accreditation may show that, on a given day, a forensic laboratory's

¹⁴ This standard establishes general requirements for the competence of testing and calibration laboratories.

¹⁵ See UKAS : *Accreditation: A Tool to Support the Criminal Justice System* (2011) London: UKAS

testing, calibration and inspection services met a pre-ordained standard, UKAS caution that this 'should not be interpreted to mean that an organisation has demonstrated the technical competence to produce valid and accurate information and results.'¹⁶

Compliance with quality standards, and the monitoring of forensic laboratories, is the responsibility of the office of the Forensic Science Regulator. The regulator is a public appointee whose office is required to operate independently of the Home Office (through which it is sponsored). The regulator is supported by a team of 4 civil servants, three of whom are forensic scientists, with additional support provided by shared services from the Home Office and Home Office Science Secretariat. The regulator holds no legislative powers and employs a 'light touch' but is nonetheless required to ensure that forensic service providers comply with certain requirements relating to accreditation and quality assurance. The regulator also publishes guidance through working groups with particular foci (such as the End Users Working Group, DNA Working Group and Quality Assurance Working Group). Although the regulator's jurisdiction extends only to the forensic industry in England & Wales, both the Forensic Service of Northern Ireland and the Scottish Police Authority abide by her recommendations.

In addition to national recommendations, forensic science providers must take account of international developments. In order to facilitate the exchange of information and harmonisation of procedures across national boundaries - particularly the functioning of DNA databases - most FSP's are members of the European Network of Forensic Science Institutes (ENFSI).

The contribution of commercial forensic science laboratories towards scientific research also deserves mention. Daemmrich¹⁷ noted the forensic industry's commercial interest in developing marketable products which could become industry standards, while Lawless

¹⁶ See UKAS Calibration Brochure; <https://www.ukas.com/technical-services/publications/ukas-brochures-and-publicity-material/>

¹⁷ Daemmrich, A. *The Evidence Does Not Speak For Itself: Expert witnesses and the organization of DNA-typing companies*. *Social Studies of Science* (1998), 28, pp. 741-772

and Williams¹⁸ felt that commercial research was a largely performative activity that bore little real fruit. Nonetheless, there have been some interesting developments. LGC are at the forefront of developing the 'ParaDNA HyBeacons' screening system. This mobile DNA 'multiplex' allows a trained technician in the field to rapidly screen samples based on a limited set of three STR loci. The purpose of the ParaDNA system (currently undergoing a trial with West Yorkshire Police), is to triage samples at the scene of crime or an associated locus. Having screened and selected samples in the field, only those samples most likely to provide a match will be forwarded to the laboratory for analysis. The use of such a system may have a significant impact on the CAI process, since traces displaying incomplete profiles, low-template 'trace' evidence, and DNA mixtures - all of which could hold evidential value, if only to prove that no DNA is present - may all be discarded in favour of providing a single 'strong' source.

This overview of forensic science provision demonstrates the contingency and diversity of the field, and begins to explore the ways in which it is structured by the key dimensions outlined in the introduction; standardization, expertise, efficiency, and regulation. In the following section the study focusses on the process of DNA profiling in greater detail.

¹⁸ Lawless, C.J. & Williams, R. *Helping With Inquiries or Helping With Profits? The trials and tribulations of a technology of forensic reasoning*. *Social Studies of Science* (2010), 40, 731-755

Part Two: DNA Profiling

The evaluation of DNA-profiling evidence is constructed around a form of inferential reasoning derived from Bayes' theorem. It must be stressed that 'the Bayesian approach' is not a direct application of Bayes' theorem. Indeed, it may be argued that many iterations of Bayesian philosophy are better considered as sophisticated forms of hypothetico-deductivism developed from causal Markov chains.¹⁹ Indeed, Bayesian probabilistic methods should be seen as a form of inferential reasoning rather than a strict calculus. The method is based on the proposition that, while it is impossible to state with absolute certainty that a trace comes from a particular source, it is possible to draw inferences from the analytical results. Since there can only be two possibilities (match and non-match) the task for the forensic scientist is to evaluate the likelihood that each of these two mutually exclusive possibilities is correct. This is achieved by comparing pairs of propositions, in order to arrive at a likelihood ratio.

The likelihood ratio balances the likelihood of obtaining the particular analytical result (e.g. a DNA match) given that one proposition is true (e.g. the DNA from the blood found on the suspect's clothes comes from the victim), against the likelihood of obtaining the same result (a DNA match) given that the alternative proposition is true (the DNA from the

¹⁹ Discussed in following chapters.

blood found on the suspect's clothes does not come from the victim). Thus, the likelihood ratio expresses the weight of the evidence, rather than its accuracy.

The above example deals with a relatively common and straightforward pair of propositions. In such an example the pair of propositions typically translates to the respective prosecution, and defence, versions of events. However, more than one set of propositions can be constructed depending on the complexity of the case and the availability of information. Further, the Bayesian approach allows for the incorporation of contextual information which may lead to the modification of propositions, and the creation of successive hypotheses, which serve to nullify prior hypotheses. As such, the Bayesian 'inference engine' exhibits Popperian falsification (discussed below). The unique features of this calculi of causal reasoning are explored in the following section.

Standardisation through probabilistic evidence techniques

Epistemological theories of causality find their most concise expression in Hume, who notes that,

‘after a repetition of similar instances, the mind is carried by habit, upon the appearance of one event, to expect its usual attendant, and to believe that it will exist. This connexion, therefore, which we feel in the mind, this customary transition of the imagination from one object to its usual attendant, is the sentiment or impression from which we form the idea of power or necessary connexion.’²⁰

The mapping of the connections between causal beliefs and commonly-perceived effects, allows for the modelling of predictions, diagnoses, and accurate decisions, which allows agents to reason in the face of uncertainty. Within the forensic-scientific domain such reasoning is expressed through the use of probabilistic tools. Statistical translations thereby

²⁰ Hume, D. *An Enquiry concerning Human Understanding*, le Beauchamp, T. (Ed.) (New York: Oxford University Press, 1999), at Section 7.

comprise the strategic means by which the particular epistemic cultures stabilises and standardises the practice of forensic-scientific expertise.²¹

The literature relating to the use of probability models in forensic science - and the presentation of statistical evidence in court - is extensive, and predates the use of DNA ‘fingerprinting’ as a forensic tool. It is clear that the appearance of DNA on the forensic-legal field served merely to crystallise pre-existing debates relating to the accurate interpretation and exposition of probabilistic evidence, and to throw ongoing concerns into sharp relief. The body of literature devoted to the forensic use of statistics and probabilistic reasoning thus represents an ongoing attempt, by both academics and practitioners, to develop a coherent approach to the presentation of evidence derived from forensic techniques. In recent years this project has been most closely associated with a method of statistical reasoning based on the use of Bayes’ Theorem.²²

As stated above, Bayes theorem offers forensic scientists the means to reason in the face of uncertainty. While probabilistic reasoning always starts with a hypothesis and follows a series of well-defined arguments to reach a conclusion that is guaranteed to be true, statistical reasoning starts with some observations and tries to use them to infer something about the wider world. This inference is not guaranteed to be true and so we say that it has a probability of being true. Note that the use of probability is not the same as probabilistic.

Inductive inference means that we take some available evidence and extend it to form a conclusion. Because this is inductive inference, we cannot be 100% certain that the conclusion made is a result of well-defined logical steps from a hypothesis. Therefore, we attach a likelihood or a probability of our conclusion being true. Therefore, inductive inference falls under the umbrella of statistical reasoning. This kind of inference involves reasoning in the face of uncertainty and hence a probability that the result will be true.

²¹ Haack, S. *Irreconcilable Differences? The Troubled Marriage of Science and Law* (2009) 72 Law and Contemporary Problems 1.

²² Bayes’ Theorem is a mathematical formula that can be applied to update probabilities of particular issues in the light of new evidence. Bayesian methods are further explained at section 1.4.4.

Bayes theorem is a mechanism which allows us to infer something about A (which we cannot observe) from B (something we can observe). Since we are making an inference about A using the available evidence given by B we have some uncertainty that A is really true. Bayes theorem calculates the probability of A being true given that we know B is true. There is no guarantee that B being true will imply that A is also true, and as a result this method must belong to inductive inference.

Redmayne describes the widespread use of such methods as ‘the Bayesian Turn in forensic science.’²³ He traces the ‘Bayesian turn’ to a paper presented to the Royal Statistical Society in 1977, in which Lindley²⁴ - using the example of the interpretation of glass evidence - championed the use of Bayesian, as opposed to classical, statistics. In this paper, Lindley laid out the problems associated with the use of classical statistics. The main problem can be put in statistical terms, as follows: when attempting to place a value within a normal distribution curve around the benchmark value, the standard deviation limits (i.e. the limits of error) around the mean are treated - in classical statistics - as absolute limits. What this means is that the scientist can only declare two possibilities: a match and a non-match. If a source sample and a reference sample are compared and the data fall within a certain range they will be treated as matching perfectly, and vice versa. Conversely, a value falling just beyond these limits is completely discounted. This ‘fall-off-the-cliff’ effect appears to be predicated on an arbitrary criterion: the standard deviation limit set by the examiner. Lindley’s approach was to employ Bayesian statistics in order to prevent evidence from falling of the probabilistic cliff.

The Bayesian approach is markedly different. As stated above, it incorporates similarities and differences between two samples, in addition to other factors, expressing these differences in terms of a likelihood ratio, which measures the probative force of a particular piece of evidence relative to two hypotheses. Without going into the technicalities of Bayesian analysis (of which there are many) it will serve present purposes to state that Bayes’ theorem adds precision but is still dependant on contextual background information,

²³ Redmayne, M. *Expert Evidence and Criminal Justice* (2001), Oxford: Oxford University Press

²⁴ Lindley, D.V. ‘*Probability and the Law*’ (1977) 26, *The Statistician*, 203 at p.211

and invites the scientist to ask different questions regarding the object of analysis. It also requires that the investigator solicits different sorts of information with regard to the crime. However, the use of Bayesian statistical methods does not dispense with the need to make assumptions, and the results will be affected by those assumptions.

The persistence of subjectivity in arriving at assumptions against a background of incomplete and imperfect knowledge has been the subject of concern amongst academics. Evett²⁵, Redmayne²⁶, Taroni and Aitken²⁷, addressed this issue, whilst Hacking²⁸ and Cohen²⁹ attempted to add philosophical context, raising awareness that there exists a long-running philosophical dispute with regard to the qualitative nature of probability.

The problem crystallises around the use of Bayesian statistics to arrive at a 'likelihood ratio' based on the prior and posterior odds relating to a particular proposition. In order to determine the likelihood ratio it will be necessary to determine the size of the 'suspect population' from which the crime sample is believed to originate. 'Suspect population' is a problematic term insofar as it suggests that all people within a defined group are equally likely (before any other evidence is obtained) to have committed the crime, and that those outside the group could not have committed the crime. However, common sense would suggest that a suspect living within five miles of the locus might be more likely to have committed the libeled crime than a suspect five hundred miles distant.³⁰ It is clear that the use of Bayes' theorem in the criminal justice system is subject to evidential premises that carry broad implications. As Tillers states, 'it is in fact the case that the most complex

²⁵ Evett, I.W. *Expert Evidence and Forensic Misconceptions of the Nature of Exact Science*, (1996) 36 *Science and Justice* 118

²⁶ Redmayne, M. *Expert Evidence and Criminal Justice* (2001), Oxford: Oxford University Press

²⁷ Taroni, F. & Aitken, C.G.G. *Forensic science at trial*, *Jurimetrics* 37 (1997) 327–337; Taroni, F. & Aitken, C. *Probabilistic Reasoning in the law. Part 1: Assessment of Probabilities and Explanation of the Value of DNA Evidence* (1998) *Science & Justice*. 38, 3, p. 165-77

²⁸ Hacking, I. (1999) *The Social Construction of What?* (Cambridge, MA: Harvard University Press)

²⁹ Cohen, J.L., *Can Human Irrationality be Experimentally Demonstrated?*, (1981) 4 *Behavioural and Brain Sciences*, 317, 329-330

³⁰ Donnelly, P. & Friedman, R.D., *DNA Database Searches and the Legal Consumption of Scientific Evidence* 97 *Michigan Law Review* 931 1998-99

argument about inferences from evidence rests on almost innumerable personal and subjective judgements.³¹

These implications were recognized before the advent of DNA profiling. As early as 1970, Finkelstein and Fairley proposed the use of Bayes' theorem in criminal cases.³² Their suggestion prompted a 'rhetorically powerful and multipronged attack' from Professor Laurence Tribe of Harvard Law School on what he called 'trial by mathematics'.³³ Tribe's criticisms of the use of probability theory to model factual inferences were as follows:

1. Bayes' theorem makes precise what is inherently imprecise.
2. Bayes' theorem makes objective what is subjective.
3. Trial by mathematics and statistics is morally and socially offensive.
4. Lay triers of fact cannot understand Bayes' Theorem.
5. Numbers tend to dwarf soft variables.
6. Bayesian analysis ignores the possibility of source uncertainty.

Tribe's arguments are interesting insofar as they go beyond mere technicalities, drawing on moral, social and philosophical grounds relating to the nature of subjective human reasoning and its place in the criminal trial. They were also largely successful, at least in the short term. Despite a flurry of rejoinders from Finkelstein and Fairley it seemed to most legal scholars that Tribe had succeeded in putting the lid back on Pandora's box.

As Twining notes³⁴, since 1977 the debate has centred around a more fundamental issue. Cohen³⁵ has suggested that there is more than one form of probabilistic reasoning. He posits the existence of a non-mathematical mode which he terms Baconian probability, in

³¹ Tillers, P. *Trial by Mathematics – Reconsidered* Law, Probability & Risk (2011) 10, 167-173

³² Finkelstein, M.O. & Fairley, W. *A Bayesian Approach to Identification Evidence* 83 Harvard Law Review 489 (1970)

³³ Tribe, L. *Trial by Mathematics: Precision and Ritual in the Legal Process* 84 Harvard Law Review 1329 (1971)

³⁴ Twining, W. (2006), *Rethinking Evidence*, (Cambridge: Cambridge University Press), at page 127

³⁵ Cohen, L.J. (1977) *The Probable and the Provable* (Oxford: Oxford University Press)

addition to the standard mathematical mode which he terms Pascalian probability. Further, he asserts that Baconian probability is commonly used by lawyers when reasoning about facts under conditions of uncertainty, in forensic contexts. Cohen's arguments have drawn criticism from both Eggleston³⁶ and Glanville Williams³⁷, who retort that there can be no more than one mode of probabilistic reasoning and that Cohen's conclusions are unsupported by his reasoning. Further, that the Baconian mode may be accounted for within the Pascalian mode.³⁸

The appearance of DNA-profiling evidence on the forensic field has altered the nature of the debate considerably and those moral, social and philosophical arguments - which had previously characterised the debate – have tended to wilt in the face of new developments. From the advent of DNA profiling academic debate has become grounded in more pragmatic concerns, particularly around the 'correct' presentation of DNA-profiling evidence. Academics have attempted to posit a variety of guidelines for the exposition of statistical evidence, as have the courts. The literature on the presentation of evidence - and the ability of the trier-of-fact to understand such evidence - is quite considerable, the debate centering around the communication of statistical information, which can be constructed in a variety of ways. It may be communicated as a match probability or a likelihood ratio, though a brief survey of cases has thrown up a whole variety of terms (statistical probability, statistical likelihood, likelihood ratio, frequency ratio, frequency, random occurrence ratio) and the latter term has now gained widespread acceptance.

However, the purpose of this thesis is not to consider the relative utility of alternative forms of inferential reasoning, and their translation and expression (though this forms an integral part of the discussion and analysis). Rather, it aligns with Lawless indication of 'the potential for qualitative ethnographic studies to uncover finer practices which underpin performative aspects of consciously 'Bayesian' reasoning, but which evade the gaze of philosophical accounts and models presented in technical journal articles.'³⁹ With this in

³⁶ Eggleston, R. (1978) *Evidence, Proof and Probability* (Weidenfeld and Nicolson)

³⁷ Glanville-Williams, *The Mathematics of Proof I* (1979) *Criminal Law Review*, 297

³⁸ See Twining, W., *Debating Probabilities The Liverpool Law Review*, (1980), Vol.2(1), pp.51-64

³⁹ Lawless, C. (2016) *Forensic Science: A sociological introduction* (Routledge: London) at p.97

mind, discussion turns to the evaluation of DNA profiling evidence in context, followed by an account of the Case Assessment and Interpretation process.

The ‘hierarchy of propositions’

The construction of DNA profiling evidence begins at the earliest stage of a criminal investigation. Investigators select particular items of evidence in accordance with their own experience and overarching investigative protocols. Crime scene technicians thereby begin the process of turning the material scene into what Latour labels ‘inscriptions’⁴⁰, i.e. written traces. Once the evidence has been collected it is stabilized, and moved to the laboratory. The forensic science laboratory acts as a crucible in which evidence undergoes further refinement before being translated into a tangible product for consumption within the courtroom. It is here that source materials are converted into statistical data. This is also the site of conflict between traditional scientific methods, economic imperatives, and regulatory protocols.

Scientific truth claims regarding DNA evidence are currently explicated using Bayesian probabilistic reasoning. Indeed, the Bayesian approach to probabilistic reasoning is now a central feature of DNA ‘casework’. Bayesian reasoning derives its strength from its flexibility, and its capacity to assimilate new facts under fresh hypotheses. Rather than applying a rigid formula, the forensic scientist - taking into account the surrounding facts of the case – is freed to construct various sets of alternative propositions. Therefore, the construction of propositions under the Bayesian approach is highly dependent on context. Although this approach is designed to promote a balanced view of the evidence (and achieves a degree of transparency in respect of its underlying assumptions) the framing of alternative propositions remains a difficult process. As Cook (1998) states,

⁴⁰ Latour, B. & Woolgar, S. (1986) *Laboratory Life: The Construction of Scientific Facts* 2nd Ed. (Princeton: Princeton University Press)

‘In practice, the propositions that are addressed will depend on the circumstances of the case, the observations that have been made, background data that is available and the domain of expertise of the scientist.’⁴¹

These propositions fall into four major categories, which together form a ‘hierarchy of propositions’: Sub-Source (Level 0), Source (Level I), Activity (Level II) and Offence (Level III). Examples of propositions from these generic classes are given below:

III	Offence	Miss X assaulted Mr Y
II	Activity	Miss X is the person who stabbed Mr Y
I	Source	The blood on Miss X’s clothing came from Mr Y
0	Sub-source	The DNA on Miss X’s clothing came from Mr Y

Level 0 and I propositions are made from observations, measurements and analyses. The prosecution proposition will be determined from a comparison between two samples, and the defence proposition will be determined by considering one of these samples in reference to an external population (such as the National DNA Database, NDNAD).

Level II propositions relate to activities. These too are based on observations, measurements and analyses. However, in order to construct an activity proposition the scientist must take account of the circumstantial framework. The scientist will need to exercise judgment in relation to the construction of Level II propositions and will require as much information as possible regarding the circumstances of the case. This will entail some degree of interaction between the forensic scientist and the investigator or prosecutor.

Another notable feature of Level II propositions is that they may be constructed in respect of a complete absence of source material. They might also take into account the possibility of contamination or the manufacture of evidence.

Level III propositions relate to the commission of offences. The forensic scientist, in his capacity, as expert witness, is forbidden from expressing an opinion on the ultimate issue.

⁴¹ Cook, R., Evett, I.W., Jackson, G, Jones, P.J. & Lambert, J.A. *A Model for Case Assessment and Interpretation* Science & Justice (1998) 38 151-156 at p. 151

However, the three generic grades are not rigidly demarcated and it may be possible to construct propositions which approach the ultimate issue without encroaching on the responsibilities of the trier-of-fact.

An analysis based on Level II (activity) propositions will be of greater use to the customer than a Level I analysis that is confined to source material and may also offer greater value for money. Forensic scientists are therefore encouraged to address their analyses to the highest propositional level possible, stopping short of an opinion on the ultimate *probandum*:

‘...in some cases the scientist might be able to address propositions which are quite close to the deliberations of the court such as ‘this is the person who murdered the victim’; in other cases it might be necessary to settle for propositions further removed from the ultimate issue such as ‘these fibres came from that garment.’’⁴²

As the forensic scientist ascends the scale of propositions she must solicit a greater amount of contextual information from the customer. However, the shift in focus from Level I (source) to Level II (activity) propositions may also be viewed as an attempt by forensic experts to claim ownership of the actual process of contextualisation, in preference to lawyers or triers-of-fact.⁴³

‘The probative value of scientific findings depends on the propositions that they are taken to be addressing. If scientists were always to restrict their interpretations to *source* level issues and propositions they would effectively be trusting other criminal justice professionals, or fact-finders themselves, to contextualise the scientific findings and interpret them correctly...It must at least be seriously open to question whether lawyers and courts are currently sufficiently well-informed about the relational nature of scientific evidence or calculations of likelihood ratios to perceive

⁴² Cook, Evett, Jackson & Jones (1998) at p. 153

⁴³ Thus, with the introduction of CAI, a subtle shift in the balance of power between lawyer and scientist takes place, as the latter ascends the propositional ladder and demarcates an indispensable role for herself within the criminal justice system.

these evidential subtleties, and fully to appreciate their forensic significance, without expert assistance.’⁴⁴

The Case Assessment and Interpretation (CAI) Method

The ‘case assessment and interpretation model’ was designed around the hierarchy of propositions. It may appear relatively unproblematic when presented in its basic form. However, both its history and practical application reveal some areas of concern. CAI was developed by a management and advisory working group within the Forensic Science Service. The objective of the model was,

‘To enable decisions to be made which will deliver a value for money service meeting the needs of our direct customers and the Criminal Justice System.’⁴⁵

Case Assessment and Interpretation was designed to proceed through three interlinked phases - customer requirement, case pre-assessment and service delivery – all of which are inscribed with those discourses of economic rationality discussed in the opening section: During the first phase (customer requirement) the customer’s needs are determined in relation to economic imperatives. This requires that the scientist open up a dialogue with the customer in order to form an appraisal of the circumstances of the case, the kinds of examinations which can be conducted, and what might be expected from them. The scientist also solicits information with regard to the suspect in order to maintain a balanced view, though this is mediated through the investigative authorities.

The next phase of CAI, case assessment, is seen as a natural extension of the determination of customer requirements. At this point the scientist is required to tighten up the formulation of pairs of propositions in light of the information solicited from the customer, and the latter’s requirements. At this point, the scientist is encouraged to document his expectations, these notes forming an integral part of the final written report.

⁴⁴ Para 2.40 of Jackson, G., Aitken, C. & Roberts, P. (2015) *Practitioner Guide 4 - Case Assessment and Interpretation of Expert Evidence*, Royal Statistical Society’s Working Group on Statistics and the Law

⁴⁵ Cook, Evett, Jackson & Jones (1998) at p. 153

The final phase, service delivery, accounts for the forensic scientist's main examination. Products are commissioned in light of prior assessments, and - following a consultation with the customer - source material is analysed, results are interpreted, and a report is drafted. The fact that the expectations were noted before the examination is carried out is a measure designed to counter any accusations of *post hoc* rationalisation. However, this safeguard is compromised by the recursive, as opposed to linear, nature of the CAI process.

A central feature of the Bayesian approach is its flexibility and its capacity to assimilate new facts under fresh hypotheses. Rather than simply applying a formula, the forensic scientist - taking into account the surrounding facts of the case - may construct various sets of alternative propositions. Therefore, the construction of propositions under the Bayesian approach is highly dependent on context. Although this approach is designed to promote a balanced view of the evidence, and achieves a degree of transparency in respect of its underlying assumptions, the framing of alternative propositions remains a difficult process. As Cook (1998) states,

‘In practice, the propositions that are addressed will depend on the circumstances of the case, the observations that have been made, background data that is available and the domain of expertise of the scientist.’⁴⁶

These propositions fall into three major categories, which together form a ‘hierarchy of propositions’ : Source (Level I), Activity (Level II) and Offence (Level III). Examples of propositions from these generic classes are given below:

III	Offence	Miss X assaulted Mr Y
II	Activity	Miss X is the person who stabbed Mr Y
I	Source	The blood on Miss X's clothing came from Mr Y

Level I propositions are made from observations, measurements and analyses. The prosecution proposition will be determined from a comparison between two samples, and

⁴⁶ Cook, Evett, Jackson & Jones (1998) at p. 151

the defence proposition will be determined by considering one of these samples in reference to an external population (such as the National DNA Database, NDNAD).

Level II propositions relate to activities. They too are based on observations, measurements and analyses. However, in order to construct an activity proposition the scientist must take account of the circumstantial framework. The scientist will need to exercise judgement in relation to the construction of Level II propositions and will require as much information as possible regarding the circumstances of the case. This will entail some degree of interaction between the forensic scientist and the investigator or prosecutor.

Another notable feature of Level II propositions is that they may be constructed in respect of a complete absence of source material. They might also take into account the possibility of contamination or the manufacture of evidence.

Level III propositions relate to the commission of offences. The forensic scientist, in his capacity, as expert witness, is forbidden from expressing an opinion on the ultimate issue. However, the three generic grades are not rigidly demarcated and it may be possible to construct propositions which approach the ultimate issue without encroaching on the responsibilities of the trier-of-fact.

The case assessment and interpretation model may appear relatively unproblematic when presented in its basic form. However, its history and practical application reveal some areas of concern. CAI was developed by a management and advisory working group within the Forensic Science Service. The objective of the model was,

‘To enable decisions to be made which will deliver a value for money service meeting the needs of our direct customers and the Criminal Justice System.’⁴⁷

Case Assessment and Interpretation proceeds through three interlinked phases - customer requirement, case pre-assessment and service delivery – all of which are inscribed with those discourses of economic rationality discussed in the opening section: During the first phase (customer requirement) the customer’s needs are determined in relation to economic imperatives. This requires that the scientist open up a dialogue with the customer in order

⁴⁷ Cook, Evett, Jackson & Jones (1998) at p. 153

to form an appraisal of the circumstances of the case, the kinds of examinations which can be conducted, and what might be expected from them. The scientist also solicits information with regard to the suspect in order to maintain a balanced view, though this is mediated through the investigative authorities.

An analysis based on Level II (activity) propositions will be of greater use to the customer than a Level I analysis that is confined to source material and may also offer greater value for money. Forensic scientists are therefore encouraged to address their analyses to the highest propositional level possible, stopping short of an opinion on the ultimate *probandum*:

‘...in some cases the scientist might be able to address propositions which are quite close to the deliberations of the court such as ‘this is the person who murdered the victim’; in other cases it might be necessary to settle for propositions further removed from the ultimate issue such as ‘these fibres came from that garment.’⁴⁸

As the forensic scientist ascends the scale of propositions she must solicit a greater amount of contextual information from the customer. However, the shift in focus from Level I (source) to Level II (activity) propositions may also be viewed as an attempt by forensic experts to claim ownership of the actual process of contextualisation, in preference to lawyers or triers-of-fact.

‘The probative value of scientific findings depends on the propositions that they are taken to be addressing. If scientists were always to restrict their interpretations to *source* level issues and propositions they would effectively be trusting other criminal justice professionals, or fact-finders themselves, to contextualise the scientific findings and interpret them correctly. But...the probative value of scientific findings addressed to source level propositions may *appear* considerably weaker...than if the same findings are presented in terms of activity level propositions. It must at least be seriously open to question whether lawyers and courts are currently sufficiently well-informed about the relational nature of scientific evidence or calculations of

⁴⁸ Cook *ibid* at page 153.

likelihood ratios to perceive these evidential subtleties, and fully to appreciate their forensic significance, without expert assistance.’⁴⁹

Thus, a shift in the balance of power between lawyer and scientist takes place as the latter ascends the propositional ladder, and scientists demarcate an indispensable role within the criminal justice system.

The next phase, case assessment, is seen as a natural extension of the determination of customer requirements. At this point the scientist is required to tighten up the formulation of pairs of propositions in light of the information solicited from the customer, and the latter’s requirements. At this stage, the scientist is encouraged to document his expectations, these notes forming an integral part of the final written report.

The final phase, service delivery, accounts for the forensic scientist’s main examination. Products are commissioned in light of prior assessments, and following a consultation with the customer. Source material is analysed, results are interpreted, and a report is drafted. The fact that the expectations were noted before the examination is carried out is a measure designed to counter any accusations of *post hoc* rationalisation. However, this safeguard is compromised by the recursive, as opposed to linear, nature of the CAI process.

The CAI model, being designed to meet customer requirements, has a strong iterative element. The propositions and expectations laid down in the second phase are subject to review, reframing and modification in light of the results of the material analysis and the availability of new information. The FSS stated that,

‘There are many reasons why both propositions and expectations might change as a result of unexpected developments during the examination. There should be a continuous process of review and, where necessary, further consultation with the customer.’⁵⁰

⁴⁹ Para 2.40 of Jackson, G., Aitken, C. & Roberts, P. (2015) *Practitioner Guide 4 - Case Assessment and Interpretation of Expert Evidence*, Royal Statistical Society's Working Group on Statistics and the Law

⁵⁰ Cook, Evett, Jackson & Jones (1998) at p. 153

Evetts and Jackson⁵¹ provide a series of case studies, which illustrate the ways in which mutually exclusive pairs of propositions may be revised and refined in order to take account of new information. The following example is adapted from one such study.

An armed robbery was carried out on a post office by masked men, who left the incident in a stolen vehicle. Eyewitnesses saw clothing being discarded from the car as it drove off. One of the items of clothing was a balaclava. The following day, a suspect was interviewed. He denied any involvement in the robbery. He said that the balaclava was not his and that he had never worn such an item. A DNA swab was taken from the suspect and submitted for examination against traces found on the balaclava.

The circumstantial framework in this case concerns material that may have been transferred from the suspect to an object associated with the locus, and time is relevant to the interpretation of the evidence. The scientist is tasked with framing a pair of propositions, and the framework of circumstances suggests that she is justified in addressing level II propositions, which might take the form:

The suspect was wearing the balaclava on the day of the robbery.

The suspect has never worn the balaclava.

These two propositions represent the prosecution and defence accounts of the incident. In this case the likelihood ratio will be determined by considerations based on the presence of DNA on fibres.

The above example shows how the propositions are determined to a significant degree by anything the suspect might say. If, under further questioning, the suspect changes his story then, the propositions must change to account for the change. If the suspect revises his story, claiming that he does own the balaclava but that he was not wearing it on the day of the robbery - and had not worn it for some weeks - then the propositions must now be expressed as follows.

⁵¹ Evetts, I.W., Jackson, G. & Lambert, J.A., *More on the Hierarchy of Propositions: exploring the distinction between explanations and propositions*, Science & Justice (2000); 40 (1): 3-10

The suspect was wearing the balaclava on the day of the robbery.

The suspect was wearing the balaclava a few weeks before the robbery.

In this revised analysis, the likelihood ratio will be determined by considerations based on the *persistence* (rather than the *presence*) of DNA on fibres.

The above example demonstrates the significance of ongoing communication and collaboration between the investigating authorities and the forensic scientist, allowing the latter to construct case propositions that accurately reflect the existing case theory and which can be adapted to take account of, and incorporate, new contextual information. Evett, *et al*, prescribe an ideal mode of forensic investigation and evaluation. As demonstrated above, collaboration and feedback are also regarded as necessary for the efficient and timely management of the casework process. The customer ‘has a greater participation than hitherto in decisions about what work is done in the laboratory,’⁵² and dictates the direction of the evaluative process by ordering a particular forensic test, or ‘product’. Before ordering a test (or series of tests) to be carried out, the forensic scientist will provide some indication as to the sorts of inferences that can be made from the possible results, and their potential probative value. This allows the customer to make an informed decision as to the desirability of conducting particular tests, and to allocate resources accordingly.

Analytical problems associated with the allocation of limited resources may be aggravated by technological and physical factors, both of which can increase the cost, complexity, and probative value of a forensic analysis. The dramatic increase in the sensitivity of DNA profiling systems has enabled them to construct DNA profiles from very small quantities of ‘touch’, or Low Template DNA. However, when dealing with minute traces of DNA evidence it can become difficult to differentiate ‘signal’ from ‘noise’. This can place demands on the CAI process which are exacerbated when DNA profiling evidence is transferred to the courtroom. The following section focusses on some of the challenges which the courts face when dealing with the issue of transfer and persistence of DNA, and mixed DNA profiles.

⁵² Cook, Evett, Jackson & Jones (1998) at p. 152

To summarise, the ‘customer-directed’ nature of the casework process appears to introduce economic and commercial factors into the process of forensic analysis which may impinge on the evaluative process: since the creation of propositional pairs is highly dependant on the availability of contextual information, and the collection of samples and background information is determined by economic factors (and a perceived scarcity of resources), then it may be posited that the evaluative process itself might be directly affected by operational determinations.⁵³ Further, while the exercise of forensic expertise becomes standardised through adherence to a process which is structured around the need to deliver value to the perceived customer, the introduction of such a process could itself be seen as an attempt to retain control of the evaluation of forensic DNA profiling evidence within the overarching process of marketisation. In the next section, that overarching process is defined.

⁵³ Lawless, C.J. & Williams, R. *Helping With Inquiries or Helping With Profits? The trials and tribulations of a technology of forensic reasoning*. *Social Studies of Science* (2010), 40, 731-755; Lawless, C. (2010). *A Curious Reconstruction? The Shaping of ‘Marketized’ Forensic Science*. CARR Discussion Paper 63; Lawless, C. *Policing Markets; the Contested Shaping of Neo-Liberal Forensic Science*. *British Journal of Criminology* (2011) 51, 671-689

Part Three: Marketisation of Forensic Science Provision

Having given a comprehensive account of the process of DNA profiling (perceptions of which under developed marketisation are the focus of this study), it is next necessary to define what is meant by ‘marketisation’. The terms marketisation, commercialisation, and privatisation, are employed in a variety of contexts, and are frequently used with ambiguity and imprecision. Powell and Miller note that much of the literature makes empirical claims on the basis of definitions which are ‘absent at worst, or rather shaky at best.’⁵⁴ Further, Starr points out that marketisation is often conflated with cognate terms such as privatisation, and commercialisation.⁵⁵ However, as will be demonstrated, these distinct terms are neither synonymous, nor interchangeable.

Starr distinguishes the three terms, noting that privatisation properly refers to a ‘shift from the public sector to the private sector, not a shift within a sector’.⁵⁶ Therefore, the shift from a state forensic science agency to a state-owned forensic science enterprise with ‘GovCo’ status does not fall within the ambit of privatisation, as described. He categorises intra-sectoral developments, of the type outlined in the above example, as examples of ‘commercialisation’, which - he stresses - may yet serve as a preliminary stage to

⁵⁴ Powell, M. & Miller, R. *Framing Privatisation in the English National Health Service* (2014) *Journal of Social Policy* (2014), 43, 3, 575–594, at p. 576

⁵⁵ Starr, P. (1988), *The meaning of privatization*, *Yale Law and Policy Review*, 6: 6–41

⁵⁶ Powell and Miller, *ibid*, at p.576

privatisation.⁵⁷ Peedell makes a similar distinction, contrasting privatisation with marketisation, and noting that privatisation is a relatively restricted term referring specifically to the change in ownership of public assets, through ‘which non-state actors become increasingly involved in provision...or an increase in work contracted out.’⁵⁸ This definition – which encapsulates the process of winding down the Forensic Science Service by stages, and transferring provision to private providers - corresponds with that used by Krachler and Greer, who describe privatisation in similar terms, as a specific process through which ‘ownership of public assets (services, organisations, land, buildings, equipment, information and intellectual knowledge) are sold or transferred to the private or voluntary sector.’⁵⁹

Marketisation - as compared with both privatisation and commercialization - is understood to represent a broader, and more complex, concept. It has been defined as ‘a change in transactions, through the introduction or intensification of price-based competition.’⁶⁰ Such ‘changes in transactions’ - encompassing changes to employment contracts, training, working conditions, quality control, products, and services - may be implemented through a variety of mechanisms; specifically,

‘an increase in the standardisation of the good or service being exchanged, the frequency of exchange, the openness of the market to new providers, and/or the transparency and importance of the price mechanism.’⁶¹

Thus, fully marketised transactions are defined as those ‘in which actor choices are made purely on the basis of price (see Chapter Five on the efficiency of Streamlined Forensic

⁵⁷ Excluded from this definition are ‘hybrid’ organisations, such as Foundation Trusts, because they remain part of the state.

⁵⁸ Peedell, C. (2011), ‘*Further privatisation is inevitable under the proposed NHS reforms*’, *British Medical Journal*, 342: d2996.

⁵⁹ Krachler, N. & Greer, I. *When does marketisation lead to privatisation? Profit-making in English health services after the 2012 Health and Social Care Act* (2015) *Social Science & Medicine*, Vol. 124, issue C, pp. 215-223, at p.216

⁶⁰ Krachler & Greer, *op cit*.

⁶¹ Krachler & Greer, *op cit*.

Reporting), the good or service in question is standardised (see Chapter Four on the standardization of forensic products and services), exchanges are frequent, and competition is open to a wide range of participants.⁶² Economists have sought to analyse marketisation using theories of market failure, public choice, property rights and the principal-agent approach. However, as Krachler and Greer point out, studies of privatisation and marketisation ‘cannot be limited by economic theory alone because it has equally important political and social dimensions.’⁶³ Further, since marketisation may encompass elements of both commercialisation, and privatisation. studies of economic dimensions will necessitate discussion of the political and social dimensions. Krachler and Greer highlight their interrelatedness;

‘a focus on privatisation to the exclusion of marketisation is inadequate. Privatisation and marketisation are inseparable, the latter encompasses the economic and ideological conditions and social relations through which further privatisation is developed.’

The most comprehensive definition is that provided by Whitfield, who describes marketisation as a process based around the imposition of market forces in those public services, which have traditionally been planned, delivered, and financed by local and central government. This process has five key elements:

1. The commodification of services and infrastructure, often through standardisation.⁶⁴
2. The commodification of labour and expertise such as the reorganisation of work and jobs to maximise productivity and efficiency, and to assist transfer to another employer.⁶⁵
3. Restructuring the sector for competition and market mechanisms.⁶⁶

⁶² Greer, I. & Doellgast, V. *Marketisation, inequality, and institutional change: Toward a new framework for comparative employment relations* (2013) *Journal of Industrial Relations* 59(3)

⁶³ Krachler and Greer, *ibid*

⁶⁴ See Chapter Four on Standardisation

⁶⁵ See Chapter Five on Expertise, and Chapter Six on Efficiency.

⁶⁶ See n.62, above.

4. Restructuring democratic accountability and user involvement, often through regulation.⁶⁷

5. Embedding business interests.⁶⁸

The presence of these five key elements can be discerned in Krachler and Greer's study of the English National Health Service following the introduction of the Health and Social Care Act 2012 (which provides a foretaste of the major themes which will be discussed in the instant study). They highlight the way in which, following the introduction of a process of marketisation,

‘Efficiencies [were] gained through managing staff differently from the NHS. Low pay in the NHS [was] compensated with a high degree of professional autonomy, which reinforced a public-sector ethos and upheld quality standards.’⁶⁹

In contrast, marketisation led to ‘tight performance management’. Lower personnel costs resulted from employing lower-skilled workers, this deskilling complemented by an increased turnover derived from the implementation of lean management techniques. Control was facilitated through standardisation, and further efficiencies were gained through intensive asset utilisation, specialisation, and streamlining. These processes ultimately led to difficulties in demonstrating quality, pointing to a need for regulation.

Despite the forensic science sector in England and Wales having undergone a process of marketisation that is unique in global terms, studies of the marketisation of forensic science provision are scarce. Following his work on the Runciman Commission, and the completion of ‘the Bristol Study’ into forensic science in the criminal justice system in England and Wales Paul Roberts considered the dangers of introducing a free market in forensic science services.⁷⁰ Roberts made a passionate call for retained government control

⁶⁷ See Chapter Seven on Regulation

⁶⁸ Whitfield, D. (2006) *A Typology of Privatisation and Marketisation*, ESSU Research Report No. 1, (European Services Strategy Unit)

⁶⁹ Krachler and Greer, quoting Hyde *et al* 2009

⁷⁰ Roberts, P. 1996. What price a free market in forensic science services? The organization and regulation of science in the criminal process. *British Journal of Criminology* 36: 37–60.

which would, he opined, ‘stick in the gizzard of true free marketers.’⁷¹ He argued against the private provision of forensic science services which, he predicted, would lead to a low quality service, and low levels of innovation, resulting from the introduction of profit as the ultimate goal. This ran counter to the assertion of market proponents that competition enhances quality and efficiency. Indeed, Roberts argues that privatisation may create a market with a low level of competition, wherein one dominant company acts as a virtual monopoly alongside a number of smaller, and less competitive, providers. A further objection, which Roberts believes to be the most serious, is that markets are - in reality - imperfect mechanisms, which will therefore fail to deliver perfect outcomes. Due to such systemic problems, the defined consumers of forensic services – police, or defendants - may not make the best choices when deciding which forensic services to purchase. Indeed, Roberts argues that substandard forensic services will be purchased due to the introduction of market forces which foreground costs and benefits.⁷²

Applying the definitions previously discussed, Roberts study could be characterised as one focussing on planned privatisation, taking place in the shadow of turbulent intra-sectoral development, or commercialisation. His predictions had yet to materialise, and his focus is restricted to the mechanism, and consequences, of privatisation. This takes place in the absence of a more theoretical discussion of marketisation. Roberts does not consider the role of regulation in contributing to quality assurance, nor the ways in which streamlining might deliver efficiencies against a background of budgetary cuts.

Roberts is not alone. Lawless’ study of commercialisation, and imminent privatisation, in the forensic sector, is based on interviews conducted between 2006, and 2010, the year in which the Forensic Science Service was privatised.⁷³ Thus many of the elements of developed marketisation (such as regulation, and streamlining), had yet to materialise.

⁷¹ Roberts, *ibid*, at page 52

⁷² Roberts, P. 1996. What price a free market in forensic science services? The organization and regulation of science in the criminal process. *British Journal of Criminology* 36: 37–60.

⁷³ Lawless, C.J. & Williams, R. *Helping With Inquiries or Helping With Profits? The trials and tribulations of a technology of forensic reasoning*. *Social Studies of Science* (2010), 40, 731-755

Lawless highlights the importance of Case Assessment and Interpretation – a novel forensic evaluative process which was introduced to standardise, and bring efficiency, to forensic science provision, whilst allowing the reporting scientist to retain a degree of control over the case analysis. Nonetheless, as stated above, due to the appearance of this study at an intermediate – if not nascent - stage of the marketisation process, Lawless was unable to comprehensively gauge the marketisation of forensic services across all of its key elements. The omissions of these studies points to a need for a study of marketised forensic science production which surveys all of the key elements. As will be demonstrated below, such an account may only be feasible within the context of a developed market.

The problem noted above are compounded by the structural differences between growing markets, and mature markets. Proponents of the ‘product life cycle’ paradigm have noted significant structural differences between growing, and mature, markets. As the market transitions from the growth stage to the mature stage there is a concomitant shift in levels of competition, functions, commodification of services, and commodification of labour, resulting from staff transferring between providers. There may also be a corresponding decrease in state support for the market in the mature phase, and a shift from ‘light touch’ regulation, to developed regulation and quality assurance. As Cao and Folan argue, ‘the key point of the division of the product’s life into stages is that different strategies may be applied to a product class as it moves from one to another, thus allowing the product lifecycle to act as a basis for production, planning, and control.’⁷⁴

The ‘product life cycle’ may be regarded as a useful paradigm through which to understand the developing forensic market. As the forensic product moves through successive stages, different strategies are enacted. The development of standardizing processes, such as the Polymerase Chain Reaction, allowed routinised DNA profiling to develop out of the comparatively cumbersome science of DNA fingerprinting, followed by its instrumentalisation, through efficient streamlined forensic reporting. Further, these processes required to be regulated in order for DNA to retain its status as the pre-eminent forensic technique. The transition from ‘light touch’ regulation to a developed regulatory,

⁷⁴ Forrester, J. W. (1958). Industrial dynamics. *Harvard Business Review*, 36(4), 37-66; Cox, W. E., Jr. (1967). Product Life Cycles as Marketing Models. *The Journal of Business*, 40(4), 375-384.

and quality assurance, framework, is thus an essential part of any comprehensive study of expert perceptions of marketised forensic DNA profiling. Further, it is clear from Government committee reports that policy makers understood the market through the PLM paradigm. Thus, since the conditions in each phase may differ significantly, this necessitates that researchers embark on up-to-date studies.

To summarise, it has been shown that there are important conceptual distinctions between commercialisation, privatisation, and marketisation. Further, that studies of marketisation must focus on a small number of key elements, including standardisation, deskilling and expertise, the introduction of efficiencies, and the use of developed forms of regulation. No study has hitherto focussed on the mature forensic science market, following privatisation and the introduction of a developed system of market regulation. Such a study could therefore make a contribution to the literature in this field by addressing the research gap outlined above. The following section will specify the research questions, distilled from the foregoing accounts, and from the corresponding thematic literature review.

Research questions

Central research question:

In what ways, if any, has marketisation influenced expert forensic biologists perceptions of DNA profiling evidence in England and Wales?

Secondary Research Questions

- RQ1: To what degree, if any, has marketisation influenced the perceptions of DNA profiling expert's in relation to the conduct and evaluation of DNA profiling evidence in England and Wales?
- RQ2: How do DNA profiling experts in England and Wales perceive marketisation as having influenced the introduction, and implementation, of standardised practices?
- RQ3: How do DNA profiling experts in England and Wales perceive marketisation as having influenced the exercise of forensic expertise?

- RQ4: How do DNA profiling experts in England and Wales perceive marketisation as having influenced the introduction, and implementation, of measures designed to promote efficiency in evaluative reporting?
- RQ5: How do experts in England and Wales perceive marketisation as having influenced the introduction, and implementation, of a regulatory framework?

Chapter Two: Thematic Literature Review

This thematic review was informed by a primary thematic of the relevant literature. Having enacted the search strategy, the researcher embarked on an initial phase of reading and evaluation. At this point a comparatively open approach was employed. However, during the successive phases inclusion and exclusion criteria were more rigorously applied in order to narrow and refine the source material. Included were; quantitative and qualitative research literature from peer-reviewed English language journals in Europe and the United States; high quality legal literature focusing on forensic science, and related evidential issues; high quality sociological literature focused on marketisation, and forensic science; studies outwith the forensic, or legal, sectors, where these illuminated a central research process or theme. Excluded were; scientific literature which focused on the evaluation of a particular biomedical forensic technique, or compared, or trialed, innovative biomedical forensic products; legal case analyses that focused largely on evidential issues, albeit that these included forensic opinion evidence; studies of organizational culture, and comparative business models; material that was over fifteen years old, unless this was particularly apposite to the research question, or offered useful background information; quantitative studies which focused on highly specific geographical areas, time periods, topics, or issues; and opinion, or editorial pieces.

Part One: Standardisation

As defined in the foregoing discussion, marketisation involves ‘changes in transactions, through the introduction or intensification of price-based competition.’⁷⁵ Marketised changes in transactions exhibit a number of key elements. This section reviews the literature related to the first major thematic element, specifically ‘an increase in the *standardisation* of the good or service being exchanged.’⁷⁶

The formal definition of a standard is a ‘document, established by consensus and approved by a recognized body, that provides for common and repeated use, rules, guidelines or characteristics for activities or their results, aimed at the achievement of the optimum degree of order in a given context.’⁷⁷ As Easterling notes, the use of such standards are an omnipresent, and global phenomenon,

‘The phone-voice promises, ‘Your call will be monitored for *quality assurance purposes*.’ Credit cards, all 0.76mm thin, slide into slots and readers all around the world. Screw threads conform to a given pitch. Every make of car shares the same dashboard pictograms. Batteries with consistent durations are sized to fit any device. Books, magazines, music, and audiovisual works are indexed with ISBN numbers. Paper sizes and the machines that handle them are standardized. RFID tags, trans-shipment containers, trucks, car seats, film speeds, protective clothing, book bindings, units of measure, personal identification numbers (PINs), and fasteners of

⁷⁵ Krachler, N. & Greer, I. *When does marketisation lead to privatisation? Profit-making in English health services after the 2012 Health and Social Care Act* (2015) *Social Science & Medicine*, Vol. 124, issue C, pp. 215-223, at p.216

⁷⁶ Krachler & Greer, *op cit*.

⁷⁷ Hatto, P. (2010). *Standards and Standardisation Handbook*. European Commission Directorate General for Research, Innovation and Technology; Directorate G1 (Industrial Technologies)

all kinds conform to global standards. All of these shared standards emanate from the International Organization for Standardization...'⁷⁸

The above quote cites diverse iterations of formal international standardisation. However, there are several different categories of standards, which together form a body of requirements and/or recommendations in relation to products, systems, processes or services. Standards are also used to describe measurements or test methods, or to establish a common terminology within a specific sector.

Standards thereby serve a variety of functions. They provide a recognised means for assuring quality, safety, and interoperability. They ensure the reliability of products, processes, and services, and provide technical support for regulations. Standards also play a pivotal role in marketisation, through providing a technical basis for procurement - of both consumables,⁷⁹ and processes⁸⁰ - and the basic support for commercialisation, markets, and market development. Furthermore, they may contribute to variety, and promotion of best practice. They also contribute to cost reduction, through enabling efficiency and optimisation.⁸¹

Standards and Regulations

It is important to distinguish standards from regulations. Regulations specify legally enforceable requirements, non-compliance with which may attract a sanction. Unlike the majority of standards, regulations are not exclusively the result of democratic, consensual processes. Indeed, the obligation to comply with overarching regulations applies to individuals and organisations who may not agree with them.

⁷⁸ From Easterling, Keller (2017) *Extrastatecraft: the power of infrastructure space* (London: Verso) at Chapter 5: *Quality*

⁷⁹ An example of a formal standard for 'Ensuring reliability of forensic consumables' is ISO 18385: 2016

⁸⁰ An example of a formal standard for 'Ensuring reliability of laboratory testing processes' is the generic ISO 17025

⁸¹ See Chapter Five, on Efficiency through the implementation of streamlined forensic products.

Unlike regulations, standards are voluntary codes. There is no legal obligation to comply with a standard. However, as will be demonstrated, standards may be used to demonstrate compliance with regulations, and form the basis for regulatory accreditation schemes.⁸² Organisations, both public and private, agree to voluntarily comply with external standards, which themselves derive legitimacy from their creation through altruistic, consensual, and democratic processes.

Formal and Informal Standards

As noted above, standards are generally the result of democratic, consensual co-production. The majority of standards address technical issues. However, as Hatto states,

‘...there has been an increasing recognition over the last few decades that voluntary, consensus based standards can contribute far more to business, and society in general, than simply technical specifications, testing methods, and measurement protocols.’⁸³

Formal standards are approved and adopted by National, Regional & International bodies. National Standards Bodies (NSBs) form the core component. Examples would include the British Standards Institute, or the German Institute for Standardisation (*Deutsches Institut für Normung* – DIN). All of these bodies facilitate the development of standards through a series of Technical Committees (TCs).

Technical Committees also contribute to development of regional, and international, standards (European Committee for Standardisation / Comité Européen de Normalisation, or CEN / International Organisation for Standardisation, or ISO). These regional, and international, standards are then adopted as national standards by the appropriate NSB. The main regional standards are ‘full European standards’ or ENs (European Norms). These are produced by the European Committee for Standardization (CEN). National members

⁸² See Chapter Seven, on the regulation of the forensic science market.

⁸³ Hatto, P. (2010). *Standards and Standardisation Handbook*. European Commission Directorate General for Research, Innovation and Technology; Directorate G1 (Industrial Technologies)

are obliged to adopt all ENs to the exclusion of national standards (though, notably, there is no concomitant obligation to adopt ISOs). The benefits of these formal standards lies in their unrivalled rigour and transparency.

Informal Standards

Informal standards are published by Standards Development Organisations (SDOs), such as the European Network of Forensic Science Institutes (ENFSI), the National Institute Of Forensic Science Australia New Zealand (ANZPAA NIFS), or the American Society for Testing and Materials (ASTM). The advantages of informal standards development is their focus, and relative speed of delivery. Furthermore, private standards may be developed internally for the use of a particular company, organisation, or conglomerate.⁸⁴

Formal standards may include both normative documents, and informative documents. The former category comprises; technical specifications, full standards, vocabularies, management systems standards, management standards, and workshop agreements. All contain requirements which must be met in order for claims of compliance to be certified. The majority of standards are normative, but may contain informative elements. Informative documents include technical reports, and guidelines. Neither of these contain requirements, and compliance with informative standards cannot be certified.

A further category comprises Workshop Agreements. These are consensus documents, developed as the output of a workshop, and are widely used in Europe. The advantages of Workshop Agreements are their creation as a result of open participation by a number of stakeholders, and the ability to produce such agreements quickly to address specific market requirements. Thus,, workshop agreements may focus on areas not subject to formal standardization. Workshop agreements are analogous to those created by the Forensic Science Regulator Specialist Working Groups, and may complement private standards.

⁸⁴ This latter category will be analysed in detail in Chapter Four, on Standardisation

Non-marketised Standardisation in the Forensic Science Sector

It is important to appreciate that standardization may serve a number of heterogeneous aims, and may be created at regional, state, or private level, in order to fulfill different objectives. Therefore, standardisation is not always introduced to conform to, or advance, market goals and incentives. Prior to the privatisation of forensic services in England and Wales, an attempt was made to implement regional standardisation through the European Quadropol⁸⁵ initiative, conducted by the European Network of Forensic Science Institutes in 2003. Quadropol involved four national laboratories, including the Forensic Science Service, all of whom developed ‘a [common] standard for consistent measures and collected data relating to budgets, personnel and expenses in order to enable comparisons for a consideration of efficiencies.’⁸⁶

‘Throughout Europe governments are aiming at a more efficient public sector. At the same time private enterprises are entering the forensic science market. This development is making cutting costs by compromising quality a tempting alternative for forensic laboratories. Quality of forensic investigations should thus be considered with great care, both in scientific and judicial terms.’

In this case, standardisation measures were engendered from within the forensic science sector, at supra-national level, in accordance with over-arching objectives of EU harmonisation. Standardisation was seen as a necessary element to achieve efficiency. However, standardisation was viewed as a means to achieve efficiency without compromising quality, through harmonizing practices between publicly owned state laboratories, the four participating laboratories continuing to operate as centralised providers within a system of public provision of forensic science services (exemplified by FSS provision in the UK prior to managerial restructuring).

The American *FORESIGHT* project sought to achieve similar objectives. It represented an attempt to develop the *Quadropol* project, and expand its economic dimensions, through

⁸⁵ See http://www.forensicscience.pl/pfs/50_himberg.pdf

⁸⁶ Strom, K. J. & Hickman, M. J. *Forensic Science and the Administration of Justice: Critical Issues and Directions* (Sage: Los Angeles, 2014) at p.224

the imposition of a set of standard metrics across a number of state crime laboratories, in order to accurately measure efficiency in relation to the standard work streams of the forensic laboratory. Specifically, the *FORESIGHT* project - allied to the management reform agenda of the Journal of Forensic Science Policy and Management - involved standardising definitions for performance metrics to evaluate work processes and the linking of financial information to work tasks and functions. The purpose of *FORESIGHT* was to allow laboratory managers to assess resource allocations, efficiencies, and the value of services. Key performance metrics were tied to forensic outputs (though the formulation of desired objectives may have political, cultural, and social dimensions). Indeed, *FORESIGHT* constitutes an attempt to frame the debate in economic terms and standardise the criteria and metrics through which performance can be judged, whilst resisting the temptation to move towards complete privatisation.

‘Many laboratory managers feel that their employees are well-trained and that they have sufficient instrumentation to carry out their duties and, yet, the US has thousands of cases backlogged. Personnel are the single largest portion of any forensic laboratory's annual budget and human resources management may present difficulties.’⁸⁷

The progenitors of Project *FORESIGHT* claim that it led to significant research developments for 'the business of forensic sciences'. In so doing, and applying the definitions specified in the preceding section, *FORESIGHT* could be seen as facilitating marketisation through the restructuring of processes, and the reconfiguration of labour, workers - and working practices - around new goals, incentives and quantitative measurements, all of which interface more readily with the indices of commercial efficiency.

Forensic Practice and Theories of Standardisation

It should be noted that research science, including forensic science, progresses through the utilization of standard protocols, reporting forms, and methods. Indeed, a primary form of standardisation is related to the stabilization of novel laboratory techniques; a process

⁸⁷ University of West Virginia *FORESIGHT* project: <http://www.be.wvu.edu/forensic/foresight.htm>

which enables their refinement and replication, as well as providing consistency of results, all of which elements are central to the scientific method. Nonetheless, this same standardization process may result in a significant degree of routinisation, such that novel methods no longer come to be regarded as embodying truly scientific (as opposed to merely technological) processes.

In the field of forensic DNA profiling, Jordan and Lynch demonstrate the intimate links between standardisation, efficiency, expertise, and commercialisation.⁸⁸ They discuss the way in which the Polymerase Chain Reaction (PCR) technique, which forms the lynchpin of DNA profiling, shifted from a unique product of scientific research, to a mundane and routinised process; one which was outsourced, standardised, and commoditised, before being sold back to forensic laboratories as a collection of purchasable products (e.g. GlobaFiler 24, SGM Plus).

As Lynch and Jordan explain, these stabilized and standardised modes of production in forensic-scientific knowledge claims deviate from the ideal of research science;

‘the technical economy begins to resemble a familiar industrial form. Deliberate efforts are made to save labour (and reduce the number of labourers) by standardizing techniques and downgrading skill requirements. This more abstract treatment of laboratory labour differs profoundly from the incorporation of routine techniques into the apprenticeship system of a university labor.’⁸⁹

In her analysis of the Cervical Screening Program (CSP) Singleton goes further, suggesting that the management of ongoing instabilities are a necessary feature of laboratory practice, and that it is the laboratory’s ability to deal with ambiguity and

⁸⁸ Jordan, K. & Lynch, M. *The Dissemination, Standardization and Routinization of a Molecular Biological Technique* (1998) *Social Studies of Science*, Vol. 28, No. 5/6, *Special Issue on Contested Identities: Science, Law and Forensic Practice* pp. 773-800; M’charek, A., Hagendijk, R., & Vries, W. de. (2013). Equal before the Law: On the Machinery of Sameness in Forensic DNA Practice. *Science, Technology, & Human Values*, 38(4), 542–565.

⁸⁹ Jordan and Lynch, *op cit*.

uncertainty which cement its scientific status; ‘the CSP emerges as composed of a series of interacting, complex, decentered identities and as characterized by ongoing instability.’⁹⁰

Rather than jeopardizing the laboratory process, the management of instability on the micro level, thus contributes to overall stability on the meso-level. ‘It becomes an important complex component carrying out difficult and lengthy procedures and hence worthy of increased status and resources.’⁹¹

These studies answer Timmermans’ call for ‘for careful empirical analyses of the specific and unintended consequences of different sorts of standards operating in distinct social domains.’⁹² Further, they demonstrate Timmermans’ three stages of standardization: namely creation, implementation, and resistance. However, Singleton takes the novel step of demonstrating that this is a constant, recursive process. Deviation from standards leads to innovation, followed by further rounds of standardization. These deviations and corrections are enacted across the boundary of scientific method, and come to define what is, and is not, regarded as science. As will be discussed in greater detail in chapter seven on regulation, this process creates tensions involving boundary work - and compels agents to further define scientific method and endeavour - when enacted within a more rigid regulatory framework.

The above studies focused on specific protocols in (forensic) laboratory research, demonstrating stabilisation, recursion, ambiguity, disambiguity, and enacted expertise. It should be noted, however, that evaluation of material samples combines novel forensic techniques alongside standard contextual, and behavioural, categorisations (or

⁹⁰ Singleton, Vicky. 1998. "Stabilizing Instabilities: The Role of the Laboratory in the United Kingdom Cervical Screening Programme." In *Differences in Medicine: Unraveling Practices, Techniques, and Bodies*, edited by Marc Berg and Annemarie Mol. London, UK: Duke University Press.

⁹¹ Singleton, *op cit*.

⁹² Timmermans, S. & Epstein, S. A World of Standards but not a Standard World: Toward a Sociology of Standards and Standardization (2010) *Annual Review of Sociology*. 2010. 36:69–89; Standardization and Omics Science: Technical and Social Dimensions Are Inseparable and Demand Symmetrical Study

‘typifications’) about the social origins of particular objects.⁹³ Thus, as Kruse demonstrated, the laboratory process becomes interpenetrated with standards, both scientific, and social.

Standardisation and Marketised Forensic Science: The Forensic Science Regulator

Having considered the creation of informal forensic science standards it remains to consider the formal guidance, and standard-setting, on the part of the Forensic Science Regulator. Whilst the Forensic Science Regulator is nominally tasked with the regulation of the forensic science market, closer analysis of her role, in line with the foregoing definition, reveals a more ambiguous status. The Forensic Science Regulator is ‘sponsored’ by the Home Office, though does not hold an official position within that department. Therefore, there is no ‘*office*’ of the FSR. Further, the FSR has no statutory authority, despite ongoing efforts to place her on a statutory footing.⁹⁴ Therefore, it may be inaccurate to treat the FSR as a regulator *per se* (unlike, for example, the Financial Conduct Authority, which is tasked with enforcing regulations and standards, or the Information Commissioner, who upholds legal rights. Nor is the FSR’s ‘quasi-regulatory’ role analogous to that of the Legal Ombudsman, who investigates complaints raised by members of the public, or to The Consumer Council for Water, which represents a body of end users.

As stated in the foregoing discussion on marketisation, that process displays evolving dimensions, which frequently involve a change in the regulatory landscape, typically commencing with ‘light-touch regulation’, and proceeding to more developed forms of regulation, accreditation, and quality assurance. During the earlier phase of forensic science marketisation in England and Wales, the nascent form of regulation was evident, evolving out of a natural standard-setting process, and typified by the work of the first FSR, Andrew

⁹³ Kruse provides the example of blood found on a broken basement window. See Kruse, C. (2012) *Legal storytelling in pre-trial investigations: arguing for a wider perspective on forensic evidence*. *New Genetics and Society*, 31:3, 299-309

⁹⁴ See The Forensic Science Regulator Bill 2017-19:

<https://services.parliament.uk/Bills/2017-19/forensicscienceregulator.html>

Rennison.⁹⁵ During this period, standardization was engendered through the work of private sectoral stakeholders, absent of regulatory input. Only later did a comprehensive quality assurance and regulatory framework appear in response to market maturation. Therefore, these issues — though interrelated in respect of marketisation - will be dealt with separately, and discussion of the enforcement of formal standards and regulation will be dealt with at a later stage.

In closing, it should be noted that, notably absent from the studies reviewed, is a focus on the effects of marketisation on the creation of formal, and informal, forensic science standards as perceived by forensic scientists themselves. Winickoff has considered the links between standardization and carbon markets, whilst Fomin, *et al*, focus on the struggles to in the private telecommunications market.⁹⁶ Missing is discussion of the introduction of wide-ranging informal standards in the private sector, and subsequent productisation. Thus, the present study may contribute to the extant literature by filling the research gap, offering an account of DNA profilers perceptions of standardization within the forensic science sector that is alive to the effects of marketisation, commercialization and economic factors, engendered within the sector. The next section reviews the related literature on expertise.

⁹⁵ See, for example, Forensic Science Advisory Council (FSAC), Minutes of the meeting held on 25 February 2014 Home Office, London, in which the FSR highlights the need for a ‘light touch’ approach.

⁹⁶ Fomin, V.V., Keil, T.A., & Lyytinen, K. (2008). *Theorizing about Standardization: Integrating Fragments of Process Theory in Light of Telecommunication Standardization Wars*.

Part Two: Expertise

The greatest contribution to the literature on expertise has been made by science and technology studies scholars. However, it is evident that - despite a small number of notable exceptions⁹⁷ - early STS scholarship almost completely overlooked the forensic field. The task of filling the research gap fell to socio-legal scholars, who embarked on broad, but piecemeal, critiques of the forensic field. A notable example is Redmayne,⁹⁸ who, in his treatment of expert evidence, makes a significant contribution. However, in an early paper calling for sociological work in the field of DNA profiling, Thompson⁹⁹ criticises him for not taking the sociological perspective far enough. Jasanoff¹⁰⁰ reiterates Thompson's argument, stating that 'our understanding of the nature of DNA evidence cannot be considered complete until we have gained a fuller understanding of the sociology of forensic technique.' This assertion echoes Redmayne's statement that 'there might be areas of DNA science [beyond the technology itself] where talk of construction would lead to the sort of profitable debunking of assumptions that it does in other areas.'

These early engagements hinted at the need to develop in-depth social-constructivist accounts of the co-production of forensic-scientific knowledge claims. Therefore, in the early 1990's, Science and Technology Studies (SaTS) scholars increasingly began to turn their attention towards the subject. The 'forensic turn' paved the way for a significant line of research, which can be categorised under the following headings:¹⁰¹

⁹⁷ Wynne, B (1989) 'Forensic Pathology, Scientific Expertise, and the Criminal Law' pp.56-92 in Smith, R. and Wynne, B. (eds.) (1989) *Expert Evidence: Interpreting Science in the Law* (Routledge: London)

⁹⁸ Redmayne, M. *Expert evidence and scientific disagreement*, Univ. California Davis Law Rev. 30 (1997) 1027–1080.

⁹⁹ Thompson, W.C., *A sociological perspective on the science of forensic DNA testing*, Univ. California Davis Law Rev. 30 (1997) 1113–1136.

¹⁰⁰ Jasanoff, S. (1995) *Science at the Bar: Law, Science & Technology in America* (Cambridge, MA: Harvard University Press)

¹⁰¹ Mnookin, J., Cole, S., et al. (2010) *The Need for a Research Culture in the Forensic Sciences* 58 UCLA Law Review 725

- The incorporation of economic imperatives into forensic analyses.¹⁰²
- The writing of attributes such as race into forensic traces.¹⁰³
- The contestability of all forensic knowledge claims.¹⁰⁴
- The ethnographic (or historical) tracing of forensic practitioners on the journey from laboratory to courtroom.¹⁰⁵
- The effort to discipline forensic practitioners and objects through quality assurance mechanisms.¹⁰⁶

Further studies began to explore the emergent realities of productisation and marketisation, within the United Kingdom forensic science sector. An example is Daemmrich,¹⁰⁷ who embarked on a detailed study of the construction of forensic-scientific knowledge claims, prior to the introduction of the 'casework' model of forensic interpretation. His research offered insights into the ways in which companies were able to control the production of

¹⁰² Daemmrich, A. *The Evidence Does Not Speak For Itself: Expert witnesses and the organization of DNA-typing companies*. *Social Studies of Science* (1998), 28, 741-772; Lawless, C.J. & Williams, R. *Helping With Inquiries or Helping With Profits? The trials and tribulations of a technology of forensic reasoning*. *Social Studies of Science* (2010), 40, 731-755

¹⁰³ Cole, S.A. *Twins, Twain, Galton & Gilman: Fingerprinting, individualization, brotherhood and race in Pudd'nhead Wilson*. *Configurations* (2007) 15, 227-265; Kahn, J. *Race, Genes and Justice: A call to reform the presentation of forensic DNA evidence in criminal trials*. *Brooklyn Law Review* (2008) 74, 325-375; M'Charek, A. *Technologies of population: Forensic DNA Testing practices and the making of differences and similarities* *Configurations* (2006), 8, 121-158; M'Charek, A. *Silent witness, articulate collective: DNA evidence and the inference of visible traits*. *Bioethics* (2008), 22, 519-528

¹⁰⁴ Jasanoff, S. (1995) *Science at the Bar: Law, Science & Technology in America* (Cambridge, MA: Harvard University Press); Lynch, M. *The Discursive Production of Uncertainty: The OJ Simpson 'dream team' and the sociology of knowledge machine*. (1998) *Social Studies of Science*, 28, 829-868; Lynch, M., Cole, S.A., McNally, R. & Jordan, K. (2008) *Truth Machine: The Contentious history of DNA Fingerprinting* (Chicago: University of Chicago Press); Mnookin, J.L. *Fingerprint Evidence in an Age of DNA Profiling* (2001) *Brooklyn Law Review*, 67, 13-70

¹⁰⁵ Jordan, K. & Lynch, M. *The Dissemination, Standardisation and Routinisation of a Molecular Biological Technique* *Social Studies of Science* (1998) 28: 773; Timmermans, S. (2006) *Postmortem: How medical examiners explain suspicious deaths*. (Chicago: University of Chicago Press)

¹⁰⁶ Leslie, M. *Quality Assured Science: Managerialism in Forensic Biology Science Technology Human Values* (2010) 35, 283

¹⁰⁷ Daemmrich, A. *The Evidence Does Not Speak For Itself: Expert witnesses and the organization of DNA-typing companies*. *Social Studies of Science* (1998), 28, pp. 741-772

forensic knowledge through investment in research and new technologies, and the subsequent widespread standardisation of practices in conformation with those technologies: phenomena which he termed 'upstream', and 'downstream', integration.

While Daemmrich's study opened the door to further research, it must now be placed in historical context. The 'casework model'¹⁰⁸ – as adopted by most commercial companies and public sector laboratories - has altered the degree to which the forensic scientist can exert control over the production of forensic knowledge within the laboratory. Thus, the features which Daemmrich unearthed, may be seen to be confined to an emergent phase of DNA profiling. Nonetheless, subsequent developments were anticipated in his observation, that:

'there no longer is an 'inside' and an 'outside' to the testing laboratory: instead, company practices shape the structure of the legal and social environments as much as the former are shaped by the latter.'¹⁰⁹

The theme of emergent marketisation was developed by Lawless and Williams, whose ethnographic study of the Case Assessment and Interpretation process considered the ways in which commercial imperatives may 'condition the use of forensic science in support of criminal justice.'¹¹⁰ It should be noted that, in the intervening years between Daemmrich's study and their own, Case Assessment and Interpretation had become firmly embedded in the architecture of forensic service provision. Their empirical study - limited to the private sector, and conducted solely through interviews with forensic scientists - sought to explore the relationship between commerce and science, focussing on forensic practitioner's attempts to negotiate the CAI process. Their research establishes an explicit connection between CAI and emergent forms of economic rationalisation. However, it must be reiterated that CAI was intended, from the outset, to bring economic imperatives to bear on

¹⁰⁸ Cook, R., Evett, I.W., Jackson, G, Jones, P.J. & Lambert, J.A. *A Model for Case Assessment and Interpretation* Science & Justice (1998) 38 151-156 at p. 152

¹⁰⁹ *Ibid.* at p.759

¹¹⁰ Lawless, C.J. & Williams, R. *Helping With Inquiries or Helping With Profits? The trials and tribulations of a technology of forensic reasoning.* Social Studies of Science (2010), 40, 731-755

knowledge production, and the intention to integrate commercial imperatives into the investigative process was made publicly, and explicitly.

Lawless and Williams study provides a comprehensive account overview of the introduction, and early development, of the CAI process (prior to the LT-DNA controversy)¹¹¹. At that time they viewed CAI as a ‘boundary object’: one which provided a standardised form of communication between ‘the different epistemic worlds of science and policing.’¹¹² However, it is doubtful to what extent such insights remain relevant in the wake of the subsequent introduction of efficient forms of forensic reporting (discussed below).

Lawless returns to the subject in later papers,¹¹³ exploring the ways in which commercialised forensic science provision is shaped around constructions of ‘providers’ and ‘customers’. These later studies reiterate the link between measures of economic rationalisation and the production of forensic knowledge. However, some of the most promising aspects of these studies remain unexplored. Lawless work is largely descriptive, and does not attempt to place the contextual shaping of forensic knowledge claims in theoretical perspective. Nor does his work explore the nature of forensic-scientific expertise in any detail.

Indeed, the majority of accounts of the production of forensic-scientific knowledge claims rest on a narrative, which highlights the lack of meaningful communication between forensic scientists and legal professionals. The corollary of this ‘contest and communication’ narrative is that many of the difficulties encountered by these two discrete fields may be overcome through improved communication, and a mutual appreciation of both context and milieu. Solutions have therefore tended to be practical and pragmatic, rather than theoretical and epistemological.

¹¹¹ Discussed, *infra*.

¹¹² *Ibid.* at p.745

¹¹³ Lawless, C. (2010). *A Curious Reconstruction? The Shaping of ‘Marketized’ Forensic Science*. CARR Discussion Paper 63; Lawless, C. *Policing Markets; the Contested Shaping of Neo-Liberal Forensic Science*. *British Journal of Criminology* (2011) 51, 671-689

The ‘contest and communication’ narrative is generally associated with the view that the forensic, and legal, fields operate from within discrete ‘silos’, and that the degree to which professionals become ‘silo-ed’ is exacerbated in an adversarial context.¹¹⁴ Such views, routinely expressed in the forensic-scientific field, are echoed by members of the Judiciary and the legal profession. Lord Thomas, the Lord Chief Justice of England and Wales, perceives a similar communication problem, and likens it to the challenge facing comparative lawyers, whom he commends for their success in unearthing common legal concepts.

‘It is now accepted that the work of comparative lawyers, whose discipline was based on finding differences, and the globalization of many legal concepts, particularly the rule of law as applicable to all governmental action and the right to a fair and open trial, have brought about a considerable narrowing of the differences.’¹¹⁵

It may be argued that the desire to share common concepts is based on an idealised conception of underlying similarity between two heterogeneous disciplines whose normative basis is completely divergent. This will be the subject of further discussion below.

A further contribution to the sociology of forensic science has been made by Kruse, whose extended empirical studies attempt to recreate the ‘biography’ of forensic evidence by following its trajectory from crime scene to courtroom. Her ethnographic analysis of ‘the social life of forensic evidence’ leans heavily on the social-constructivist scholarship of ‘Wave Two’ STS, and borrows from Latour’s theories of material agency. However, Kruse methodological approach owes more to Arjun Appadurai’s homologous concept of ‘the social life of things,’¹¹⁶ which ‘allows for the combining of a theoretical focus on

¹¹⁴ See Kelty, SF; Julian, R; and Ross, A. *Dismantling the Justice Silos: avoiding the pitfalls and reaping the benefits of information-sharing between forensic science, medicine and law*. Forensic Science International ; Jul 10;230(1-3): pp.8-15.

¹¹⁵ Thomas, LCJ. 2015 *The legal framework for more robust forensic science evidence*. Philosophical Transactions of the Royal Society B 370: 20140258 at page 1.

¹¹⁶ Kruse, *Op. Cit.* note 2, at page 11; Appadurai, A. (Ed.) (1986) *The Social Life of Things*, (Cambridge University Press: Cambridge)

human actors...with a methodological focus on objects...travelling through [the criminal justice system].’

Undoubtedly, a culturally-focused analysis of the social life of forensic evidence may be greatly facilitated by ‘recognising the material agency’¹¹⁷ of forensic evidence. However, it may be argued that this is a partial, and limited, approach, and that an obverse approach may prove more fruitful, insofar as it would allow for a focus on those interposing contextual factors which condition the practice of relational forms of forensic-scientific expertise. Such an approach - utilising theoretical perspectives from Latour, rather than Appadurai - would require that we ascribe material agency, not to the evidence, but rather to the DNA/Bayes casework process itself. Such an approach will be outlined in the following chapter.

Kruse further admits that her work is culturally circumscribed, in terms of both its subjects and its perspective. Rather than following the traditional focus on the resolution of scientific controversy, she adopts a constructive outlook, which – she concedes - is culturally inflected. Both she, and her interlocutors, ‘share a language and live under the same public administration.’¹¹⁸ Thus, their shared perspectives are conditioned by the Nordic social-democratic model of governance, which places a great emphasis on the openness and transparency of governmental institutions and activities. However, Kruse foregoes the opportunity to make explicit connections between the overarching mode of governance and the production of forensic-scientific knowledge claims.

This omission has ramifications on the procedural level. Kruse ethnographic studies were conducted solely within the Swedish state forensic laboratory: an institution, which shapes forensic-scientific knowledge claims in preparation for their entry onto a non-adversarial legal field. This inquisitorial system practices complete freedom of evidence, and requires that the prosecutor present both inculpatory, and exculpatory, evidence, in relation to the accused. Further, the requirements of formal adjudication procedures within the Swedish jurisdiction, are such that they do not entail extensive use of expert witnesses (though the

¹¹⁷ *Loc. Cit.*

¹¹⁸ Kruse, *ibid* at page 13

courts may make occasional recourse to skilled consultants). Nor are scientists routinely required to produce witness statements.

These local procedural elements shape an epistemic culture, in which forensic knowledge claims from SKL (the state laboratory) are greeted with almost unquestioning acceptance. Kruse quotes a member of the Swedish judiciary as saying: ‘you don’t question DNA profiling, whether the SKL did it right, you don’t question that. It leads too far to...go in [to the laboratory] and look at their work...’

Given the above, it is questionable to what extent Kruse’ empirical work - which remains highly descriptive of local practices - may translate to an adversarial context. Further, Kruse does not engage with regulatory factors, quality assurance regimes, and audit protocols, which are a regular feature of forensic-scientific practice in the United Kingdom, except to say that – outwith the casework process – ‘SKL works correctly and impartially.’¹¹⁹ Thus, a major contextual factor is absent from her analysis. Finally, while her empirical studies capture the conceptual fluidity, and diverse terminology, deployed by institutional actors, these factors are not placed in a theoretical context.¹²⁰

Nonetheless, Kruse does offer some valuable insights into narrative theories of evidence-production. These flow from her understanding of the centrality of the concept of the ‘chain of evidence’, and of the need for socio-legal studies to account for the co-production of evidence prior to its arrival at the administrative border of the courtroom. In the first of a series of studies,¹²¹ she uses the theory of ‘legal story-telling’ to explain the work of the forensic scientist, as (s)he attempts to reason in the face of uncertainty.¹²² Kruse notes that, whatever the source, science does not enter the court as bare facts, or as claimed truths, but

¹¹⁹ Kruse, *ibid* at page 28

¹²⁰ See chapter one

¹²¹ Kruse, C. (2012) *Legal storytelling in pre-trial investigations: arguing for a wider perspective on forensic evidence*. *New Genetics and Society*, 31:3, 299-309

¹²² Bennet, W.L., & Feldman, M.S. (1981) *Reconstructing Reality in the Courtroom* (New Brunswick: Rutgers University Press); Jackson, B.S. (1988) *Law, Fact and Narrative Coherence* (Deborah Charles Publications: Liverpool); Wagenaar, W.A., Van Koppen, P.J. & Crombag, H. F.M. (1993) *Anchored Narratives: The psychology of criminal evidence* (London: St. Martin’s Press); White, J.B. (1973) *The Legal Imagination* (Boston).

as evidence (within a Swedish jurisdictional context). For evidence to be considered relevant it must deliver answers that are germane to the legal case. Therefore, facts must be placed in context in order to gain meaning and significance: the disjointed facts must be transformed into propositions, and representations, which bind together to form a credible narrative. These familiar stories may be drawn from a catalogue of stock scripts, and may be peopled with archetypal characters. Such an approach – she suggests – may be useful to the court, insofar as the forensic-legal narrative helps to associate people, and actions, with legal categories, in an attempt to account for all of the available evidence.

Shifting her focus to the production of forensic knowledge, Kruse observes that legal story-telling does not only happen in the court-room. It is a central part of the investigative process: beginning at the crime scene and continuing within the forensic laboratory. She posits that 'story-telling' is now so central to criminal investigation that forensic scientists have developed a particular form, which they call 'casework'. Casework, she observes, accounts for that activity which we most closely associate with forensic inquiry - the analysis of source material. More importantly, it provides a narrative framework in order that the scientist may order those material analyses in ways that makes sense.

In a later paper Kruse¹²³ returns to the topic of legal 'story-telling' through casework, adding further theoretical detail. Kruse acknowledges the uncertainty inherent in the 'story-telling' process, and asserts that casework functions as a means of distributing responsibility for these uncertainties between the scientific and legal fields.¹²⁴ In contrast to many commentators, she speaks of the shared understanding that exists between scientists and lawyers and the unity of purpose which allows for a substantial degree of transparency to exist: a transparency which allows those practices and activities, which normally take place within the 'black box' of DNA profiling, to become visible to the courts. Nonetheless, Kruse acknowledges that the maintenance of a state of increased (if not complete) transparency is a difficult task.

¹²³ Kruse, C. (2013) *The Bayesian approach to forensic evidence: Evaluating, communicating and distributing responsibility*. *Social Studies of Science* 2013 43: 887

¹²⁴ This section of Kruse' analysis - though unacknowledged - owes much to Moreira, T., May, C. & Bond, J. *Regulatory Objectivity in Action: Mild cognitive impairment and the collective production of uncertainty*. *Social Studies of Science* (2009) 35/9 pp. 665 - 690 (2009) at p.678.

It is clear that Kruse takes a more optimistic approach to the subject of interdisciplinary knowledge creation than do other STS scholars. Kruse finds co-operation where others unearth contestation, and - in conversation - Kruse admits that this constructive outlook may flow from the overarching Nordic, social-democratic model of governance, which places great emphasis on the openness and transparency of governmental institutions and activities. However, it remains highly questionable to what extent Kruse account of the casework process accords with its original aims, as conceived within the United Kingdom Forensic Science Service. Further, Kruse account of the co-operative enterprises, and shared understandings, of scientists and lawyers - though feasible within the Swedish criminal justice system - runs counter the 'contest and communication' narrative advanced by authors within adversarial jurisdictions, and is of limited application in the United Kingdom.

Epistemological privileging of knowledge claims derived from DNA-profiling techniques.

The above analysis does not demonstrate how DNA profiling techniques have achieved an unparalleled epistemological status. Indeed, it may be posited that knowledge claims derived from forensic-scientific techniques might enjoy a comparatively low status, as many are derived from practices which fails to meet many of the criteria applicable to progressive forms of research science. However, criticisms which focus on the relative status of forensic, and 'normal', science, cannot fully account for the dynamic and heterogeneous nature of the forensic field. Most notably, the 'subnormal' status routinely applied to forensic craft practices does not apply to those DNA-profiling techniques borrowed from the biosciences. Such techniques are widely regarded as conforming to the positivist ideals of research science, and may even be viewed as the means through which the larger body of forensic science practices have been rehabilitated (at least within the public sphere).

It is clear that, in the eyes of the law alongside those of the general public, DNA-profiling techniques, and Bayesian analytical methods, together constitute 'an exceptionally

scientific form of evidence.’¹²⁵ which may be easily contrasted with a body of ‘subjective and pre-scientific’ forensic craft practices. As such, the introduction of DNA/Bayes may be construed as heralding a ‘paradigm shift’¹²⁶ in forensic science. However, commentators have recommended caution in this regard. Saks and Koehler¹²⁷ argue that - by Kuhnian criteria - DNA profiling has not inculcated a paradigm shift within the forensic science field, insofar as DNA profiling techniques do not overthrow an existing conceptual framework, thereby generating a new stream of ‘normal’ science. However, accepting Saks and Koehler’s position, it is still possible to claim that there has been a non-Kuhnian ‘revolution’ in forensic science, insofar as an array of expert forensic-scientific practices has managed to achieve, if not surpass, scientific status.¹²⁸

Nonetheless, the emergent ‘scientific’ status of the the DNA/Bayes network may serve to make forensic knowledge claims more resistant to the interposition of contextual factors, and thereby help to shape the forensic-scientific profession. That DNA profiling has achieved scientific status may be inferred from the achievements of those analysts and researchers associated with the process. Focussing on the academic, and career, trajectories of those involved in ‘normal’ scientific culture, as against those of forensic science practitioners, Saks and Koehler noted that routine forensic practices - though ‘graced with an aura of science’ - are held to be of significantly lower status than those conducted within the field of ‘real’ science (in accordance with Merton’s normative approach). DNA profiling is, therefore, both significant and unusual, insofar as it has risen to the status of normal science. This achievement may be attributed to its transparency with regard to its hypotheses, its application of knowledge ‘derived from core scientific disciplines’ -

¹²⁵ Lynch, *ibid.* at page 8

¹²⁶ Saks, M.J. & Koehler, J.J. (2005) *The Coming Paradigm Shift in Forensic Identification Science*, Science, 309, 892-895 at 893

¹²⁷ Saks, M.J. & Koehler, J.J. , *ibid.*, at page 893

¹²⁸ *ibid.*, 893; See also Cole, S.A., *Forensic Culture as Epistemic Culture: The sociology of forensic science*, Studies in History and Philosophy of Biological and Biomedical Sciences (2013) 44 36-46

including chemistry, biology and mathematics - and its harnessing of ‘data-based, probabilistic assessments’¹²⁹ in order to structure evaluation.

What is not clear from the literature is whether, or to what extent, forensic practices in general have begun to be regarded as nominally scientific ‘on the coat-tails’ of DNA-profiling and its ‘elite’ status. A consideration of the epistemological basis for such claims - resting on increasingly indefensible concepts, such as ‘uniqueness’ and ‘individualisation’ - would suggest that, for this to be the case, forensic identification practices would have to overcome significant hurdles.¹³⁰ This will be the subject of further discussion in Chapter Three.¹³¹

Returning to the DNA/Bayes, it is clear from the literature that, beyond the core-set of forensic-scientific practitioners (and associated institutional actors), DNA-profiling techniques have been accorded an exceptional - if not unassailable - epistemological status. Evidence derived from DNA-profiling has been described, variously, as; ‘infallible’; as furnishing ‘irrefutable proof’; and as a ‘truth machine’; or ‘revelation machine’.¹³² Characteristically hyperbolic statements, commending the hitherto-unparalleled discriminatory potential of forensic bio-identification techniques, reach a zenith with the claim - from the president of the *Deutschen Gesellschaft für Rechtsmedizin* (German Society for Forensic Medicine) - that ‘a DNA match identifies a perpetrator with 100% certainty.’¹³³ Such statements are not uncommon amongst the literature, more frequently the secondary sources, devoted to forensic DNA profiling. However, the epistemological

¹²⁹ *ibid.*, 893; See also Lynch, M. *Science, Truth, and Forensic Cultures: the exceptional legal status of DNA evidence*, *Studies in History and Philosophy of Biological and Biomedical Sciences* (2013) 44 at pp. 60-70

¹³⁰ Cole, S., *Forensics Without Uniqueness, Conclusions Without Individualization: the new epistemology of forensic identification*. (2009), *Law, Probability and Risk* 8, 233-255

¹³¹ For a full discussion of contemporary media representations of forensic practices, see Lawless, C (2016) *Forensic Science: A Sociological introduction* (Routledge: New York) at page 20

¹³² See Lynch, M., Cole, S.A., McNally, R. & Jordan, K. (2008) *Truth Machine: The Contentious history of DNA Fingerprinting* (Chicago: University of Chicago Press)

¹³³ Lindsey, S., Hertwig, R., & Gigerenzer, G. (2003). *Communicating Statistical DNA Evidence*. *Jurimetrics*. 43, 147-163 at p.150

privileging of knowledge claims derived from such techniques is by no means limited to the claims of institutional actors.¹³⁴

Insofar as forensic-scientific knowledge claims, based upon DNA/Bayes¹³⁵ techniques, have been held to possess the epistemological status of objective ‘natural’ facts, the development of this branch of forensic inquiry follows the trajectory of prior forensic identification techniques, particularly that of latent fingerprint analysis. In a seminal example of social-constructivist Science and Technology Studies scholarship - one whose historical, and disputational, focus exhibits features common to both the Edinburgh and Bath schools – Cole has chronicled the contentious history and development of friction ridge examination (fingerprinting).¹³⁶ His account begins in the early twentieth century, when ‘fingerprinting’ was regarded as both a reliable, and reputedly infallible, source of expert evidence in criminal trials. Courts demonstrated a willingness to accept the testimony of fingerprint examiners, with little - or no - inquiry into the scientific and epistemological basis of their judgements, insofar as the latter claimed to be able to make correct source attributions. All elements of the criminal justice system accepted the proposition (flowing from the philosophical concept of ‘uniqueness’), that no two individuals exhibit the same friction ridge patterns. Further (in an example of institutional actors articulating the second limb of the ‘forensic imaginary’, discussed *infra*), it was accepted that trained examiners could detect ‘matches’ without error.¹³⁷ The courts

¹³⁴ ‘DNA – deoxyribonucleic acid – is God’s signature. God’s signature is never a forgery.’ Prison inmate Loyd, E-J., quoted in Wilgorin, J. *Confession Had His Signature; DNA Did Not*: The New York Times, August 26th 2002

¹³⁵ The use of ‘DNA/Bayes’ terminology prefigures discussion of the probabilistic interpretation of biological identification techniques as constituting an actor-network (see Chapter Three).

¹³⁶ Cole, S.A. (2001) *Suspect Identities: A History of Fingerprinting and Criminal Identification* (Cambridge, MA: Harvard University Press); See also Cole, S.A., *Witnessing Identification: Latent Fingerprint Evidence and Expert Knowledge*, (1998) *Social Studies of Science* 28(5/6): 687-712; Cole, S.A. *The Myth of Fingerprints: A Forensic Science Stands Trial*, (2000) *Lingua Franca* (November): 54-62; Cole, S.A. *Fingerprinting: The First Junk Science?*, (2003) *Oklahoma City University Law Review* 28(1): pp. 73-92; Cole, S.A., *Grandfathering Evidence: Fingerprint Admissibility Ruling from Jennings to Llera Plaza and Back Again* (2004), *American Criminal Law Review* 41(3); Cole, S.A. *Twins, Twain, Galton & Gilman: Fingerprinting, individualization, brotherhood and race in Pudd’nhead Wilson*. *Configurations* (2007) 15, 227-265; Cole, S., *Forensics Without Uniqueness, Conclusions Without Individualization: the new epistemology of forensic identification*. (2009), *Law, Probability and Risk* 8, 233-255

¹³⁷ Uncritical acceptance of dogmatic concepts e.g. uniqueness and the ‘science of individualisation’ is attributed to a longstanding failure to articulate a defensible epistemological foundation for the testimonial

therefore allowed examiners to express ‘unqualified certainty’ when making testimonial claims, and did not require them to supply error rates, or other probabilistic estimates normally associated with scientific procedure.¹³⁸

However, the first challenge to friction ridge examination arose from the application of new admissibility tests laid out in *Daubert v Merrel Dow Pharmaceuticals* and *Kumho Tires v Carmichael*,¹³⁹ which required expert testimony to exhibit, and meet, verifiable scientific standards (see below). The second challenge arose from the introduction of DNA ‘fingerprinting’ techniques, and the application of a new ‘gold standard’ in forensic science. Mnookin¹⁴⁰ points out distinct similarities between the ways in which the courts treated friction ridge analysis, and later treatment of DNA ‘fingerprinting’. Both of these bio-identification techniques relied on an analyst’s ability to make strong discriminatory assertions in respect of suspect populations, and to link these to an ineradicable bodily substrate. Thus, both fingerprints, and DNA evidence, were widely regarded as being derived directly from nature, with human mediation a mere triviality. Mnookin’s research (which draws on Cole’s historical study of fingerprint analysis¹⁴¹) throws light on the problems that were faced by forensic identification experts, and which would later be faced by those advancing DNA-based knowledge claims. Both faced initial challenges with regard to the precision of their claims. Indeed, DNA analysts - whose methods for calculating random match probabilities were based upon dubious statistical assumptions - weathered robust criticism in both scientific journals, and legal hearings.¹⁴²

claims of forensic bio-identification experts. See Cole, S., *Forensics Without Uniqueness, Conclusions Without Individualization: the new epistemology of forensic identification*. (2009), *Law, Probability and Risk* 8, 233-255

¹³⁸ Lynch, M. & Cole, S.A. *Science and Technology Studies on Trial: Dilemmas of expertise* *Social Studies of Science* (2005) Vol.35, No.2 pp.269-311 at page 270

¹³⁹ See below.

¹⁴⁰ Mnookin, J., Cole, S., et al. *The Need for a Research Culture in the Forensic Sciences* 58 *UCLA Law Review* 725 2010-11

¹⁴¹ Cole, S.A. (2001) *Suspect Identities: A History of Fingerprinting and Criminal Identification* (Cambridge, MA: Harvard University Press);

¹⁴² Lynch, M. *Science, Truth, and Forensic Cultures: the exceptional legal status of DNA evidence*, *Studies in History and Philosophy of Biological and Biomedical Sciences* (2013) 44 60-70

However, Cole highlights the way in which the same forms of techno-legal controversy, which had been deemed problematic for fingerprinting, came to be regarded as strengths when applied to DNA-profiling. The controversies and contretemps of the 'DNA wars' led, not to debunking, but to peer-reviewed publication, scientific status, and closure.¹⁴³

Critics of standard identification techniques, such as latent print analysis, might assert that the diminishing status of these techniques in the face of DNA evidence was both deserved and overdue. Indeed, Cole contends that the nature and magnitude of the claims made by latent fingerprint analysts could only be achieved through a 'leap of faith'¹⁴⁴ through which the analyst becomes 'subjectively certain that the patterns could not possibly be duplicated by chance.'¹⁴⁵ He contends that such 'leaps of faith' render individualisation unscientific, irrational and unnecessary. In counterpoint, DNA profiling - presented in probabilistic terms - 'has shown that non-individualising evidence can have it both ways: convey a significant probative value *and* transparently convey information...to fact-finders.'¹⁴⁶

Nonetheless, these studies left much to be done. While they addressed a series of structural problems which had hampered the forensic-scientific production of knowledge claims - primarily from a scientific-realist perspective - they did not fully account for the efficient and routinised iterations of DNA-profiling techniques which have subsequently been developed.

¹⁴³ Of particular interest in this regard is an article in the science journal *Nature* by Lander and Budowle, which has been viewed as an attempt to create the illusion of scientific consensus, with the specific intention of facilitating the use of DNA-based evidence in the landmark *Simpson* trial. See Lander, E.S. & Budowle, B. *DNA Fingerprinting Dispute Laid to Rest*, (1994) *Nature* 371, pp. 735 - 738 (27 October 1994)

¹⁴⁴ Cole, S., *Forensics Without Uniqueness, Conclusions Without Individualization: the new epistemology of forensic identification*. (2009), *Law, Probability and Risk* 8, 233-255 at p.247.

¹⁴⁵ Stoney, D.A. *What Made Us Ever Think We Could Individualize Using Statistics* (1991) *Journal of the Forensic Science Society* 31, 197-199

¹⁴⁶ Cole, S. *op. cit.* at p.247

Theories of Expertise

Science and Technology Studies and Studies of Expertise and Experience

In order to pursue socio-legal enquiries related to the development of forensic identification techniques - and their operation within the criminal justice system - it is first necessary to outline a subsisting body of literature, broadly classified as Science and Technology Studies (STS). STS is an umbrella term used to describe a corpus of anthropological, sociological, and historical, studies of science: one which also contains developed sub-categories associated with Studies of Scientific Knowledge (SSK), and Studies of Expertise and Experience (SEE). The majority of works within this diverse group of studies share a social constructivist perspective, and proceed on the understanding that scientific truth claims, and technological artifacts, are co-produced through a variety of natural, cultural and social practices. The Science and Technology Studies corpus thus tends to demonstrate - through empirical methods - the extent to which contingent historical factors, social values, and group interests, are embedded in the production of scientific practices, artifacts, and truth claims.

Attempts to categorise the field of Science and Technology Studies tend to revolve around certain common themes, which may be categorised chronologically, doctrinally, or thematically. Part one of the thematic review - which blends all three approaches - will describe, and analyse, the development of a category of STS scholarship devoted to the development of theories of scientific expertise. Beginning with Merton's scientific norms, it charts the rise of social-constructivism in the wake of Kuhn's theory of scientific revolutions. It follows the programmatic shift of sociologies of science from the Weak, to the Strong, and explores the doctrinal distinctions between the Edinburgh, and the Bath, schools. It critically analyses the Third Wave of STS scholarship - devoted to Studies of Expertise and Experience - and demonstrates the deficiencies of the current theory, before concluding by suggesting ways in which these deficiencies may be overcome, through the application of relational theories drawn from historical epistemology and the philosophy of knowledge acquisition. The following chapter will focus on the literature relating to the application of STS, and related theories, within the forensic-scientific field.

The common origins of law and science

Lynch contends that law, and science, are separated by a common language. Their shared vocabularies feature similar terms, including; ‘investigation’, ‘proof’, ‘law’, ‘test’, ‘inquiry’, ‘fact’ and ‘evidence’.¹⁴⁷ These terms may carry distinct meanings, particular to their respective fields. However, Lynch argues that the use of parallel terms, in both the legal and scientific fields, indicates a common origin. A number of scholars have attempted to trace this common origin. Their conclusions achieve little by way of consensus, excepting the fact that such studies may point to the dominant historiographical preoccupations of the time. For example, at the dawn of the Scientific Revolution, in the late 17th Century, religion was widely held to have provided the formative basis of both law and science.¹⁴⁸ This view persisted through the Enlightenment, into the 20th Century¹⁴⁹, when it was complemented by a similarly determinative theory based around the significance of economic forces.¹⁵⁰ In the modern era, scholars have embarked on more radical departures from classical social theory, developing arguments, which highlight the significance of disciplinary power and the evolution of governmentality.¹⁵¹ These ‘genealogies of fact’ have unearthed more complex - though no less compelling - narratives.

Shapiro, for example, has traced the *fons et origo* of scientific inquiry back to legal procedures and shared institutional structures. She posits that the commensurate nature of these corresponding institutional arrangements allowed for the easy transmission of common values between discrete fields, both of which were based around a particular

¹⁴⁷ Lynch, M. *Science, Truth, and Forensic Cultures: the exceptional legal status of DNA evidence*, *Studies in History and Philosophy of Biological and Biomedical Sciences* (2013) 44 60-70

¹⁴⁸ Faigman, D., (1999) *Legal Alchemy: The Use and Misuse of Science in the Law* California: W.H.Freeman: Unites States

¹⁴⁹ Thomas Merton’s 1936 doctoral dissertation – ‘The Merton Thesis’ - outlines the links between a particular mode of religious pietism and early experimental science. The thesis continues to form the subject of academic debate. See Shapin, S., [Understanding the Merton Thesis](#), *Isis*, Vol. 79, No. 4 (Dec., 1988), pp. 594–605

¹⁵⁰ See, for example, Freudenthal, G. & McLaughlin, P. (Eds.) (2009) *The Social and Economic Roots of the Scientific Revolution: Texts by Boris Hessen and Henryk Grossmann*, Springer: United States

¹⁵¹ See Foucault, Michel (1997). *Society Must Be Defended: Lectures at the Collège de France, 1975-1976*. New York, NY: St. Martin's Press. pp. 243–244.

mode of objectivity. According to her thesis it was neither God, nor Mammon - but legal bureaucracy - which provided the model for scientific method. Shapin¹⁵² and Schaffer¹⁵³ adopt a similar post-structuralist perspective, citing the congruence between the courtroom and the scientific experiment, both of which serve as discrete sites of knowledge-making, in which disinterested participants apply impersonal rules, within the context of a body transparent and 'rational' procedures, all of which are designed to produce 'morally certain' resolutions on 'matters of fact'¹⁵⁴.

Thus, in 1659, when Robert Boyle completed the construction of his *machina Boyleana*¹⁵⁵, and embarked on a program of experimentation in order to 'solicit and interrogate the testimony of nature'¹⁵⁶, his determinations were - at that time - deemed to lack the epistemological authority of those derived as a result of inferential legal reasoning. However, Shapiro¹⁵⁷ has noted that - by the mid-18th Century - a distinct split had developed between the moral certitude of the courtroom (expressed as 'a satisfied conscience', or proof 'beyond reasonable doubt'), and the 'mathematical certainty' to which science aspired.¹⁵⁸

This distinction became more pronounced throughout the course of the 20th century, as science began, increasingly, to become characterised by a particular set of norms. The 'norms of science', as described by Merton¹⁵⁹, may be listed as follows: communalism,

¹⁵² Shapin, S. (1994) *The Social History of Truth* (Chicago: Chicago University Press)

¹⁵³ Shapin, S. & Schaffer, S. (1985) *Leviathan and the Air Pump* (Princeton, NJ: Princeton University Press)

¹⁵⁴ Shapin, S. & Schaffer, S. *Ibid.*

¹⁵⁵ A pneumatic engine designed to facilitate experimentation.

¹⁵⁶ Shapiro, B. J. "*Beyond Reasonable Doubt*" and "*probable Cause*": *Historical Perspectives on the Anglo-American Law of Evidence*, (University of California Press, California, 1991)

¹⁵⁷ Shapiro, B. J. "*Beyond Reasonable Doubt*" and "*probable Cause*": *Historical Perspectives on the Anglo-American Law of Evidence*, (University of California Press, California, 1991)

¹⁵⁸ Shapiro, B.J. *To a Moral Certainty: Theories of Knowledge and Anglo-American Juries 1600-1850* *Hastings Law Journal* 1986, 38, 153-193; Shapiro, B. J. "*Beyond Reasonable Doubt*" and "*probable Cause*": *Historical Perspectives on the Anglo-American Law of Evidence*, (University of California Press, California, 1991)

¹⁵⁹ Merton, R.K. (1973) [1942], "*The Normative Structure of Science*", in Merton, Robert K., *The Sociology of Science: Theoretical and Empirical Investigations*, Chicago: University of Chicago Press

universalism, disinterestedness, and organised scepticism. Paradoxically, it should be noted that Merton's normative categorisation - which sees science as striving towards an ideal of impartiality and rationality - was heavily influenced by Boyle, whom - as we have shown above - had been heavily influenced by the 'rational bureaucracy' of the courtroom. Thus, it is posited that the normative roots of science may be traced to the fountainhead of legal inference.

As with legal positivism, the scientific method - as Merton describes it - is composed of an agglomeration of normative outputs, which - in the social context - combine to produce a privileged scientific *leitkultur*. The scientist thus speaks as an authoritative representative of a body of privileged truth claims, which are both esoteric and positivistically inflected. Collins, describing the widely-held, Mertonian view of scientific method, goes as far as to assert that [until the 1960's] 'it was inconceivable that decision-making in matters that involved science and technology could travel in any other direction than from the top down.'¹⁶⁰ Further, that the role of social science was to reinforce the nostrums of positivist science, rather than to question their basis.

Merton thus provided the means by which to recognise legitimated scientific expertise. However, studies of normative science also needed to account for the changing - and often contradictory - nature of scientific truth claims. This development is attributed to Thomas Kuhn, whose work provided the first comprehensive account of the nature of scientific revolutions.¹⁶¹ Kuhn argued that paradigm shifts in the natural sciences are best viewed as tectonic conceptual changes, which are - at first - resisted, later achieving the momentum necessary to overthrow the prevailing dogma and gaining widespread acceptance. The classic example is provided by the Scientific Revolution, which swept away the earth-centred Aristotelian universe and replaced it with a Heliocentric model, thus inculcating a mode of inquiry through which all natural phenomena could be tested by way of skepticism, empiricism and mathematisation. In addition to generating epistemological changes, Kuhn demonstrated that scientific paradigm shifts may inculcate profound,

¹⁶⁰ Collins, H.M. & Robert Evans (2002) 'The Third Wave of Science Studies: Studies of Expertise and Experience', *Social Studies of Science* 32(2): 235–296 at p.239

¹⁶¹ Kuhn, T. (1962) *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press)

frequently anomic, social changes.¹⁶² Kuhn attributed such anomic effects to the incommensurability of competing paradigms. The ‘old’ and ‘new’ paradigms would stand in opposition, and - following a brief struggle - one view would prevail, to the exclusion of the other. The dominant view, once embedded, would then generate its own body of ‘normal science’.

Ironically, Collins claims that Kuhn’s work was itself responsible for a paradigm shift in Science and Technology Studies, breaking the wave of ‘positivism’ and ushering in the era of ‘unbridled social constructivism.’¹⁶³ However, Collins’ ‘First Wave of Social Studies of Science’ must be approached with caution. It is a neat categorisation: one, which Collins concedes, may do violence to the subject through the compression of the ‘work of many authors and thinkers into a few simple formulae.’¹⁶⁴ Nonetheless, Collins and Evans were not dissuaded, for such broad categorisation was deemed necessary in order to initiate their own - programmatic - paradigm shift in Science and Technology Studies. Collins and Evans’ ‘Third Wave’ theory, will form the subject of comprehensive discussion below. However, for present purposes, it is sufficient to note that any attempt to periodise this diverse body of studies - particularly a chronological attempt to portray the development of ‘the problem of scientific legitimacy’ in Hegelian terms (thesis, antithesis, and synthesis) - may be misleading.¹⁶⁵

The taxonomy of expertises

In order to analyse the nature of forensic-scientific expertise, as embodied and enacted by FSNI personnel, it is necessary to revisit Collins and Evans’ hierarchical categorisation of

¹⁶² The poet John Donne wrote of the anomie of the Copernican Revolution. See also John Keats’ *Lamia* (1884), in which the poet laments the fact that Sir Isaac Newton had ‘unweaved the rainbow’ by using a prism to split light into its constituent parts.

¹⁶³ Jasanoff, S. (2003) ‘*Breaking the Waves in Science Studies: Comment on H.M. Collins and Robert Evans, ‘The Third Wave of Science’*’: *Social Studies of Science* 33/3(June 2003) pp. 389–400 at p.390

¹⁶⁴ Collins, H.M. & Robert Evans *Op. Cit.* at p.237

¹⁶⁵ *Infra.*

‘expertises’, as introduced in earlier chapters. According to Collins, and Evans, the array of ‘expertises’ can be tabulated, as follows:

Ubiquitous expertises					
Dispositions	Interactive ability			Reflective ability	
	<i>Ubiquitous tacit knowledge</i>			<i>Specialist tacit knowledge</i>	
Specialist expertises	Beer-mat knowledge	Popular understanding	Primary source knowledge	Interactional expertise	Contributory expertise
	<i>Polimorphic</i>			<i>Mimeomorphic</i>	
Meta-expertises	EXTERNAL		INTERNAL		
	Ubiquitous discrimination	Local discrimination	Technical connoisseurship	Downward discrimination	Referred expertise
Meta-criteria	Credentials		Experience	Track record	

Table 1 : Collins and Evans’ ‘Periodic Table of Expertises’¹⁶⁶

Collins and Evans’ taxonomic approach to the sociology of scientific expertise and experience is reducible to a conceptual ‘Periodic Table of Expertises’ (fig.1). Progression both down, and along, the table (from left to right) brings the reader in contact with more specialist, and procedural, forms of expertise. The table has a baroque quality, given the inclusion of two ‘dispositions’ and a final series of ‘meta-criteria’, which non-experts may use to judge an experts credibility and reliability. For present purposes discussion will be limited to the first three rows of the ‘periodic’ table.

Ubiquitous expertises

Ubiquitous expertises are those proficiencies, which all citizens must possess in order to live in a particular society. It is a category of universal application, which includes the expertise needed to make political judgments or to speak a native language. These ubiquitous expertises emerge from a mass of tacit knowledge (defined by Collins and

¹⁶⁶ See Collins, H. & Evans, R. 2007, *Rethinking Expertise* (University of Chicago Press: Chicago) at p.14

Evans as ‘things you just know how to do without being able to explain the rules for how you do them’¹⁶⁷).

Dispositions

Collins and Evans include personal qualities whilst discounting them as ‘not very important’. They include two dispositions: interactive ability (linguistic fluency) and reflective ability (analytic flair). Having placed communication skills, and the ability to make political decisions, within the category of ubiquitous expertises, Collins and Evans go on to assert that more skillful iterations of these ubiquitous expertises are the product of innate disposition, rather than the product of learning and development which might place them in the category of specialist expertises.

Specialist Expertises

The specialist expertises rest upon a body of ubiquitous expertise. Beginning at the first rung, we encounter what Collins and Evans call ‘Beer-mat knowledge’ by which they mean those forms of general propositional knowledge, which may increase a holder’s stock of ‘facts’ but which are, in and of themselves, insufficient to serve a functional purpose. The next category relates to popular understandings of scientific practices and developments, as derived from the media and books. Knowledge derived from such sources enables the construction of basic inferences and is ‘transmissible as a set of ideas.’¹⁶⁸ Popular understandings of science populate the outer ring depicted in Figure One and are marked by relative certainty, faith in a unified community of experts, and a lack of detail.

Collins and Evans then insert a third category of ubiquitous tacit knowledge. Primary Source Knowledge is a somewhat ambiguous category comprising a population of non-institutional actors, outwith the scientific field, who nonetheless interact with the primary literature on a particular topic.

At this stage Collins and Evans climb beyond the foothills of ubiquitous tacit knowledge, towards the domain of expertise *in stricto sensu*. According to their thesis, these developed

¹⁶⁷ See Collins, *Ibid.* at p.13

¹⁶⁸ See Collins, *Ibid.* at p.20

forms of expertise can only be gained through the accumulation of specialist tacit knowledge and ‘immersion in the specialist culture.’¹⁶⁹ Thus, they return to the ‘enculturation theory’ first advanced under EPOR.

Collins and Evans novel contribution to the sociology of expertise and experience derives from their decision to split the traditional category of specialist expertise into two sub-categories: contributory, and interactional, expertise. Contributory Expertise in a particular field allows the acquirer to contribute to that field through the efficient utilisation of an internalised set of skills.

‘When expert status is achieved, complete contexts are unselfconsciously recognized and performance is related to them in a fluid way using cues that it is impossible to articulate and that, if articulated, would usually not correspond, or might even contradict, the rules explained to novices.’¹⁷⁰

Contributory experts are seen as needing two additional faculties: ‘translation’ (the ability to move between different social worlds)¹⁷¹ and ‘discrimination’ (the ability to make distinctions between different kinds of claims and sources of credibility). This flexible definition of contributory expertise may serve as a useful tool with which to interrogate the nature of acquired skills, and can be applied to a wide range of expertises, from driving a car to gravitational-wave research. However, Collins and Evans categorisation fails to account for the conditions under which DNA-profiling experts enact their expertise. Forensic-scientific investigations are the result of co-production with non-experts; they are constrained by regulatory protocols of universal application; and are conducted under the external gaze of auditors, policy-makers, and other institutional actors within the criminal justice system. Therefore, any analysis of forensic-scientific expertise must account for these differences.

¹⁶⁹ See Collins, *Ibid.* at p.24

¹⁷⁰ *Loc. Cit.*

¹⁷¹ The prospect of interdisciplinary is largely ignored under Collins’ and Evans’ schema and can be contrasted with the reflexive epistemological relativism argued for, *infra*.

The final categorisation, introduced by Collins and Evans, relates to ‘interactional expertise’. As with contributory expertise, this category is ‘deeply tacit-knowledge-laden’¹⁷². However, interactional experts are merely conversant in the language of a particular specialist field absent of actual experience in its practice. This category would therefore apply to professionals within the legal field, whose specialist knowledge allows them to interrogate the truth claims of contributory experts from the forensic-scientific domain. Interactional expertise is therefore parasitic on contributory expertise and lacks the self-generating capacities and transmissibility of the prior category.

The ‘Third Wave’ of Science and Technology Studies

In order to offer a more complete analysis of Collins and Evans theory of expertise, it is first necessary to situate their theory within the Science and Technology Studies corpus. In their 2002 Discussion Paper,¹⁷³ *The Third Wave of Science Studies: Studies of Expertise and Experience*, the authors themselves suggest that Studies of Expertise and Experience (SEE) constitute a ‘Third Wave’ of STS scholarship: one which supercedes all previous efforts to analyse the nature of scientific expertise.

According to Collins and Evans tripartite survey of STS scholarship, Wave One STS scholarship comprised the pre-Kuhnian studies of positivistic science: those which have generally been associated with the Weak Programme. Wave Two comprises the socially-constructivist studies of the Edinburgh, and Bath, schools, and associated works. Wave Three is an attempt to steer the course of STS scholarship towards Studies of Expertise and Experience (SEE). In doing so, Collins and Evans recommend a break with relational approaches, regressing to a normative position which appears to be indistinguishable from that of the Wave One studies which they had previously derided. Indeed, given Collins’ vociferous criticism of ‘First Wave’ sociology - particularly its subservience to a positivistic view of scientific method - it is paradoxical that Wave Three promulgates,

¹⁷² See Collins, *Ibid.* at p.28

¹⁷³ Collins, H.M. & Evans, R. *The Third Wave of Science Studies: Studies of Expertise and Experience* at p. 240

‘...a preference for the norms and culture of evidence-based scientific argument [which] cannot be relinquished in the process of policy-making without giving up much more than [we] would want to surrender.’¹⁷⁴

Collins and Evans assert that such a move is necessary in order to provide STS with the means to address the problems associated with the epistemological privileging of scientific expertise in wider society. Their stated objective is ‘to find a rationale which is not inconsistent with the last three decades of work in science studies’. This is deemed necessary due to the perception that no STS scholars ‘have solved [the problem of expertise] in a way that is completely intellectually satisfying.’¹⁷⁵ Thus, the requirement for Wave Three:

‘Wave Three is one of the ways in which Wave Two can be applied to a set of problems that Wave Two cannot handle in an intellectually coherent way.’¹⁷⁶

Thus, Collins proposes that the application of scientific-realist arguments from a socially constructivist perspective would lead to intellectual incoherence: a fundamental incoherence, which can only be rectified through a normative regression, which will allow Wave Three to apply normative arguments from the perspective of scientific realism. This paradoxical claim lies at the heart of Collins approach, and informs much of Wave Three thinking.

‘Wave Three involves finding a special rationale for science and technology, even while we accept the findings of Wave Two – that science and technology are much more ordinary than we once thought.’

In counterpoint, as stated above, it may be argued that Collins’ Wave Three is not a development of Wave Two but simply a regress to Wave One, albeit a Wave One substantially diminished on the shoals of social constructivism. It is a regress, which once again places the sociology of scientific knowledge in thrall to positivist science.

¹⁷⁴ See Collins, H. & Evans, R. 2007, *Rethinking Expertise* (University of Chicago Press: Chicago) at p.11

¹⁷⁵ Collins, H & Evans, R. *Ibid.* at page 236

¹⁷⁶ Collins, H & Evans, R. *Ibid.* at page 240

While Collins and Evans may posit their theory on a critique of the shortcomings of Wave Two, their critique is, itself, flawed. Collins and Evans attribute an extreme epistemological relativism to social constructivism that it has never claimed for itself (save for its stronger proponents and iterations), a misattribution which is freighted with the unnecessary baggage of moral relativism, and which exemplifies their ‘persistently reductive reading of sources.’¹⁷⁷ In counterpoint, Jasanoff highlights the rich diversity of ‘Wave Two’ scholarship, which, ‘for more than a generation now, has formed part of a project of social theorizing that goes far beyond the relativism which the authors focus on.’

‘To say that work as diverse as that of Brian Wynne, Michel Callon, Bruno Latour, and for that matter my own (compare with C&E, 2002: 276–77), represents Wave Two’s preoccupation with relativism is to seriously misread this work.’¹⁷⁸

A further criticism of Collins and Evans theoretical approach revolves around their exclusive focus on a contemporary body of expertise enacted by a core-set of ‘esoteric’ research scientists. The emphasis on contemporary expertise flows from their assertion that past scientific disputes are deemed to have been largely settled. Therefore, the knowledge claims which exist behind the wave-front of research science, and which compose the greater part of scientific knowledge, are accorded a similar status to that which Wave One sociologists, and the Weak Programme, accorded to normative, positivistic science. Collins and Evans fail to countenance the argument that the acceptance of such knowledge claims, over an extended period of time, may not simply entail that such claims represent ‘natural’ scientific facts. Rather, such acceptance may be the product of continuing social factors associated with the longevity of a dominant social class, and the valency of a particular paradigm.

In addition to their chronological categorisation, Collins and Evans argue for the ‘necessary compartmentalisation’ of a discrete body of esoteric research science. They deem such compartmentalisation as necessary on pragmatic grounds. However, it may be argued that

¹⁷⁷ Jasanoff, S. (2003) ‘*Breaking the Waves in Science Studies: Comment on H.M. Collins and Robert Evans, ‘The Third Wave of Science’*’: *Social Studies of Science* 33/3(June 2003) pp. 389–400 at p.391

¹⁷⁸ Jasanoff, *ibid.* at page 391

the need to compartmentalise is not only pragmatic, but crucial to the validity of Wave Three theorizing. In reality, the Wave Three position can only be maintained for as long as it is incubated within the confines of a discrete field of contemporary research science. Collins and Evans strive to demarcate an area for contemporary research science that is epistemologically privileged but, in so doing, limit the application of their theory. As Jasanoff states, activities within the core-set may be only one of a number of modalities which must be accounted for when making decisions relating to the status of scientific expertise:

‘Just as in sociology of science, ‘facts’ are depicted as the results (not the causes) of closure of controversy, so ‘core-sets’ in public domain technical controversies are the results, not the causes, of controversies settling into normalized patterns of debate.’¹⁷⁹

Further criticism of Wave Three scholarship extends to Collins and Evans methodological aim, whose objective is to unearth, and reify, a kernel of epistemologically-privileged contributory expertise. The limitations of Collins methodological approach become apparent when their approach is translated to other domains beyond that of esoteric research science. Expertise, as practised, is multi-faceted, and may be exercised - not merely through the dissemination and transmission of knowledge - but through; discretion, understatement, deflection, or even silence. These features of expertise are regularly encountered in professional practice within the legal sector. However, methodological techniques, which attempt to unearth propositional knowledge may lack the ability to capture much that can be classified as practiced expertise. Therefore, more suitable alternatives will be proposed, which refract expertise, and measure the flow of knowledge across sub-system boundaries, between modalities, and through time.¹⁸⁰

If Collins theory of scientific expertise represents the most developed sociological approach then it is one, which, for all of its sophistications, remains flawed in its conception, and may be ill-suited to exploring the nature of scientific expertise: limitations which are thrown into sharp relief when attempting to analyse scientific expertise

¹⁷⁹ Jasanoff, *ibid.* at page 395

¹⁸⁰ See the Shadow Report Writing technique, *infra.*

conducted in conformation with accepted natural principles, under the external gaze of regulatory objectivity, in conformation with protocols, as part of a system of interdisciplinary co-production.

Law, science, and expertise across disciplinary boundaries: macro-sociological theories and governmentality

As demonstrated above, law's interaction with other disciplines is marked by an increasing reliance on the authority of experts to inform (or even to determine) the practical reasoning of the courts in relation to legal fact-finding.¹⁸¹ The 'rise of the expert' is frequently viewed as a symptom of functional specialisation within society, and its subsequent colonisation by diverse professions.¹⁸² This conflation of expertise with specialisation derives largely from the writings of Weber, who, discussing the role of knowledge in society, uses the terms 'experts' (*Experten*) and 'specialists' (*Spezialisten*) interchangeably. Weber's normative account of expertise is central to 'Science as a Vocation', in which he argues that:

'only by strict specialization can the scientific worker become fully conscious, for once and perhaps never again in his lifetime, that he has achieved something that will endure. A really definitive and good accomplishment is today always a specialised accomplishment.'¹⁸³

Weber's view of expertise, as being intrinsically bound with specialisation, is cognate with his views on the rationality of Western economics and administration.

'Office management, at least all specialised office management – and such management is distinctly modern – usually presupposes thorough training in a field of specialisation. This, too, holds increasingly for the modern executive

¹⁸¹ E.g. Lord Woolf, *Access to Justice: Final Report* (London: Her Majesty's Stationery Office, 1996), ch. 13.

¹⁸² E.g. R. Porter, *England in the Eighteenth Century*, 2nd edn (Harmondsworth: Penguin, 1990), p. 81. See also N. Luhmann, *Differentiation of Society*, trans. S. Holmes and C. Larmore (New York: Columbia University Press, 1982).

¹⁸³ Weber, M (1919) *Science as a Vocation* from *Gesammelte Aufsätze zur Wissenschaftslehre* (Tübingen, 1922),

and employee of a private enterprise, just as it does for the state officials.’¹⁸⁴

What Weber appears to describe is the colonisation of society by experts - a process with ramifications, which echo beyond the field of scientific endeavour. Weber is not alone. Since the beginnings of social-scientific inquiry, scholars have focussed on the development of expertise, its inextricable links to democratic government, and the interactions between expertise and democratic values. Weber's enquiries were preceded by those of Henri de Saint-Simon, and Auguste Comte, both of whom argued for the reconfiguration of society under the direct governance of scientific precepts rather than politics. Their technocratic approach to sociology had, in turn, a formative influence on thinkers as diverse as Mill, and Marx.¹⁸⁵

Returning to the Weberian model, expertise is seen as providing the government with the required knowledge regarding which means to select in order to reach a political goal. Weber noted that experts make decisions based on verified knowledge, while politicians (or citizens) attempt to negotiate goals, based on norms and values. Therefore, the establishment of a tier of knowledge-based administrators, whose competences were limited by speciality, and compartmentalized within a norm hierarchy, would provide political authorities with a powerful instrument with which to attain their goals. It is banal to note that the modern politician has learned to make use of such specialist, objective knowledge as the means by which to attain political goals.¹⁸⁶

The gradual encroachment of the expert administrator on the democratic sphere by expert administrators observed by Jurgen Habermas, who - contrary to Weber - noted the tendency for the language of systems (which he defined as 'steering media') to become superimposed over the natural, and spontaneous, communications of ordinary citizens.

¹⁸⁴ Weber, Max (1968), *Economy and Society: An Outline of Interpretive Sociology*, Guenther Roth and Claus Wittich (eds.) (Berkeley: University of California Press) at 158

¹⁸⁵ See Eriksen, E.O. (2011) *Governance between expertise and democracy: the case of European Security*, *Journal of European Public Policy*, 18:8, 1169-1189

¹⁸⁶ Turner, Stephen. 2008. *Blind Spot? Weber's Concept of Expertise and the Perplexing Case of China*. in *Max Weber Matters: Interweaving Past and Present*, edited by Fanon Howell, Marisol Lopez Menendez, and David Chalcraft. Aldershot, UK: Ashgate Publishing, all rights reserved. Pp. 121-134.

These judgments, and opinions - the discourses of technocrats and experts - were endowed with authority by law, to the extent that they came to replace the consensual, ethical communications of the 'lifeworld'.¹⁸⁷

Habermas' was heavily influenced by Foucault, whose work focused on the instrumental deployment of expertise by liberal government, as a means to influence and discipline the minds and bodies of human subjects.¹⁸⁸ Foucault noted the ways in which expert knowledge(s) - in medicine and science - were disseminated, and promoted, as incontestable facts. Facts, which form the taken-for-granted boundaries of common discourse. These expert knowledge's thus formed the frame, which defined the parameters of power and authority for any given era.

Foucault further considered the utility of expertise to the art of liberal government, in a process which he termed 'bio-politics'.¹⁸⁹ Bio-politics became a central theme of Foucault's work: an ordering concept which allowed governments to manage and govern populations effectively. Governance was dispersed amongst the *epistemes* of law, medicine and psychiatry, and these expert knowledge's - legitimated by their seeming neutrality - would prove effective in their ability to penetrate the private family unit. From within, they could then manage, reshape and enroll individuals as disciplined subjects.

The macro-theoretical groundwork provided by Weber, Habermas, and Foucault, continues to influence discussion of the role of expertise. Neo-Weberian perspectives focus on the ways in which professional groups further their collective interests, through processes of

¹⁸⁷ Habermas, J. *The Theory of Communicative Action*, vol. 2 (Cambridge, CUP, 1987) at p.183

¹⁸⁸ See Foucault, M. & Deleuze, G. (1977) "Intellectuals and Power" in *Language, Counter-memory, Practice: Selected Essays & Interviews*, Bouchard, DF (Ed.)(Ithaca: Cornell University Press), (1979) *Discipline and Punish: the birth of the prison*. (New York: Vintage), (1980) *The History of Sexuality Vol. 1* (New York: Vintage), (1994) *The Birth of the Clinic: An Archaeology of Medical Perception* Translated by Sheridan A. New York: Vintage Books, (2006b) *Psychiatric power: Lectures at the Collège de France 1973–1974*, ed. J. Lagrange, trans G. Burchell. New York: Vintage Books

¹⁸⁹ Foucault describes bio-politics as 'a new technology of power...[that] exists at a different level, on a different scale, and [that] has a different bearing area, and makes use of very different instruments.' Bio-politics was predicated on the use of measurements, indices and statistics to create, identify and categorise new populations. Examples included measurements of the 'ratio of births to deaths, the rate of reproduction, the fertility of a population, etc.' See Foucault, Michel (1997). *Society Must Be Defended: Lectures at the Collège de France, 1975-1976*. New York, NY: St. Martin's Press. pp. 243–244.

inclusion and exclusion. Such theories view scientific controversy and consensus-building as activities central to the shaping of group cohesion.¹⁹⁰ A further demarcation theory revolves around the proposition that disciplines and professions themselves define their borders, through ‘boundary work’. Thus, the practice of inclusion and exclusion comes to determine what is science, and what is non-science. This binary demarcation is marked by negotiations between communities who claim scientific expertise, and allied institutional actors. The above theories will be referred to throughout the discussion and analysis of empirical data, in the following section.

¹⁹⁰ See Collins, H. & Evans, R. 2007, *Rethinking Expertise* (University of Chicago Press: Chicago); Lawless, C (2016) *Forensic Science: A Sociological introduction* (Routledge: New York) at page 3;

Part Three: Efficiency

Economic rationalisation and efficiency in forensic science

The third of the major themes related to the marketisation of forensic DNA profiling, is efficiency. Marketisation is underpinned by fiscal and ideological principles that are most commonly associated with ‘economic rationalization’, and is characterized as the means through which to deliver efficiencies to a particular sector.

In the UK Government’s Response to the Science and Technology Committee Report on the closure of the publicly operated Forensic Science Service, and the transition to a marketised form of provision, primary objectives are stated which conform with the key features of economic rationalization.

‘Our primary objectives for the transition are: To ensure the continued supply of effective forensics to the CJS; to provide value for money for the taxpayer; and to create a stable, healthy and competitive market for forensics, that will provide cost effective and innovative forensic services to support the CJS...We believe that a mixed approach considering both procurement of FSS’s work and the sale of...FSS’s business and assets is the best approach to mitigate risks for all and ensure best value for money for the taxpayer.’¹⁹¹

It is necessary to establish in greater detail what is meant by the term ‘economic rationalization’ and its key elements; value, and cost effectiveness. Discussion and thematic review of such concepts may be germane, insofar as it provides a clearer account of the basis for marketisation, and the connection between efficiency and standardisation, as discussed in the previous section.

¹⁹¹ The Government Response To The Seventh Report From The House Of Commons Science And Technology Committee Session 2010-12 Hc 855

The concept of economic rationality is used across many domains, to many ends, and is frequently accompanied by ‘considerable imprecision, confusion and controversy.’¹⁹² Lawless talks of the marketisation of forensic science in terms of ‘the shaping of neo-liberal science’, the latter term being synonymous with economic rationality. Garland notes that innovations aimed at promoting efficiency are frequently labeled as ‘neo-liberal’, though these measures exhibit neither a ‘strict logic, nor a tight conceptual structure. Rather, [they form] a ragbag of techniques, models, analogies and recipes for action that are loosely bound up together by their appeal to economic rationality.’¹⁹³ Brenner goes so far as to call ‘neo-liberalism’ an unhelpful ‘rascal concept’, while Peck suggests that it has become little more than ‘radical-theoretical slogan.’¹⁹⁴ A review of the literature would therefore suggest that the term is malleable, and serves a variety of purposes from which it is difficult to distil any rigorous and exhaustive definition.¹⁹⁵

Indeed, the diverse nature of the literature on economic rationality reveals that the concept itself has undergone a significant transformation. Attempts to distill further detail regarding the meaning of economic rationality, and to describe its most salient features, may therefore prove difficult. Further, even if it is possible to infer the presence of actually-existing iterations of ‘neo-liberalism’ from the presence of those features most closely associated with economic rationality - a preoccupation with promoting value and cost-effectiveness through marketisation - such phenomena may be adapted to local settings and may also be contingent upon pre-existing practices. Therefore, this section of the thematic review will avoid these politicized terms in favour of a focus on more tractable analysis focused on issues of the cost-effectiveness and value of DNA profiling, alongside a review of the academic literature which discusses its contribution to the criminal justice system.

¹⁹² Brenner, N., Peck, J. & Theodore, N. *After Neoliberalization* Globalizations, September 2010, Vol.7, No.3, pp. 327-345

¹⁹³ Garland, D. *The Culture of Control* (OUP: Oxford, 2002) at p.190

¹⁹⁴ Peck, J. *Geography and Public Policy: constructions of neoliberalism* Progress in Human Geography (2004) 28 pp. 392 – 405 at page 403

¹⁹⁵ For a review of the transformation of the concept of neo-liberalism see Boas, T.C. & Gans-Morse, J., *Neoliberalism: From New Liberal Philosophy to Anti-Liberal Slogan*, (2009) Studies in Comparative International Development 44 (2), 137-161

Efficiency and forensic science: overview

The previous section considered one of the dominant political-theoretical approaches to understanding efficiency, if only to reject it, having attempted to distil its main principles, and outline its characteristic features. In order to understand the way in which efficiency, social forces, and institutional imperatives, interact with the marketised production of forensic scientific knowledge in the UK, it is necessary instead to begin with a broad review of the policy discussions which led to the privatisation of the sector. The discussion proceeds by way of an examination of science and technology policy agendas. It is hoped that - as well as indicating the extent to which commercial discourses now shape the forensic scientific process - the discussion will demonstrate the central importance of efficiency (and standardization) as the mechanism through which reforming goals are attained. That will be the central topic of the following section.

Efficiency and Forensic Science Policy

To reiterate the foregoing discussion, it is clear that marketisation is most closely associated with attempts to privatise organisations which had hitherto been publicly funded and managed directly by the state. However, even in the absence of a complete market, organisations may be opened up to marketisation through processes of commercialization and commodification. The continued expansion of economic policy has demonstrated that no sector should consider itself to be impervious to marketisation. The 'invisible hand' of the market has touched utilities and public services alike; from water and electricity production, to healthcare and defence. Nor has the shift from an industrial mode of production to a service economy impeded its advances. The production of knowledge may have largely replaced the production of goods, but no sector of knowledge production has been left unaltered by the 'logic of the market'.

In order to understand the ways in which the forensic scientific field has been directed towards economic goals of increased efficiency and value, it is first necessary to focus on the governing bodies who shape policy goals. The key to understanding the shifting dynamic between science and commerce is therefore science policy. The interplay between the scientific community and society at large can – to some degree - be understood through

a study of the dominant policy culture, and it might be posited that any study of the developing forensic scientific field is naive to the extent that it remains uninformed by a science and technology policy perspective¹⁹⁶.

Salomon defines science policy as comprising those,

‘collective measures taken by a government in order, on the one hand, to encourage the development of scientific and technical research and, on the other, to exploit the results of this research for general political objectives.’¹⁹⁷

The resulting science policy cultures are not homogenous. They can be related to distinct ‘national styles’, which reflect different blends of bureaucratic, academic, economic and civic policy inputs.¹⁹⁸ Nonetheless, despite national specialties, it is possible to discern underlying currents which conform to international agendas.

Academics have noted the growing dominance of a distinctively economic policy culture, beginning in the 1980's, with a corresponding weakening of the influence of civic policy culture. At that time 'Foresight' became one of the central policy methodologies.¹⁹⁹ Under this methodology, committees and programs for advanced technology were created in most Western countries, which attempted to bring together a variety of specialised actors, in order to visualise future possibilities and options that would be converted into policy inputs. These elite groups of experts shaped an alliance between science, commerce and bureaucracy to the exclusion of more democratic forms of civic participation. The fruits of their labour have been termed 'orchestration policy', a raft of measures shaped to provide the means to integrate science with the strategies of the private sector.

¹⁹⁶ Lakatos, I. *The Role of Crucial Experiments in Science*, (1974) *Studies in History and Philosophy of Science*, Vol.4(4), pp.344-355

¹⁹⁷ Salomon, J.J. (1973) *Science and Politics*, London: MacMillan at pp.45-46

¹⁹⁸ Jasanoff, S. (Ed.) *Handbook of Science & Technology Studies* (1995) New York; Sage

¹⁹⁹ C. Daheim, C. & Uerz, G. *Corporate foresight in Europe: from trend based logics to open foresight* (2008) *Technology Analysis & Strategic Management*, vol. 20, pp. 321-336

Reactions to such strategic integration amongst academics have been mixed. Mirowski²⁰⁰ notes that the responses to advancing commercialisation within scientific communities have fallen into two distinct categories. The first group views the influx of commercial imperatives as an unwelcome intrusion, and resists a perceived breakdown of those attributes which separate science from other social activities. This approach is typified by Brown, who points to,

‘an increased dependence on industry and philanthropy...an increased amount of resources being applied to practical subjects; a proprietary treatment of research results, the commercial interest in secrecy overriding the public's interest in free, shared knowledge; and attempts to run [scientific endeavours] more like a business that treats industry as clients and ourselves as service providers with something to sell.’²⁰¹

Mirowski labels this group 'Mertonian Tories'²⁰² in reference to their supposed subscription to Merton's concept of the ideal scientific community.²⁰³ Mirowski's characterisation of these scholars as being overly pessimistic in their predictions is not borne out by the theoretical sophistication and objective tone of their contributions. Nonetheless it remains a useful categorisation. Running counter to the Mertonians, Mirowski identifies another body of literature, which he attributes to the 'Economic Whigs'. These commentators focus on the allocation of outputs, whilst adopting the view that the 'producers' and 'consumers' remain ‘relatively unscathed through the process of commercialisation.’²⁰⁴ Mirowski notes

²⁰⁰ Mirowski, P. & van Horn, R. *The Contract Research Organisation and the Commercialisation of Scientific Research* *Social Studies of Science*, Vol.35, No. 4 (2005) pp.503-548

²⁰¹ Brown, J.R. (2001) *Who Rules in Science? An Opinionated Guide to the Wars* (Harvard: Harvard University Press)

²⁰² Examples might include Budowle, Kayser and Sanjantilla (2011), writing on the closure of the Forensic Science Service, and Randalls (2010) writing on the commercialisation of meteorological knowledge.

²⁰³ Merton sought to understand scientists as a group defined by their common project: building a body of reliable knowledge about the world and how it works. Like any community the ‘tribe of science’ had shared normative values; universalism (the idea that the important issue is the content of claims about knowledge and not the identity of the person making the claim); communism (the view that scientific knowledge is a shared resource); disinterestedness (in the benefits attendant to the discovery of knowledge) and organized skepticism (in order to rigorously test knowledge claims).

²⁰⁴ Mirowski, *op. cit.* at p.504

their tendency to gather empirical evidence to support the assertion that the commercialisation of science is inevitable. Mirowski concludes that the concerns raised by the Mertonian Tories, will not be solved by looking to the Economic Whigs. Rather, he recommends that the best way,

‘to encourage debate over the possible consequences of the commercialisation of science since the 1980's is to pay more attention to functional innovations in the organisation of [science and] scientific research within the corporate sphere.’²⁰⁵

During the debates leading up to the privatisation of the Forensic Science Service, and through the ensuing committee inquiries, both congregations are represented. Established academics and practitioners such as Roberts,²⁰⁶ Gill,²⁰⁷ and Boudowle,²⁰⁸ engaged in robust criticism of the marketisation of forensic services in general, and the privatization of the FSS in particular. These perspectives are met by equally lucid proponents of privatization, such as McAndrew²⁰⁹, Gallop, and Brown²¹⁰. Also, by the UK Government, whose response to the findings of the Science and Technology Committee Inquiry into the closure of the FSS, concludes;

‘We do not agree that the forensic procurement framework does not adequately recognise the value of complex forensic services. All forensic services are adequately valued - the framework delivers the market price for services, whether complex or not.’

²⁰⁵ Mirowski, *ibid.* at p.505

²⁰⁶ Roberts, P. 1996. What price a free market in forensic science services? The organization and regulation of science in the criminal process. *British Journal of Criminology* 36: 37–60.

²⁰⁷ Peachy, P. 2012. Privatisation is a catastrophe, warns godfather of forensics. *The Independent*, April 2. Accessed April 3, 2012, <http://www.independent.co.uk/news/uk/crime/privatisation-is-a-catastrophe-warns-godfather-of-forensics-7606789.html>.

²⁰⁸ Boudowle, B., M. Kayser, and A. Sanjantila. 2011. The demise of the United Kingdom’s forensic science service (FSS): Loss of the world’s leading engine of innovation and development in the forensic sciences. *Investigative Genetics* 2:4.

²⁰⁹ William P. McAndrew (2012): Is Privatization Inevitable for Forensic Science Laboratories?, *Forensic Science Policy & Management: An International Journal*, 3:1, 42-52

²¹⁰ Gallop, A., & Brown, J. (2014). The market future for forensic science services in England and Wales. *Policing: A Journal of Policy and Practice*, 8(3), 254-264.

Efficiency through privatization: global perspectives

A review of the literature relating to forensic science reveals little in the way of debate. The study of forensic science policy and management has been largely ignored, with one notable exception. The US Journal of Forensic Science Policy and Management provides a voice for Mirowski's 'economic whigs' to advance a modernising agenda in a collection of papers that are as prescriptive as they are descriptive. McAndrew²¹¹, for example, wonders whether the privatisation of forensic science laboratories in the US is not inevitable. Citing the example of the privatisation of forensic science provision in the UK, he develops an economic argument which is undergirded by all of the nostrums of classical liberal economics but fails to address any of the realities. McWilliams rebuts the claim that forensic sciences are 'public goods' which should be left in the public sector. He asserts that a service which benefits a large section of the public does not *need* to be provided publicly. While it is true that public provision is not an absolute necessity, McAndrew offers no compelling reason why this should necessitate a transition to private provision. He notes that a similar point was raised in the US Supreme Court in relation to healthcare provision, and that Justice Antonin Scalia declared 'individuals, rather than the government, ought to make decisions about how much of a good ought to be purchased and thus produced.'²¹² In response it might be posited that Justice Scalia was enunciating a particular ideological position which is of limited application outwith the United States.

In addition to arguing for the creation of a privatised forensic service sector, McAndrew calls for the removal of all governmental interference in the sector, in order for the 'invisible hand' of capitalism to bring harmony to the market. He cites Hayek²¹³, stating that 'the beauty of markets is that they are natural systems that no single human or small

²¹¹ McAndrew, W. P. (2012) *Are Forensic Science Services Club Goods? An Analysis of the Optimal Forensic Science Service Delivery Model* Forensic Science Policy & Management: An International Journal, 3:4, 151-158

²¹² *Department of Health and Human Services v Florida* [2012], US Supreme Court.

²¹³ Hayek, F. (1988) *The Fatal Conceit: The errors of socialism*. (Chicago: University of Chicago Press)

group of humans has designed, but which still form what is called spontaneous order.’ McAndrew fails to overcome the fact that inducing the emergence of spontaneous order in the forensics services sector rests upon a belief in neoclassical economics and the ability of customers to assess the true value of goods and services through ‘price transparency.’ That theoretical approach inaccurately analyses the nature of developed markets, particularly those emerging from the public sector, enjoying light touch regulation and incentives provided through central government funding. Nonetheless, he states his faith in the ability of the ‘natural’ market to provide the best of all possible worlds to producers and consumers alike.

‘If privatization truly occurred, certain forensic tests from various forensic laboratories may likely become the standard precisely because they were the best, similar to the way that Microsoft and Apple have become the standard in computers...’²¹⁴

However, McAndrew also admits that, within a market system, quality of output is a function of the demand side. If consumers do not demand quality, or cannot pay for it, suppliers naturally lower the quality of their output. He recommends that, in order to prevent a drop in the quality of forensic science outputs, police budgets remain sufficiently high to guarantee that they can afford high quality forensic products.²¹⁵ Elsewhere, McAndrew prescribes the imposition of a market system as a means for governments to cut costs, borrowing from the discourses of austerity economics. What he fails to address is the fact that police budgets, being provided by the state, are also liable to fall foul of government austerity programs. Therefore, it is difficult to see how a privatised system would result in savings whilst producing high-quality products. And it is worth remembering that, when we speak of 'high-quality products' we are really talking about the production of facts, on whose accuracy a person's liberty may depend.

Much of the output of Forensic Science Policy and Management rests on the same assumptions. In summary, it might be said that the journal’s contributors advance a set of

²¹⁴ McAndrew, *op. cit.* at p.50

²¹⁵ *ibid.* at p.49

arguments which proceed from a uniformly rationalizing perspective.²¹⁶ These arguments make assumptions regarding the goals of forensic inquiry, which are framed in quantitative terms and predicated on notions of scarcity. For example, much is made of the existence of backlogs of work, the existence of which is conflated with the idea of a scarcity of resources. However, as Gialamo points out, the backlog of work in the DNA laboratory is a 'false metric': an unreliable method of measuring efficiency, which was not created by a scarcity of resources but rather by external factors, not the least of which is the tendency of government to expand the functions of DNA databases.²¹⁷

Metric approaches to determining efficiency and value in forensic science nonetheless persist, as do concerns relating to 'turnaround time'. In a recent quantitative empirical study, released as a Working Paper by the RAND Corporation²¹⁸, the researchers conducted a quantitative statistical analysis of the Census of Forensic Labs data to estimate the relation between crime laboratory output and the forensic 'inputs' – from a variety of sources including DNA and trace samples – in order to understand, from a policy perspective, the ways in which specific institutional and structural factors may affect the efficiency of forensic evidence processing. The study reported that;

'Fee-based laboratories appear to have a substantial positive effect on clearance rates, implying efficiency gains in terms of more careful use of the crime laboratory by police and prosecutors, which may in turn free analysts to work submitted cases more thoroughly.'

This quantitative study – which must be subject to the foregoing criticism of the use of

²¹⁶ See Houck, M.M., P.J. Speaker, A.S. Fleming, and R. Riley. *The Balanced Scorecard: Sustainable performance assessment for forensic laboratories*. *Science and Justice* 52 (2012) 209–216

²¹⁷ See the following:

<http://nij.ncjrs.gov/multimedia/video-nijconf2010-gialamas.htm>

<http://crimeandsciencerradio.com/tag/backlogs/>

<http://www.nij.gov/journals/266/Pages/backlogs.aspx>

²¹⁸ Anderson, James M., Carl F. Matthies, Sarah Michal Greathouse, and Amalavoyal V. Chari, *The Unrealized Promise of Forensic Science: An Empirical Study of its Production and Use*. Santa Monica, CA: RAND Corporation, 2018. https://www.rand.org/pubs/working_papers/WR1242.html.

turnaround times as a reliable metric - fails to consider the implications of marketisation. However, it produced secondary data which found that DNA evidence was being under-utilised prior to trial. However, the study demonstrated a correlation between forensic evidence, and conviction, or plea-bargaining, with DNA evidence exhibiting the greatest effect. This echoes an earlier US Department of Justice Study study, prior to the advent of DNA profiling, which demonstrated that clearance rates of offences involving forensic evidence were about three times greater than in cases where such evidence was not used.²¹⁹

This raises the question, relevant to the instant study, of whether restructuring - through marketisation - might result in more efficient uses of DNA profiling evidence, and whether the power of DNA might be more efficiently utilised during the investigative and pre-trial phases of the criminal justice process. A number of studies converge around these questions.

A 2004 study conducted in New Zealand found that homicide cases utilising DNA evidence were more likely to be prosecuted, and juries in such cases were more likely to convict.²²⁰ However, this is countered by a 2010 study by Baskin and Sommers which found that none of the forensic evidence variables – including DNA database searches – had any significant influence on any stage of criminal case processing. Nonetheless, the authors admit that the study was based on data from 2003, prior to the expansion of DNA databases, and the advent of ‘trace DNA’ analysis.

More recently, a study by the Urban Institute demonstrated that, in respect of property crime, ‘clear-up’ rates, and prosecution rates, were twice as high when DNA evidence was collected, as when it was not.²²¹ Despite the demonstrable value of DNA profiling evidence to the criminal justice system, in respect of both ‘serious’, and ‘volume’ crime, studies

²¹⁹ Peterson, J.L., Mihajlovic, S. and Gilliland, M. (1984). *Forensic evidence and the police: the effects of scientific evidence on criminal investigations*. Washington DC: US Government Printing Office

²²⁰ Briody, M. (2004). The effects of DNA evidence on homicide cases in court. *The Australian and New Zealand Journal of Criminology*, Vol.37, No2. pp. 231-252

²²¹ Roman, J., Reid, S. Reid, J., Chalfin, A., Adams, W., & Knight, C. *The DNA Field Experiment: Cost-Effectiveness Analysis Of The Use Of DNA In The Investigation Of High Volume Crimes* (2008) The Urban Institute Justice Policy Center: Washington DC.

reveal concerns that this power is not being efficiently utilised in cases of burglary and assaults.

A 2010 study by Peterson (albeit using crime data from 2003, prior to the expansion of DNA databases) reported that, with the exception of homicides, ‘overall percent of reported crime incidents that had physical evidence examined in crime labs was low.’ For aggravated assaults in the study sample, evidence was collected in 30.3% of cases and examined in 9.2%; for burglaries the corresponding rates were 19.6% and 9.2%; for rapes, 63.8% and 18.6%, 24.8% and 9.9%, but for homicides, the rates were 97% and 81%.²²² However, as the DNA Field Experiment showed, the collection and use of DNA evidence in property crimes has increased to some degree. However, as the RAND report indicates, most crime labs still treat property crime as a low priority.

In aggregate, these studies demonstrate the increasing importance of DNA profiling evidence, in respect of both the investigation, and prosecution, of both serious, and volume, crimes, irrespective of jurisdiction. Although not concerned with economic factors, the studies nonetheless converge around the topic of efficiency, albeit that efficiency is conflated with ‘value’, or ‘impact’, or subsumed into discussions of the ‘contribution’ of forensic science to the criminal justice system. The implications of these studies – which do not consider the issue of marketisation - are that more efficient use may be made of DNA profiling evidence in order to maximize its contribution to the criminal justice system. Two approaches are now considered.

Ribaux, *et al.*,²²³ The debate in forensic science concentrates on issues such as standardisation, accreditation and de-contextualisation, in a legal and economical context, in order to ensure the scientific objectivity and efficiency that must guide the process of collecting, analysing, interpreting and reporting forensic evidence. At the same time, it is

²²² Peterson, J. L., & Sommers, I. B. (2010). *The role and impact of forensic evidence in the criminal justice process: Revised final report, 6-10-10*. Rockville, MD: NCJRS.

²²³ Ribaux, O., Walsh, S.J., & Margot, P.A. (2006). *The contribution of forensic science to crime analysis and investigation: forensic intelligence*. *Forensic science international*, 156 2-3, 171-81 .

recognised that forensic case data is still poorly integrated into the investigation and the crime analysis process, despite evidence of its great potential in various situations and studies. A change of attitude is needed in order to accept an extended role for forensic science that goes beyond the production of evidence for the court. To stimulate and guide this development, a long-term intensive modelling activity of the investigative and crime analysis process that crosses the boundaries of different disciplines has been initiated. A framework that fully integrates forensic case data shows through examples the capital accumulated that may be put to use systematically.

Sallavaci²²⁴ discusses an innovative solution to the problems raised by Briody, Kelty, and others. This alternative approach involves the introduction of streamlined forensic reporting, in order to maximize the utility of DNA profiling evidence at the pre-trial stage, in respect of volume crimes. Her critical review focusses on the use of streamlined reporting within the marketised forensic science sector in England and Wales, and – whilst Highlights potential for miscarriages and explores case fragmentation. - is largely distilled from official guidance. However, the study is largely descriptive, and does not consider the reasons for the introduction nor the contribution to efficiency, or the background of marketisation.

The foregoing discussion demonstrates the extent to which forensic-scientific knowledge creation is structured by a number of interposing social, economic, and political, forces. This section explored the nature of those external forces. The thematic review revealed a distinct research gap in respect of qualitative accounts of efficiency and streamlining related to the key elements of marketisation. This will form the topic of chapter five. The next, final, section of the thematic review discusses and reviews the literature relating to regulation and quality assurance as it applies to the marketised forensic sector.

²²⁴ Sallavaci, O. (2016). Streamlined reporting of forensic evidence in England and Wales: Is it the way forward? *The International Journal of Evidence & Proof*, 20(3), 235–249.

Part Four: Regulation

The departure point for a review of the relevant literature relating to the marketisation of DNA profiling services in England and Wales, is the publication – in February 2009 - of the landmark National Academy of Science report entitled *'Strengthening Forensic Science in the United States: A Path Forward.'*²²⁵ In this report, The Committee identified many of the systemic problems that plague forensic science, and the report identified thirteen specific recommendations to address these systemic problems. The report, and subsequent recommendations, may have been aimed at improving the delivery of forensic science in the United States. However, the issues raised were familiar to forensic scientists, and allied institutional agents, around the world. Therefore, the report exerted an extra-jurisdictional influence that merits discussion, and review.

The NAS/NRC and PCAST reports

In 2005, in the wake of a number of well-publicised failures of forensic science, involving disputed expert evidence claims²²⁶, the United States Congress voted to devote \$1.5 million to fund a National Research Council study into the most appropriate ways to improve forensic science. They appointed a National Academy of Science committee, comprising three distinct groups of experts, drawn from beyond the National Academy of Science; five legal practitioners and academics, including a senior member of the judiciary; six forensic-scientific practitioners from the key forensic disciplines (pathology, biology, and chemistry); and six representatives from allied disciplines outwith forensic science, consisting of a statistician, a bio-statistician, a chemist, two chemical engineers, and a computer scientist. The Committee took evidence from a wide variety of expert

²²⁵ Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council. *Strengthening forensic science in the United States: a path forward*. Washington, DC: *National Academy of Sciences*, 2009.

²²⁶ Not least the misattribution – based on erroneous fingermark reporting - of lawyer Brandon Mayfield, as the 'Madrid bomber', in 2005. See Stacey, R. (2005) *Report on the Erroneous Fingerprint Individualization in the Madrid Train Bombing Case*. US Department of Justice Federal Bureau of Investigation Report (Virginia: FBI)

perspectives, before publishing their report. That 2009 NAS/NRC report opens with a strong statement of purpose:

‘When scientific methodologies once considered sacrosanct are modified or discredited, the judicial system must accommodate the changed scientific landscape.’²²⁷

The long-awaited report then embarked on a review of the organisations that produce forensic science evidence, as well as those which conduct research. Crucially, the report surveyed the state of the various forensic disciplines, described concerns relating to the judicial system, and recommended major interdisciplinary institutional reforms. The committee was struck by ‘the community's current fragmentation and inconsistent practices’²²⁸ and - crucially - by the ‘noticeable dearth of peer-reviewed, published studies establishing the scientific bases and validity of many forensic methods.’²²⁹ It regarded the latter as a particularly serious problem, especially given the practice – widespread amongst the forensic ‘field techniques’ – of proffering forensic evidence to support conclusive statements about individualisation.

In its conclusion, the committee stated that ‘some courts appear to be loath to insist on such research as a condition of admitting forensic science evidence..., perhaps because to do so would demand more by way of validation than the disciplines can presently offer.’²³⁰ Moreover, ‘[t]he judicial system is encumbered by ... judges and lawyers who generally lack the scientific expertise necessary, ... trial judges with little time ..., and the highly deferential nature of the appellate review afforded trial courts' *Daubert* rulings’. The

²²⁷ (see Butler note 7).

²²⁸ Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council. *Strengthening forensic science in the United States: a path forward*. Washington, DC: National Academy of Sciences, 2009 at page 6

²²⁹ *Ibid.* at page 8

²³⁰ *Ibid.* at page 109

bottom line, ‘given these realities,’ is that ‘there is a tremendous need for the forensic science community to improve.’²³¹

Before considering the key sections of the NAS report in finer detail, it is necessary to highlight that, while the issues raised in the report spoke to forensic science the world over, the report is situated in a jurisdiction whose particular features set the trajectory of the inquiry. It should be noted that, in 1993, many US states introduced a ‘gate-keeping’ test governing the admissibility of expert opinion evidence, and judged according to the ‘scientific validity’ of the opinion. This ‘*Daubert* test’²³² will be discussed in greater detail in subsequent chapters. However, for present purposes it should be noted that the *Daubert* requirements preface, and structure, subsequent discussions relating to scientific validity and reliability. The latter concepts feature heavily in the NAS/NRC report, and will be discussed in greater detail below.

The key recommendations of the NAS/NRC report centred around structural reforms, such as the creation of a National Institute of Forensic Science (NIFS), in order to implement research addressing accuracy, reliability, and validity. Further, that enforceable standards were implemented, facilitating a uniformity in protocols, reports, and testimony. A further limb of the Committee’s recommendations related to education and training, with a particular insistence on the need to move beyond apprenticeship to a more modern training regime involving university education, and based on scientifically valid principles. The recommendations went as far as to commend the adoption of a paradigm of evidence-based medicine.

However, the report also recognised the importance of looking beyond the disciplinary boundaries of the forensic sciences, making recommendations that education with regard to scientific principles (as outlined in *Daubert*) be extended to the judiciary, and legal practitioners. Thus, the NAS/NRC report bore implications for law and forensic science, for the legislature, and for those responsible for forensic science and criminal justice policy, management, and governance. As previously noted, the NAS/NRC report had a

²³¹ *Ibid.* at page 110

²³² See *Daubert v Merrel Dow Pharmaceuticals* 509 U.S. 579 (1994)

global reach, which resonates a decade after its publication. The report allowed commentators to compare the review, and the raft of recommendations, to domestic governance and practices. Ross, for example,²³³ writing in 2012, states that;

‘the specific issues raised by the NAS Report (NAS 2009) and the UK Report (Silverman 2011) on research and development are not unique to those countries and, in fact, many are common throughout the world of forensic science.’²³⁴

Ross goes on to note the tripartite categorisation of forensic science used by the committee, and the overarching requirement that each branch underpinned by scientific knowledge and understanding.

1. Field Sciences (Fingerprinting, ballistics, footwear impressions, etc.)
2. Laboratory Sciences (DNA, toxicology, etc.)
3. Medical Sciences (Pathology)

Ross notes that Australia was well placed to capitalize on the NAS/NRC recommendations, benefitting in agility from its small scale. Indeed, many NAS recommendations were already in place in that jurisdiction; a NIFS, accreditation programs, national education and training programs, and a standards program were all included in the 2001 ANZPAA strategy report, *‘The Advancement of Science for Justice’*.

Ross relates that the Australian experience took a global view with regard to research. Furthermore, he posits that the Australian NIFS was unique in its appreciation of the social science component of forensic scientific research, engaging in productive collaborations with the Tasmanian Institute of Law Enforcement Studies (TILES) on projects related to the efficiency and effectiveness of forensic science.²³⁵ Ross highlights the work done within the Australian jurisdiction with regard to accreditation. However, he cautions that;

²³³ Alastair Ross (2012) *Forensic Science in Australia: Where does Australia sit in relation to Trends and Issues in the International Context?*, *Current Issues in Criminal Justice*, 24:1, 121-129,

²³⁴ *Ibid.* at page 128

²³⁵ The social-scientific studies of forensic science by Julian and Kilty are of particular note, whilst being specific to their jurisdictions. See; http://www.utas.edu.au/tiles/research/completed_projects/the-effectiveness-of-forensic-science-in-the-criminal-justice-system/project-outputs

‘Accreditation does not guarantee a ‘mistake-free’ environment. However, it institutionalises work practices and relevant checks and balances as a risk minimisation strategy...’²³⁶

Further, Ross notes that a degree of intra-disciplinary, and cross-disciplinary, silo-ing and fragmentation is apparent between forensic science, science, medicine, law, and law enforcement. This theme is taken up by Kelty, who identifies the same patterns of silo-ing between, and within, particular disciplines.²³⁷ Turning to validation studies, Ross notes the crucial distinction between DNA profiling, and on the palette of pattern-matching techniques which formed the focus of the NAS/NRC report. This distinction which will form the subject of further discussion below. However, for present purposes, it will suffice to note that Ross focusses on implementation, but does not address the question of whether validation studies can provide a ‘scientific’ underpinning to the pattern-matching techniques discussed in the original report.

European responses to the NAS/NRC report were mixed. Van Asten²³⁸, writing from the perspective of the Netherlands Forensic Institute, noted the acrimony that the NAS report engendered, preferring to focus on developments in the academic literature, such as the creation of the Journal of Forensic Science Policy and Management. He also notes the importance of the FORESIGHT program (discussed below) in contributing to best practice within the field. However, his comments are less concerned than those of Ross and Kelty with the reconciliation of existing tensions between forensic science, and the legal system. Instead, the NFS takes a comparatively technocratic approach, preferring to focus on how best to incorporate new scientific and technological advances, in order to increase the value of forensic expertise, and to provide new means to solve crimes.

²³⁶ *Ibid.* at page 124

²³⁷ See Kelty, SF; Julian, R; and Ross, A. *Dismantling the Justice Silos: avoiding the pitfalls and reaping the benefits of information-sharing between forensic science, medicine and law.* Forensic Science International ; Jul 10;230(1-3): pp.8-15.

²³⁸ van Asten, A.C. ‘*On the added value of forensic science and grand innovation challenges for the forensic community*’ (2014) Science & Justice, 54, 170-179

In counterpoint, Kaye²³⁹ presents a less technocratic review of the report on behalf of the European Academy of Forensic Science. The EAFS Conference Report (presented at the 5th Triennial Conference of the European Academy of Forensic Science, Glasgow, 8-11 September, 2009) reflects the concerns of the Academy's members. Responses focus on detail, and organisational arrangements. EAFS states one of its key purposes as 'promoting the individual forensic sciences, their integration and interdisciplinarity from a theoretical, technical and practical points of view,'²⁴⁰ However, Kaye does not address the findings in a systemic manner, or from a trans-disciplinary, perspective. For example, he states that the NAS report calls for 'structural and cultural changes in the forensic science community', when the NAS/NRC makes recommendations which go beyond the forensic science community. Further, Kaye fails to engage with a prime recommendation of the NRC/NAS report; that relating to validation, a topic which he subsumes into a discussion of training.

Throughout the foregoing discussion of the NAS report, and the review of the relevant commentary, one crucial feature is absent; that is the centrality of DNA profiling to forensic science, and the criminal justice system. Murphy is alone in highlighting the importance of what was omitted from the NAS/NRC report; 'The committee was not charged with studying DNA evidence and the report, on its face, only peripherally addresses it.'²⁴¹ Murphy goes on to show that 'the story of DNA typing is intimately entwined with the story of the NAS report'²⁴², and 'lurks in the background and interstices' of the NAS/NRC study.

As Murphy convincingly demonstrates, DNA profiling was accorded a special status by the NAS Committee, when delineating the ambit of the 2009 study. DNA, as noted above, had

²³⁹ Kaye, D. *The good, the bad, the ugly: The NAS report on strengthening forensic science in America* (2010) *Science & Justice*; Vol. 50 (1), pages 8 - 11

²⁴⁰ See EAFS: <http://www.forensicsciences.eu/about.php>

²⁴¹ Murphy, E. *What 'Strengthening Forensic Science' Today Means for Tomorrow: DNA Exceptionalism and the 2009 NAS Report* (2010) *Law, Probability & Risk*, Vol. 9, pages 7-24

²⁴² *Ibid.* at page 9

previously been subject to two landmark studies,²⁴³ which had settled ‘the DNA wars’ and had firmly established the uniquely scientific pedigree of forensic DNA profiling. Meanwhile;

‘Yet at the same time, the traditional forensic disciplines that had long served as the backbone of scientific evidence in the courtroom, and continued to make up the majority of the scientific evidence in criminal cases, went largely ignored despite loud pleas from a dedicated coterie within the scholarly and scientific community.’²⁴⁴

Thus, the comprehensive restructuring of forensic science proceeded on the basis that DNA was to be regarded as the model forensic science discipline. The purpose of the NAS report was to provide the groundwork for the residuary categories of forensic techniques to establish similar credentials. Murphy sheds valuable light on the way in which DNA became to be regarded as a ‘*sine qua non*’. However, absent from her critique is the conception that DNA may itself be fallible, or affected by technological developments, or by alterations to overarching governance structures.

Thus, it may be posited that Murphy offers a convincing analysis, but does not proceed far enough. She rightly highlights the difference between ‘first generation’ pattern-matching techniques, and ‘second generation’ bio-identification sciences. However, her analysis does not take account of the constructed nature of DNA profiling, nor account for the possibility that later iterations of DNA profiling techniques may themselves require to establish foundational validity. Therefore, it may be asserted that studies should re-focus on DNA profiling, its foundational claims, and contemporary developments. Further, we must ask the questions that NAS (and the later PCAST report) overlooked, and focus on the of DNA profiling, in relation to the governance structures which influence its implementation.

²⁴³ National Research Council Committee on DNA Technology in Forensic Science (1992): National Research Council Committee on DNA Technology in Forensic Science: An update, The Evaluation Of Forensic DNA Evidence (1996) (NRC: Washington)

²⁴⁴ Murphy, *Ibid.* at page 9

The Runciman Report and UK Government Committees

As stated above, the thirteen recommendations proposed by the NRC/NAS report were, collectively, held to ‘represents the triumph of serious science over political expediency.’²⁴⁵ The recommendations addressed concerns relating to ‘the science half of forensic science’, highlighting the systematic failings of contemporary forensic scientific validation, and education., whilst focussing on shortcomings specific to particular disciplines.

As will be demonstrated, whilst the report had a global impact, it cannot be said to have influenced the trajectory of forensic-scientific development in England and Wales to an appreciable degree. Discussion of the landmark reports in the United Kingdom also begins in 1993 (the year of the *Daubert* decision), with the publication of the findings of the Runciman Royal Commission on Criminal Justice.²⁴⁶ Chapter nine of the Commission report comprised the findings of qualitative research carried out by Paul Roberts and Chris Willmore.²⁴⁷ This research – colloquially know as The ‘Bristol Study’ comprised seventy in-depth, semi-structured interviews with Crown Prosecution Service (CPS) personnel, defence lawyers, and scientific and medical experts. The interviews focused on the preparation and use of scientific evidence in twenty seven cases in which the interviewees had participated, together with more open-ended discussions about respondents' wider experiences of forensic science, experts and the criminal process.

The results of the Bristol study, and the findings of the Runciman Commission, highlighted the need for enhanced quality in forensic science. However, it should be noted that the experience in England and Wales differed from US in one major aspect. Whilst reports spoke of ‘quality’, and concentrated on implementation, they did not enter into a discussion of the heterogeneous nature of forensic techniques to the same degree as their US counterparts. This may be explained by the fact that Runciman pre-dated the DNA

²⁴⁵ Murphy, E. *What ‘Strengthening Forensic Science’ today means for tomorrow : DNA exceptionalism and the 2009 NAS Report.*

²⁴⁶ Royal Commission on Criminal Justice (Chairman: Viscount Runciman) Report Cm. 2263 (1993) (London: HMSO)

²⁴⁷ Roberts, P. and Willmore, C. *The Role of Forensic Science Evidence in Criminal Proceedings (Royal Commission on Criminal Justice Research Study No 11, London: HMSO, 1993).*

watershed. Nonetheless, Runciman set the trajectory of subsequent debate and laid out the architecture of the discussion. Comparing the two approaches, it may be stated that the UK debate was largely undertaken by lawyers and policymakers (increasingly absent of scientific input), whose focus on ‘quality’, rather than foundational validity, led to the privileging of economic and governance issues. These will be discussed in greater detail, in relation to the establishment of UK Government Science and Technology Committees, and in the context of the closure of the Forensic Science Service, below. However, in closing this section, it is important to note both the lack of appreciation of the need to establish the foundational validity of DNA-profiling techniques, and a lack of discussion with regard to the effect of policy and governance innovations on such techniques.

Before turning to the methodology, it is necessary to offer a preface. As regulation is a normative practice, the normative basis of forensic endeavour should be outlined and reviewed. Whilst this study does not seek to advance a distinctive normative agenda, but rather to interpret the understandings of DNA profiling scientists, this becomes a necessary task. The purpose of this section is therefore to explore the normative basis of scientific method. It will be proposed, in subsequent chapters, that normative Mertonian science has been replaced, to some degree, by regulatory objectivity. Here, it will suffice to show that the domains of law, and science, nonetheless demonstrate an underlying commitment to rationality, based upon the rationalist tradition of adjudication and evidence scholarship, and the correspondence theory of truth, both of which are cognate with the scientific realist perspective. However, it will be demonstrated subsequently, that, in practice, these commitments may have been overwritten by regulatory imperatives, and may have, in effect, been reduced to representations. Nonetheless, the rational, and realist, perspectives serve not only to shape these discrete fields, but to structure their relations with each other.

It may be argued that legal support for scientific autonomy is based upon law’s recognition of the existence of a number of features of scientific method, all of which share a common commitment to rationality, similar to those evinced within the legal domain: features which resonate with rational approaches to adjudication and inferential logic. Nonetheless, law’s treatment of the branches of science is far from uniform. Indeed, the contrasting approaches - between, for example law and medicine, and law and forensic science – may

testify to the continuing influence of power asymmetries based upon the underlying cultural status of separate professional groups, and their varying abilities to structure the interdisciplinary co-production of scientific knowledge within the legal context.

However, the discussion begins with a discussion of rationality, and normativity, within the forensic-scientific domain. From the foregoing discussion it may be possible to ascertain some similarities between law's rational approach to evidential interpretation, and that of scientific realism. Just as the rational evidential approach posits a consistency between the results of adjudication and an accurate description of a mind-independent and language-independent world, so the scientific realist approach argues for the existence of the same mind-independent, and language-independent, world. Thus, the aim of positivistic science is to give an account of that world through theories, whose acceptance is predicated on a similar orientation towards truth. In short, science describes the real physical materials, properties and effects, which together underpin concepts.

The rational approach extends to encompass the normative principles which govern scientific method. The classic articulation of normative scientific endeavour is that presented by Robert K. Merton in 1942. Merton described 'four sets of institutional imperatives [comprising] the ethos of modern science'²⁴⁸: universalism, communism, disinterestedness, and organized skepticism.

- Communalism: all scientists should have equal access to scientific goods (intellectual property) and there should be a sense of common ownership in order to promote collective collaboration. Communalism stands against secrecy.
- Universalism: all scientists can contribute to science regardless of race, nationality, culture, or gender.
- Disinterestedness: scientists are supposed to act for the benefit of a common scientific enterprise, rather than for personal gain.
- Organised Skepticism: entails that scientific claims must be exposed to critical

²⁴⁸ Merton, R. K., The Normative Structure of Science (1942) in Merton, R. K., *The Sociology of Science: Theoretical and Empirical Investigations*, (Chicago: University of Chicago Press)

scrutiny before being accepted.

As will be demonstrated below, this approach is broadly cognate with the rationalist approach to legal scholarship.

Mertonian norms, scientific-realism and the ‘forensic imaginary’

It will be demonstrated in the course of the instant discussion, that the co-production of forensic-scientific knowledge claims conforms to normative accounts of interdisciplinary communication, and that the legal and scientific domains retain an alignment to objectivism and a realist epistemology. However, these commitments are not always reflected in practice (despite being sustained by representations). Indeed, it has been shown (with regard to the problem of transfer and persistence, for example) that the addition of contextual information to forensic DNA evaluations, essential to thorough forensic analysis, threatens law’s autonomy, and capacity for normative self-generation, to the extent that it challenges objectivist accounts of error-free scientific endeavour: a challenge which is addressed through recourse to measures related to pragmatism and efficiency, expertise and value. However, they are also sustained through reference to the ‘forensic imaginary’.

As stated above, the representation of efficient forensic practice aligns with both rationalist accounts of evidence scholarship, and positivist legal decision-making. Further, these accounts find common expression in the concept of the forensic imaginary. The ‘forensic imaginary’, as outlined by Williams,²⁴⁹ rests upon a commitment to two (demonstrably ambiguous) principles. The first of these is the assertion that objects are unique, and that it is possible to capture the unique identifiability of any object (whether or not tied to an ineradicable bodily substrate). The second principle is encapsulated in the proposition - widely attributed to the French scientist Edmond Locard - that ‘exchange always happens’. Thus, it is posited that any physical contact between two unique objects (or between one object and a defined physical space) results in transfer of physical material. The second

²⁴⁹ Williams, R. *DNA Databases and the Forensic Imaginary*, in Hindmarsh, R. & Prainsack, B. (Eds.) *Genetic Suspects: Global Governance of Forensic DNA Profiling and Databasing* (Oxford: OUP, 2010)

limb of the ‘forensic imaginary’ is known as ‘Locard’s law’ and is widely understood as the generative principle from which all forensic identification techniques proceed.²⁵⁰

Recourse to the ‘forensic imaginary’ may serve a particular purpose within an institutional setting. As Williams states,

‘...the imaginary has been carried in ‘images, stories and legends’ (Taylor 2014: 23)...and it has contributed hugely to the willingness of governments to fund forensic science developments and ambitions.’²⁵¹

As Williams goes on to suggest, a number of institutional actors within the forensic-scientific matrix - particularly those whose tasks include the shaping of forensic policy - aspire ‘to alleviate [public] fears concerning security, safety, crime control and the management of ‘risky’ individuals...’²⁵² They seek to alleviate such fears through ‘the demonstrably effective use of current and emergent technologies’: techniques which are deemed capable of capturing, knowing, and recording, individuality, and of anchoring members of suspect populations to an inscription derived from a stable and ineradicable biological substrate. The socio-legal enquiries of Kitzberger, Machado, and Prainsack, have also proved influential in this regard.²⁵³

The ‘forensic imaginary’ thus serves as a conceptual tool whose purpose is to signal the closure of problematic scientific debates to non-institutional actors. In the context of DNA profiling activities at FSNI it may be argued that the ‘forensic imaginary’ serves to allay fears – and to diffuse emerging concerns - centred around the loss of discriminatory power

²⁵⁰ By choosing to bestow the title of ‘the Locard building’ on the FSNI Laboratory Services Accommodation Project (LSAP), the agency - wittingly - enacts, and reiterates, the phenomenon of the ‘forensic imaginary’.

²⁵¹ *Op. cit.* at p.135

²⁵² *Loc.cit.*

²⁵³ Prainsack B, Kitzberger M. (2009) *DNA behind bars: other ways of knowing forensic DNA technologies*. *Social Studies of Science* 2009 Feb;39(1) pp. 51-79; Machado, H. & Prainsack, B. (2012) *Tracing Technologies: Prisoners' Views in the Era of CSI* (London: Taylor & Francis)

of DNA profiling techniques, when those techniques are required to be used to evaluate (mixed) samples containing low template ‘touch’ DNA.²⁵⁴

The problems associated with transfer and persistence may be viewed as an ‘inversion of the forensic imaginary’. However, it is sufficient for present purposes to note that both limbs of the forensic imaginary are subject to criticism and revision. A commitment to uniqueness - on anything other than a pragmatic level - has been shown to be both scientifically, and philosophically, untenable.²⁵⁵ Likewise, an adherence to ‘Locard’s Law’ becomes problematic as the discriminatory power of DNA profiling techniques becomes inversely proportional to the scientist’s ability to evaluate mixed samples, or to account for the transfer and persistence of ‘touch’ DNA.

Nonetheless, within a broader social context, resort to the ‘forensic imaginary’ may serve to placate the wider forensic-scientific community - in addition to non-institutional actors - insofar as the deployment of this concept signals a commitment to an explicitly scientific-realist perspective. Scientific realism describes a positivistic belief in the ability of scientific experimentation to deliver ‘genuine’ claims about actually existing entities and phenomena, alongside the corollary that any derogations from this ideal are attributable to extrinsic, and preventable, human factors (e.g. contamination, bias). Thus, scientific realism is a normative commitment whose adherents regard wider social factors as non-legitimate scientific inputs. Collins labels such an approach as ‘scientism’: ‘an overpedantic [*sic*] cleaving to some canonical model of scientific method or reasoning.’²⁵⁶

Paradoxically, the promulgation of a positivistic scientific-realist perspective, through the deployment of the ‘forensic imaginary’, may serve to demonstrate that forensic science is not a discrete site of scientific endeavour but, rather, that the forensic field is highly influenced by political factors (even if such factors do not constitute a legitimate input to scientific decision-making). In order to explicate this assertion it is necessary to consider

²⁵⁴ See previous chapter and judicial report in *R. v. Sean Hoey* [2007] NICC 49

²⁵⁵ See previous chapters. Also, Cole SA (2009) *Forensics without uniqueness, conclusions without individualization: The new epistemology of forensic identification*. *Law, Probability and Risk* 8(3): 233–255.

²⁵⁶ See Collins, H. & Evans, R. 2007, *Rethinking Expertise* (University of Chicago Press: Chicago) at p.10

the formative intentions of institutional actors against a wider social backdrop i.e. to allow for social constructionist accounts of forensic DNA profiling. (RQ4) (RQ6)

However, it may be argued that, while the conceptual frameworks, and terminologies, of law and forensic-science, may differ greatly, these dissimilarities are of negligible importance, when stood against the underlying normative commensurability of these competing fields and their shared commitment to rational fact-handling. These approaches will form the backdrop to informant responses in the subsequent discussion sections.

Chapter Three: Methodology

Introduction

The following chapter provides a detailed account of the process of shaping, and enacting, the research methodology in order to generate the most suitable data necessary in order for the researcher to answer the research question. It provides a comprehensive account of all of the necessary elements of the research methodology. Specifically;

1. An introduction to the overall methodological approach for investigating the instant research problem, linking the literature review to the methodological approach.
2. An indication of how the approach fits the overall research design.
3. A description of the specific data collection methods used in order to suitably address the problem, and an account of the design of the semi-structured interview schedule.
4. An account of the sampling procedure and subject selection, including a justification of decisions taken in order to negotiate access.
5. An account of the method of analyzing the results, and steps taken to avoid bias and ensure validity.
6. A clear account of the limitations of the study.

The focus of this study is on DNA profilers working in private forensic science providers in England and Wales.

An initial thematic analysis of the literature allowed for the identification of four distinct areas of research focus; standardization, expertise, efficiency, and regulation. A detailed thematic review of the literature pertaining to each of these four distinct areas then allowed the researcher to distil a primary research question, and a set of secondary research questions. To recap, the primary research question asks ‘in what ways, if any, has marketisation influenced expert forensic biologists perceptions of DNA profiling evidence

in England and Wales. The secondary research questions focus on ascertaining to what degree, if any, marketisation has influenced the perceptions of DNA profiling expert's in relation to the introduction, and implementation, of standardised practices; the exercise of forensic expertise; the introduction, and implementation, of measures designed to promote efficiency in evaluative reporting; and the introduction, and implementation, of a regulatory framework.

The task of this chapter will be to provide a clear and detailed account of the way in which the research design and methodology were shaped, and implemented, in order to derive the data necessary to answer the foregoing questions. Thus, the task was to select research methods and techniques which were appropriate to identifying, gathering, and analysing the data central to addressing the research problem.

The chapter therefore shows how the initial research design, the process of data gathering, followed by analysis - and interpretation - of data, allowed the researcher to systematically select, shape, and utilise, the methods most appropriate to answering the research question, in order to understand the ways in which marketisation has shaped the perceptions of DNA profiling scientists in England and Wales. The chapter begins with a clear statement of the methods used, and surveys advantages and disadvantages, before providing a detailed account of participant selection criteria, the enactment of the methodology, and the research topics addressed during the data collection phase. The chapter then gives a comprehensive account of the thematic data analysis methods used, before offering a candid description of the limitations of this study. The chapter is intended to meet the requirements of reproducible social-scientific research.

Method Selection

The section provides a detailed account of the underlying research philosophy and design, leading to the decision to proceed with a qualitative study. In order to answer the research questions using qualitative methods, a participant observation, or ethnographic approach could have been employed. However, these would unearth emergent themes rather than answer specific research questions. Therefore, the decision was taken to employ semi-

structured interviews (supplemented with documentary materials from official sources; primarily committee policy documents, and regulatory guidance). It should be noted that the methods selected are similar to those used in previous studies, reviewed in the foregoing section, specifically those employed by Paul Roberts in his Bristol Study, and those employed by Christopher Lawless in his study of forensic privatisation. Since the instant study seeks to answer related questions, it was deemed appropriate to adopt a similar methodological approach, albeit that the chosen approach was ultimately determined by means of a rigorous process of research design described below, and in the appendix.

Participant Selection and Recruitment

The criteria for inclusion in the study, was the participant's expertise in forensic biochemical analysis, and the participant's role as a DNA profiler and/or analyst within a private sector forensic science provider in England or Wales. The participants were expert biochemists specialising in the analysis and interpretation of DNA-profiles for use within the criminal justice system. Full informed consent was sought from all of the participants in advance. This was confirmed, by the participant signing and returning the consent form attached to the Participant Information Sheet. All participants were over the age of 21, in accordance with the accreditation necessary to work in a UKAS-accredited forensic science laboratory, as laid out under UKAS standard ISO 17025.

The recruitment process began with the compilation of an exhaustive list of private, Forensic Science Providers (FSPs) operating in the UK. The list was limited to those FSPs who undertake forensic DNA-profiling work. In order to compile this list the researcher approached the Forensic Science Regulator, the Chartered Society of Forensic Science and ENFSI (the European Network of Forensic Science Institutions). None of these sources was able to offer a comprehensive list.

However, it was known that all FSPs conducting DNA profiling activities had to receive United Kingdom Accreditation Service (UKAS) laboratory accreditation in order to operate. Therefore, the researcher approached UKAS and sourced an exhaustive list of some 2,500 accredited UK laboratories conducting a diverse body of activities from food

preparation, to pharmaceuticals, to MOD research. The researcher sifted through this database, checked all of the laboratories and companies against their internet profiles, and was able to compile a shortlist of 16 Forensic Service Provider labs in England and Wales. DNA profilers working in Forensic Service Providers in England and Wales are the focus of the instant study. From the list of sixteen FSP's the researcher identified twelve private sector forensic science providers operating in England and Wales who offered forensic DNA analysis services. The remaining four did not.²⁵⁷

Using the details gleaned from the UKAS database, the researcher approached all of the twelve FSPs on the shortlist by telephone. The name of the staff member possessing both the relevant knowledge to assess the project, and the authority to authorise participation, was obtained. These were contacted by telephone, in order to introduce the researcher, and to provide a brief summary of the research. This also allowed the researcher the opportunity to better determine the needs, interests and, in some instances, the particular research focus, of the FSP. Introductory letters were then sent to fourteen forensic service providers.

The researcher offered no payments, expenses, or incentives, beyond the opportunity to participate in a study: a study which could lead to a greater understanding of the effect of governance structure on the construction of DNA-profiling evidence. From a shortlist of twelve providers, four providers agreed to participate. Site visits were arranged with these four FSPs, representing one Tier One (main service providers), and three Tier Two (defence providers). This constituted an adequate sample frame of four out of twelve providers (or one third of the population).

Even though this might constitute an adequate sampling frame, the researcher was aware that some element of sampling bias might yet present itself. Since the participants were all volunteers rather than a random sample it remains possible that those who agreed to participate differed in some way(s) from those who did not agree to participate. This was, after all, a representative sample. But was it an accurate and representative sample? In order to arrive at a determination it was necessary to ascertain how the sample population

might differ from the wider set of forensic service providers, and institutional agents. It was notable that all of the initial participants were accredited actors in a private-sector market, some of whom were eager to highlight their accredited status. Therefore it was necessary to control for this element by recruiting non-accredited, and non-market, participants. Therefore, the recruiter sought the participation of an independent non-accredited provider and a public sector FSP. In order to add further context, and specific expert insight on specific matters relevant to the study, the researcher also sought the participation of a number of allied institutional agents, including the Forensic Science Regulator, a QC who had designed the Streamlined Forensic Reporting system, a magistrate who had experience of implementing that system, and a member of Her Majesty's Inspectorate of Constabulary with significant experience of forensic practice and standard-setting in criminal investigations (see tables, below).

Interview Setting

The investigation was carried out in context, and therefore involved site visits in order to conduct interviews with a number of members of staff. These were conducted within the administrative offices of four forensic service providers in England and Wales. This phase was scheduled to last nine months, beginning in March 2015. The chosen sites were all ancillary to UKAS-accredited laboratories, each of which had robust Health and Safety procedures in place. All interviews took place entirely within the site's administrative facilities in the presence of staff members. Given the socio-legal nature of the investigation, it was unnecessary to enter the laboratory and at no point did the researcher enter the laboratory. Nor was the researcher exposed to any physical samples or associated materials. However, site visits did entail a tour of the facilities at each site, during which the researcher was able to see the delivery of material forensic, and to view scientists processing samples in a 'clean room' from behind a viewing window. However, observation played no part in the investigation. The researcher was then able to conduct semi-structured interviews with a number of selected participants.

Procedure

The study comprised a series of semi-structured interviews of approximately one to two hours in length, which took place in the mutually agreed upon locations detailed above. The participants were informed that they might decline to answer any of the interview questions if they so wished. Further, that the participant might decide to withdraw from the study at any time, without any negative consequences, by advising the researcher. With the participant's permission, the interviews were tape-recorded, in order to facilitate collection of information, and later transcribed for analysis.

This provided the researcher the opportunity to focus on some of the issues unearthed during the observation phase. During the interviews, participants produced documentary materials, primarily case files, DNA profiles, scene-of-crime photographs, and statistical data. Reference to these materials during the interviews aided the process of data collection and analysis, insofar as it allowed for the interweaving of multiple data sources, some of which cross-corroborated. The researcher was thus able to 'triangulate' data from multiple sources, a process advocated by Yin (2003). However, it must be noted that Easton (1995) questions Yin's logic - which posits that different data sources may tend to converge on a single explanation - pointing out the possibility that the data from the two phases may indicate opposite evidence. This need not prove problematic. Alternate explanations and refutations were anticipated in this study of profiler's perceptions, and added to the richness of data available to the researcher for reflexive interpretation, and analysis.

Nonetheless, the researcher was also aware of the limitations of the interview as a data source, especially given that these interviews were all conducted at the profiler's place of work. Woodside and Wilson²⁵⁸ argue that interviews should be seen as a form of presentational data, with informants producing in their responses 'a manufactured image of idealised doing' which may not conform to the operational data obtainable from observation. It was hoped that the 'intense exposure to the phenomenon under study within its context' would enable the researcher to build a rapport with participants, in order that

²⁵⁸ Woodside, A.G. & Wilson, E.J. *Case Study Research Methods for Theory Building* Journal of Business and Industrial Marketing 18 6/7 (2003) pp. 493-508 at page 498

multiple perspectives could be collected, and understood, while the potential for participants to deliver ‘socially desirable’ responses in the subsequent interviews would be reduced. In practice, this was not an issue, such was the level of informant’s expertise, and familiarity with the relevant issues.

Nevertheless, the researcher remained mindful that the outcome of triangulation may be a multi-vocal, rather than convergent, understanding of the data. Multi-vocal results would not threaten the validity of the current study, since it adopted an ontological position which accepts the social construction of certain phenomena. Multi-vocal results were thereby anticipated.²⁵⁹ The following tables provide a detailed account of the designation, and role, of the research participants, as well as offering an account of the topics covered in the interview schedule. Thirty-two interviews were conducted in total with an average length of 1.33 hours.

Name	Position
MM	Science Lead (DNA Case Assessment & Interpretation), Senior Reporter and Team Lead (Eurofins)
DE	Senior Reporter (DNA)
DK	Principal Forensic Biologist
MB	Forensic Biologist
QB	Principal Forensic Biologist
SS	Managing Director (previously Head of Homicide & Cold Case Reviews, Head of Operations)(Tier 1 FSP)

²⁵⁹ Piekkare, R., Plakoyiannaki, E. & Welch, C. ‘Goog’ case research in industrial marketing: Insights from research practice. *Industrial Marketing Management* 39 (2010) 109 – 117 at 111

BH	Chief Executive / IPC Member
KN	Principal Forensic Biologist
KP	Managing Director / Reporting Officer /
CH	Forensic Biologist / Keeper of the NIDNAD
SH	Principal Forensic Biologist
TC	Chief Executive (FSNI)
DF	Executive Board Member (FSNI)
QN	Chief Inspector (HMIC)
JX	CPS Strategy Lead / QC
HU	Forensic Science Regulator
HI	Independent Forensic Biologist
GQ	Forensic Biologist, SPA Forensics
KB	Independent Forensic Biologist
IC	Magistrate

Table 2 : Research Interview Participants & Designation

Sample category	Number of participants²⁶⁰
------------------------	---

²⁶⁰ Total number of interviews conducted: 32; Average length of interview: 1.33 hours.

Tier 1 FSP Scientist	2
Tier 2 'Defence' FSP Scientist	3
Tier 2 FSP Scientist	3
Public Sector FSP	4
FSP Management (Tier 1 & Tier 2)	3
CJS Personnel	2
CJS Administrative / QA Officials	3

Table 3 : Employment Categories of Research Participants

Semi-structured Interview Schedule: Design and Implementation

Rigorous data collection procedures fundamentally influence the results of qualitative studies. Therefore, to ensure rigour and quality in the instant study, a systematic approach was followed in order to formulate a coherent semi-structured interview schedule. This rigorous approach divides the development of the semi-structured qualitative interview guide (or schedule) into five successive phases.

- 1) identifying the prerequisites for using semi-structured interviews;
- 2) retrieving and using previous knowledge;
- 3) formulating the preliminary semi-structured interview guide;
- 4) pilot testing the interview guide; and
- 5) presenting the complete semi-structured interview guide.

1) Identifying Prerequisites for Semi-structured Interview

The initial phase involved identifying the prerequisites for using semi-structured (as opposed to structured, or unstructured) interviews. The purpose of this research design phase was to allow the researcher to evaluate the appropriateness of the semi-structured interview, as a rigorous data collection method suitable for collecting data in relation to the selected research question(s) drawn from the thematic review. Thus, the researcher was required to determine some areas of the research phenomenon, based upon knowledge gleaned prior to the interview.²⁶¹ In relation to the research topics, the semi-structured interview method was suitable for studying people's perceptions and opinions or complex social phenomena. Barriball and White advise that,

[Semi-structured interviews] are well suited for the exploration of the perceptions and opinions of respondents regarding complex and sometimes sensitive issues and enable probing for more information and clarification of answers.²⁶²

Further, the semi-structured method is recommended in order to take account of the varied professional, educational and personal histories of the sample group, a requirement which precludes the use of an exhaustively standardised interview schedule. Turner points to the utility of the semi-structured approach, noting that,

'Standardized open-ended interviews are likely the most popular form of interviewing utilized in research studies because of the nature of the open-ended questions, allowing the participants to fully express their viewpoints and experiences.'

Given that the sample group exhibited variability across their professional histories, and expertise, it was therefore deemed appropriate to adopt a semi-structured approach which would standardize the stimulus - thus avoiding the lack of comparability of an unstructured interview approach - whilst acknowledging that both vocabulary, and conceptual

²⁶¹ Turner, D. W. (2010). Qualitative Interview Design: A Practical Guide for Novice Investigators. *The Qualitative Report*, 15(3), 754-760.

²⁶² Barriball, L.K. and While, A. (1994) Collecting Data Using a Semi-Structured Interview: A Discussion Paper. *Journal of Advanced Nursing*, 19, 328-335.

frameworks, differ between participants. Thus, validity and reliability would derive from the researcher conveying equivalence of meaning, rather than standardised questions, across all interview topics.²⁶³ This approach further cohered with the constructionist and interpretative nature of the analysis, the central aim of which was to source rich detail about the participant's *interpretations* of their experiences.

2) Utilising Prior Knowledge from Literature Review

The second phase of the development of the interview schedule involved the retrieval and implementation of prior knowledge.²⁶⁴ The aim of this phase was to gain a comprehensive and adequate understanding of the research subject. This necessitated critical appraisal and review of previous knowledge, and allowed the researcher to determine the possible need for complementary empirical knowledge. The critical appraisal of previous knowledge was achieved through the completion of a comprehensive thematic literature review²⁶⁵ focussing on the aims and purpose of the study. Thus, from previous knowledge and critical analysis was derived a rich conceptual base which allowed for the creation of a predetermined framework for the semi-structured interviews.²⁶⁶ Where the researcher encountered knowledge gaps or deficits within the academic literature, empirical knowledge was sought in order to both complement, and deepen, the conceptual and theoretical background to the research topic. Rabiolet states,

²⁶³ Ibid. at page 330

²⁶⁴ Kallio, H., Pietilä, A.-M., Johnson, M. & Kangasniemi, M. (2016) Systematic methodological review: developing a framework for a qualitative semi-structured interview guide. *Journal of Advanced Nursing* 72(12), 2954–2965.

²⁶⁵ Barriball, L.K. and While, A. (1994) Collecting Data Using a Semi-Structured Interview: A Discussion Paper. *Journal of Advanced Nursing*, 19, 328-335.

²⁶⁶ Åstedt-Kurki P. & Heikkinen R-L. (1994) Two approaches to the study of experiences of health and old age: the thematic interview and the narrative method. *Journal of Advanced Nursing*, 20, 418-421.

‘To further refine the quality of the interview protocol I can seek out consultation from experts in the field and also experts in qualitative researchers who have used interviews to provide me with feedback and guidance.’²⁶⁷

Therefore, the researcher sought to achieve a consistent depth of knowledge across the area of research by consulting four experts; a forensic psychologist, a forensic practitioner (and director of the Scottish forensic service), a forensic chemist (and academic), and a forensic anthropologist (and academic). These conversations (and pilot interviews, *supra*) enabled the researcher to gather empirical knowledge, and to seek a practical understanding of the study phenomenon.²⁶⁸ In addition, methodological guidance and feedback was sought from qualitative researchers, primarily the research supervisors.

3) Formulation of Preliminary Semi-structured Interview Guide

The third phase of development involved the formulation of a preliminary semi-structured interview guide. The purpose of this phase was to use previous knowledge to create a structured, logical and coherent set of topics and questions. These would form the interview guide, which would in turn be utilised as a tool for interview data collection. An interview guide (or schedule) is defined as a list of questions which directs conversation towards the research topic during the interview.²⁶⁹ The quality of the interview guide thus affects the implementation of the interview and the analysis of the collected data.²⁷⁰

The semi-structured interview guide – as compared with a structured interview guide (or schedule) – is framed to allow for flexible responses, thus facilitating dialogue between the researcher and informant during the interview, even allowing the opportunity for the

²⁶⁷ Rabionet, S. E. (2011). How I Learned to Design and Conduct Semi-structured Interviews: An Ongoing and Continuous Journey. *The Qualitative Report*, 16(2), 563-566.

²⁶⁸ Kvale S. (2007) *Doing Interviews*. SAGE, Los Angeles, London.

²⁶⁹ Gibbs L., Kealy M., Willis K., Green J., Welch N. & Daly J. (2007) What have sampling and data collection got to do with good qualitative research? *Australian and New Zealand Journal of Public Health*, 31(6), 540-544.

²⁷⁰ Morrow S. L. (2005) Quality and Trustworthiness in Qualitative Research in Counseling Psychology. *Journal of Counseling Psychology*, 52(2), 250-260.

researcher to change the order of questioning, and to promote flow and movement from question to question.²⁷¹

The questions in the interview guide were framed to achieve the richest possible data. They were designed to meet the requirements of well-formulated questions, and thus were participant-oriented, and were not leading. Further, they were clearly worded, open-ended, and restricted to a single topic. The aim was to generate descriptive, spontaneous, in-depth responses which were based upon personal experience and perception, and through which data could be derived from which new perspectives and concepts might emerge.

Two levels of questions were used during the interviews: primary questions linked to the research topics and themes, and follow-up questions. These are listed in Appendix 1. The main themes covered the main content of the research topic. Participants were encouraged to speak freely about their perceptions and experiences. Follow-up questions were then used in order to elucidate the main theme, and to direct the ensuing conversation towards the study subject. Thus, the objective was to maintain the flow of the interview whilst gathering accurate and focused information. As a spontaneous follow-up question, the interviewer asked participants to expand on particular points that were raised in the interview, and on occasion the research participant might direct the researcher to an example within a case file.

4. Pilot Testing the Semi-Structured Interview Guide

Having formulated the preliminary semi-structured interview guide, the fourth phase of the development was to test the semi-structured interview guide. Pilot testing of the interview guide can be conducted using three different techniques: internal testing, expert assessment and field-testing. The researcher chose to test the guide through expert assessment and field-testing. Therefore, the researcher arranged a small number of pilot interviews. These

²⁷¹ Mason J. (2004) Semi-structured interview. In *The SAGE Encyclopedia of Social Science Research Methods* (Lewis-Beck M.S, Bryman A. & Futing Liao E ed.), SAGE, Thousand Oaks, London, pp. 1021-1022

pilot interviews were conducted with three forensic scientists working in Scotland. The aim of this phase was to confirm both the coverage, and the relevance, of the content of the preliminary guide, as formulated, and to identify the need to reformulate, excise, or include further questions. Through testing the interview guide, the researcher was able to make informed changes and adjustments to the interview schedule in order to improve the quality of data collection.²⁷² Thus, a question relating to the introduction of Rapid DNA testing was removed, as it became clear that this was not a substantive issue for the majority of UK jurisdictions. Further, questioning on ‘Streamlined Forensic Reporting’ was added when the researcher was made aware of its existence and relevance, discussion having been entirely absent from the academic literature.

5. Completion and Presentation of Semi-Structured Interview Guide

The fifth and last phase of the development process was to formulate the complete semi-structured interview guide, to be used across all research interviews in the instant study. The aim was to produce a clear, finished and logical semi-structured tool for data collection, which reflected the previous four phases of the semi-structured interview schedule development process. That interview guide is provided in the Appendix.

Thematic Data Analysis

Data analysis is central to credible qualitative research. During the analysis stage of this study a thematic approach was implemented. is the process of identifying patterns or themes within qualitative data.²⁷³ The goal of a thematic analysis is to identify patterns within the collected data which are important, or noteworthy, and to utilise these themes in order to address the research question, or to provide commentary about an issue. Thus,

²⁷² Rubin H. J. & Rubin I. S. (2005) *Qualitative interviewing: The art of hearing the data*. 2nd edn. SAGE, Thousand Oaks.

²⁷³ Braun, V. & Clarke, V. Using thematic analysis in psychology. (2006). *Qualitative Research in Psychology* 3, pp. 77 - 101

thematic analysis involves a more systematic effort than merely summarising the data. The goal of a competent thematic analysis and to interpret the data and makes sense of it.

One common failing is to use the main interview questions as the themes²⁷⁴ This would be to merely summarise and organize the data, rather than to analyse it. However, in the course of this study, I conducted a preliminary thematic analysis of the review material, in order to avoid this pitfall. The object of thematic analysis was to unearth latent themes, in order to interpret the data in a systematic manner, in order to ‘to identify or examine the underlying ideas, assumptions, and conceptualisations – and ideologies - that are theorised as shaping or informing the semantic content of the data.’²⁷⁵

The preliminary stage was to familiarize myself with the data. The act of transcribing the data by hand from audio recordings aided this process, and I was able to make notes on the material. The next step was to generate initial codes which reduced the data to units of meaning. Rather than inductively coding each line, the data was thematically analysed in order to address the specific research questions. Therefore, only the sections considered relevant, or which captured a particular phenomena of interest, were coded. Further, open coding was used, and modified as the work progressed.

As stated above, preliminary general coding had been conducted prior to data collection, in order to establish general themes, and to shape the interview schedule. Therefore, these were utilised when I worked through each transcript coding every segment of text that seemed to be relevant to or specifically address our research question.. I did this manually using printed copies and highlighters. I then set about searching for, and organizing, themes. As defined earlier, a theme is a pattern that captures something significant or interesting about the data and/or research question, and is characterised by its significance.

At the end of this step the codes had been organised into broader themes that seemed to say something specific about this research question. I then reviewed the themes, cutting out,

²⁷⁴ Braun & Clarke, *op cit*.

²⁷⁵ Braun & Clarke, *ibid* at p. 84

and gathering the related data. The themes were refined in order to ensure that they made sense, and that the data supported the themes. Some were altered, and split into separate themes, while others were converged. I then worked through the themes once again, attempting to define the essence of each theme. Then I organized them relative to each other, and to sub themes, and wrote up the data.

Security and Data Management

Data, in the form of notes, and audio recordings, was collected at each site, transcribed at the first available opportunity, and transferred to secure university servers from encrypted drives. The data was then pseudo-anonymised. Participants were each given a two-character identifier by which they were known throughout the development of this thesis, and supporting documentation. One master list, with the identifier and participant's details has been kept separately - on an encrypted drive in a locked cabinet - in order to link the participant to the relevant data. One exception to this was data connected to interviewees at Forensic Science Northern Ireland. The agency operates a 'No-Names Policy'. Therefore data in respect of these participants has been completely anonymised. No records of participant's identities has been kept.

Due to the sensitive nature of the tasks carried out by FSPs in all parts of the United Kingdom, staff are reliant on anonymity for security. Risks were not always directly connected to the criminal justice system. In one instance, the FSP carried out off-site activities relating to national security. In another case, the FSP handled sensitive biological data related to public figures involved in civil claims, which may have attracted media attention. Therefore, extra efforts were made to ensure that no site locations were identified.

Access to information remains suitably secure, and restricted to the investigating researchers. Hard copy records have been held securely, in lockable cabinets, and electronic records were uploaded to secure University servers at the first opportunity.

Written field notes were pseudo-anonymised, before being taken off-site, and transcribed at the first opportunity. The original notes have been destroyed. Any confidential waste

containing personal data has been shredded. Audio recordings of interviews were transferred from magnetic audio tape to electronic data files at the first opportunity. The original audio tapes were erased. The electronic data was uploaded to a secure university server at the first opportunity. Any data held on portable drives was pseudo-anonymised and encrypted before being taken off-site. The data was uploaded to a secure university server at the first opportunity. The data held on the portable storage device will be erased on submission of this thesis. Data will be retained for three years following the conclusion of the study. It will then be destroyed.²⁷⁶

Access Limitations and Data Collection

The reason for the inclusion of a public sector FSP were due to the initial research objective, which was to conduct a comparative case study across the United Kingdom, incorporating views from SPA Forensics in Scotland, Forensic Science Northern Ireland, and private sector providers in England and Wales (both ‘defence’ FSPs and those servicing Police contracts). A complete account would also have necessitated incorporating the perceptions of DNA profiling specialists working in a selection of the forty-three in-house police laboratories in England and Wales.

SPA Forensics were not prepared to participate in the project. The English and Welsh Police laboratories contacted were similarly disinclined to participate, absent of an established research protocol. Therefore, the research objective was updated, and limited to an exploration of the perceptions of DNA profilers in England and Wales. This study has no comparative element. Nonetheless, the researcher was invited to interview DNA profiling scientists, and management, at Forensic Science Northern Ireland. This resulted in the collection of data from a small number of sources. Whilst no comparative element is intended, or claimed, in a small number of sections of the study this data is referred to, in order to illustrate that diverse opinions, and approaches, may be encountered on the relevant topics.

²⁷⁶ See *Data Management Policy* in Appendix

Likewise, the researcher interviewed a small number of participants who now work primarily within the investigative, regulatory, and legal, sectors of the criminal justice system. Data from these sources was included due to their key roles, either current or historical, within the marketised forensic science sector in England and Wales. These individuals were central to the development of efficient forms of streamlined reporting, and regulatory quality assurance. Therefore, it was concluded that their relevance outweighs their designation, and justifies their inclusion.

Semi-structured Interviews: advantages and disadvantages

‘The qualitative research interview attempts to understand the world from the subjects’ points of view, to unfold the meaning of their experiences, to uncover their lived world prior to scientific explanations.’²⁷⁷

Qualitative research interviews enable researchers to gain an understanding of the research participants’ lifeworld. They provide a communicative space within which to unfold the meaning of participants’ experiences, and to elicit interpretations of events, processes, and associated phenomena. Qualitative research interviewing can thus be described as a phenomenological, and hermeneutic,²⁷⁸ mode of understanding, whose features may be briefly outlined. The qualitative interview may take many forms. The most suitable form for the instant study is semi-structured, due to a number of factors. Semi-structured interviews are

“1) centered on the interviewee's life-world; 2) seek to understand the meaning of phenomena in his [or her] life-world; it is 3) qualitative, 4) descriptive, and 5) specific; it is 6) presuppositionless; it is 7) focused on certain themes; it is open for 8) ambiguities, and 9) changes; it depends upon the 10) sensitivity of the interviewer; it

²⁷⁷ Kvale, S. & Brinkmann, S. (2009) *Interviews: Learning the Craft of Qualitative Research Interviewing* (SAGE: California)

²⁷⁸ Kvale, S. (1983). The qualitative research *interview*: A phenomenological and a *hermeneutical* mode of understanding. *Journal of Phenomenological Psychology*, 14(2), 171

takes place in 11) an interpersonal interaction, and it may be 12) a positive experience.’²⁷⁹

In short, semi-structured interviews allow the researcher and participant to enter into dialogue: a series of guided conversations between the investigator, and the subjects most actively involved in the process of DNA profiling, evaluation, and reporting.

A particular advantage of semi-structured interview techniques is that they allow the interviewer to move fluidly between description and interpretation per the interpretivist method. In some instances, the interviewer may concentrate on eliciting descriptions which are factual, or phenomenological, in nature. However, (s)he may easily switch roles, shifting the focus to clarification, and the interpretation of subject responses - or validate responses by reframing prior questions.

Semi-structured interviews also invite the contemporaneous use of other methods. Indeed, in many instances (during interviews with lead forensic biologists) semi-structured interviews were linked to documentary research methods, the researcher - and participant - working together to assess, and interpret a full forensic case report, in order to provide ‘thick description’ of the reporting process, pursuant to answering the research questions.

Disadvantages

Subjectivity

Criticism of semi-structured interviews tends to coalesce around the perception of this technique as being inherently subjective, thus open to bias, and capable only of producing data of questionable validity and trustworthiness. The response to such criticisms is that semi-structured interviews are co-produced by the researcher, and the interpreting participant. The situation is neither one of objectivity, nor of subjectivity, but rather one of ‘intersubjectivity’²⁸⁰. The intersubjective nature of semi-structured interviews flows from their common grounding in language.

²⁷⁹ Kvale, S. & Brinkmann, S. (2009) *Interviews: Learning the Craft of Qualitative Research Interviewing* (SAGE: California)

²⁸⁰ Kvale, S. & Brinkmann, S. (2009) *Interviews: Learning the Craft of Qualitative Research Interviewing* (SAGE: California) at page 242

Power Relations

Later theorists of understanding, and interpretation, in the social science field (in particular Gadamer) perceived language as possessing a particular ontological significance, insofar as the social world is constituted through, and around, language. Language acts as the medium through which to generate knowledge and understanding. Indeed, the transactional research interview may be viewed as a particular instantiation of Gadamer's thesis:²⁸¹ a mutually enlightening conversation, in which underlying assumptions are exposed, through a dialectical process of discussion and mutual enlightenment.

However, associated theorists - in particular Habermas - highlight the potential for language to manipulate, to dominate, and to mislead²⁸². Whilst accepting the central importance of language, Habermas rejects Gadamer's view of language: as possessing a particular ontological significance. Rather, Habermas focusses on the ways in which linguistic structures may be shaped, and altered, through social conditions, and interposing power structures. Thus, language is not only the key to understanding socially constructed concepts and processes, but also acts as a medium for hegemonic control, and manipulation. In short, power relations may serve to systematically distort communicative ideals.²⁸³

Habermas notes a further disparity between the researcher, and research subject. The former performs two distinct roles – those of 'speaker' and 'actor' – whilst, for those who inhabit the 'observed action system' – speech and action are intrinsically related²⁸⁴. The researcher enters this system - the virtual object domain - as a speaker. However, the researcher does not enter as an actor, though s(he) may be viewed as a 'virtual participant':

²⁸¹ Gadamer, Hans-Georg. *Philosophical Hermeneutics*. Trans. and ed. David E. Linge. Berkeley: University of California Press, 1977.

²⁸² Habermas, *Communication and the Evolution of Society* trans. T. McCarthy (Boston, 1978), pp. 95-97

Gadamer, H. *Truth and Method*, (1st English edn, 1975, trans. by W. Glen-Doepel, ed. by John Cumming and Garret Barden), revised translation by J. Weinsheimer and D.G. Marshall, New York: Crossroad.

²⁸³ Tanggaard, L. (2003). *Forskningsinterviewet som diskurser der krydser klinger. Når lærlingens og forskerens veje brydes [The research interview as discourses crossing swords. When the road of the apprentice and the researchers cross]*. Nordisk Pedagogik, 3, 21-32.

²⁸⁴ Fleming, M. (1997) *Emancipation and Illusion: Rationality and Gender in Habermas's Theory of Modernity* Pennsylvania; Pennsylvania State University Press

a potential member of the communicative context under investigation. However, the researcher's goals are related to an alternate system of action, rather than the instant research context.

Subsequent theorists highlight the potential for such distortions to create power asymmetries within the context of the research interview.²⁸⁵ Of particular concern are interviews with vulnerable groups of participants, who may potentially be misled, or unduly influenced, by the researcher's (subconscious) use of language, or may simply provide answers which they believe the researcher wishes to hear. The obverse is an equally justifiable concern, particularly in the context of the instant study. Namely, that expert practitioner's – faced with a novice researcher – may attempt to influence both the researcher's views, and the subsequent refinement and interpretation of the researcher's findings. Therefore, it is important for the researcher to remain reflexive, and aware, at all times. However, it is also important to note that the overall power relationship is dynamic, and is familiar with the interview themes, this may lead to greater parity between the researcher and interview subject. Nonetheless, it remains important to identify anomalies, and contradictions, through the use of repeat reframed questions, and triangulation, in order to sift out unhelpful responses, and to account for these during the subsequent data analysis.

²⁸⁵ Kvale, S. *Dominance Through Interviews and Dialogues* Qualitative Enquiry, (2006) Vol 12, Issue 3,

Research aim	To understand the ways in which marketisation has influenced the perceptions of DNA profilers in England and Wales
Research type	Explanatory (descriptive, and comparative)
Theoretical approach	Primarily inductive
Ontology	Social Constructionist / Anti-Positivist. Understanding of reality socially constructed (accepting a ‘reality’ but mindful that our understandings of real phenomena are jointly created)
Epistemology	Interpretivist - Co-created multiple approaches to understanding
Theoretical perspective and Research Paradigm	Interpretivist (Phenomenology / Symbolic Interactionism / Hermeneutics)
Methodology and research design	Qualitative
Sampling strategy	Generic purposive / criterion / diverse
Methods	Interviews (semi-structured) and documentary analysis
Validation	Thematic data analysis across multiple sources, respondent verification
Quality measures	Researcher reflexivity, developing research skills, academic review by legal/forensic experts.
Limitations	Choice of field settings, objective data-verification, predictivity

Chapter Four: Standardisation

Chapter Summary

Forensic science provision in the United Kingdom has undergone comprehensive, though uneven, re-structuring over the past two decades. Most notably, in England and Wales, where forensic-scientific support is now delivered through a commercial market. As a result of this innovation, police forces (and other forensic ‘customers’) have become increasingly concerned with sourcing efficient, standardized products and services. Meanwhile, forensic science providers have been tasked with maintaining a high-quality service that conforms to the overarching regulations.

Interviews with forensic biologists within the criminal justice system, reveal that a significant number of informants view standardization as beneficial, in terms of quality assurance, predictability, and economic efficiency. However, they also reveal concerns regarding the creation of standardised forensic products; informants highlight the frequently problematic process of implementing standards which they deem as having been designed to conform to customer expectations. This chapter focuses on the ways in which organisational re-structuring contributed to the creation of this ‘menu’ of standardised forensic products, and explores the contingent historical factors, which shaped this new forensic standards environment. Crucially, it exposes the ways in which power differentials between stakeholders in the developing market may have contributed to incomplete standardisation. The chapter explores the extent to which the proposed arrangement may have been intended primarily to benefit ‘customers’, and exposes perceptions relating to the ways in which perceived gains have been subverted by partial standardisation, inadequate planning, and problems related to implementation.

The chapter thus aims to provide answers to the stated research questions, with a specific focus on the early market environment. It reveals and exposes, for the first time, the process of forensic standardisation, and – in so doing - contributes to a small, but growing,

number of sociologies of standardisation; studies whose empirical grounding and careful empirical analysis reveal rich descriptions of the specific and unintended consequences of different forms of standards developed in the context of an emerging commercial market.

In broader terms, through its contribution to the nascent body of literature concerned with sociologies of standards, and standardisation., this chapter aims to answer Timmerman and Epstein's call 'for...analyses of the specific and unintended consequences of different sorts of standards operating in distinct social domains.'²⁸⁶

Introduction

As stated above, this data analysis chapter sets out to systematically, and critically, examine the forensic standard-making process, emphasising the complex negotiations required by both forensic scientists, and allied professionals within the criminal justice system. Further, it exposes the material, historical, and organisational contingencies, which led to the creation of standardised forensic products. It surveys their implementation, and explores the reported benefits of standardization, in addition to the ways in which these standards reportedly became subverted in site-specific contexts. The resulting analysis may be situated within a wider Science and Technology Studies, *corpus*. Additionally, it is hoped that the instant case – which focuses on forensic productisation and standardisation – may provide comprehensive answers to the research question(s), which may resonate with socio-legal scholars, providing the departure point for further research.

Specifically, this chapter focusses on the creation of standardised forensic 'products' within the marketised forensic science sector in England and Wales. This 'menu' of standardised forensic products emerged during a period of significant economic, and organisational, disruption, within the forensic science sector. If the perceptions of a significant proportion of forensic practitioners are accurate, then implementation of these codified products created further tensions; thus, this chapter may serve to demonstrate the (unintended)

²⁸⁶ Timmermans, S. & Epstein, S. A World of Standards but not a Standard World: Toward a Sociology of Standards and Standardization (2010) *Annual Review of Sociology*. 2010. 36:69–89

consequences, which may flow from incomplete application of standards, incomplete understanding of their effect, and the instrumental use of these same standards, not to achieve efficiencies or harmonisation, but to effect particular institutional goals, which are not shared across the wider community of practice. This section invites us to ask fundamental questions regarding the creation of informal standards within the marketplace; who should set such standards, and whom should they serve? Ultimately, it lays the groundwork for the following chapter, demonstrating the ways in which standardisation facilitates triaging, and streamlining of forensic provision.

The chapter follows Timmerman's recommended approach, sub-dividing the informal standardisation process into phases of creation, implementation and resistance, followed by a discussion of outcomes. The chapter utilises the case-study methodological perspective, and draws upon results gleaned from documentary analysis, and from original empirical research, conducted throughout the forensic science sector in all four corners of the United Kingdom. Whilst standardisation is regarded as practically beneficial, if the preponderance of informant perspectives are accurate, this chapter may serve to demonstrate the problems which can potentially arise when standards creation is dominated by one agency, when it does not emerge from consensus amongst stakeholders, when delivery is skewed towards the demand-side, and when those who bear the cost of implementation have little input into the standards creation process.

Forensic science provision in England and Wales

The governance of the provision of forensic science services, and the organisational structure and management of individual forensic science laboratories, varies widely between different countries, regions and jurisdictions. Nonetheless, across this varied forensic landscape, providers face similar economic challenges. Since the re-structuring and closure of the Forensic Science Service, commercial imperatives have intruded, to a greater or lesser extent, on scientific autonomy, with most forensic providers now recognising the need to demonstrate a willingness to embrace new management techniques,

to internalise regulatory objectives, and to enter into rudimentary forms of competition. However, despite the increasing pressure of commercial imperatives, the overwhelming majority of developed countries still choose to deliver vital forensic services through a system of public provision.²⁸⁷ The current system of forensic science provision operating in England and Wales is therefore quite exceptional, insofar as it is achieved through a system of marketised delivery.

The development of marketised forensic provision in England and Wales mirrors similar developments across the domestic sector, where the state is no longer viewed as the only agency suitable to be tasked with the provision of services to the criminal justice system. Within the forensic science sector - as across many other domains - the limitations of the state's capacity to manage the organisational complexities of social life has been relentlessly highlighted, and long-standing institutional arrangements have been transformed through volatile patterns of policy development and innovation. Hence, what were once state-monopolised powers have increasingly been transferred to private, 'for-profit' contractors. These actors are allowed to pursue commercial interests provided that they remain within the constraints established by their contract with the government authorities (and with their private customers), and submit to various forms of monitoring and regulation.

Economic Rationalisation in the United Kingdom

The privatisation of forensic services correspond precisely to the fiscal and ideological principles of (putatively 'Thatcherite') economic rationalisation, which have affected other state institutions within the United Kingdom. The reformation of subsisting modes of production has been achieved through the creation of new ideological categories, cognate with a theory of political-economic practice which proposes that human well-being can best be advanced by liberating individual entrepreneurial freedoms and skills within an

²⁸⁷ Centralisation and public ownership are common features of forensic science provision throughout Europe and across both common law, and civilian, jurisdictions: e.g. *Statens Kriminaltekniska Laboratorium* (Swedish National Laboratory of Forensic Science, SKL); Forensic Science Ireland; Netherlands Forensic Science Institute, and the *Bundeskriminalamt* Forensic Science Institute.

institutional framework that is characterised by strong private property rights, free markets, and free trade. The role of the state under this system is thus merely to create, and preserve, an institutional framework appropriate to such practices.

Although degrees of commercialised forensic science provision exist in the majority of developed countries, only in England and Wales have the government sought to re-organise the delivery of such services around an exclusively market-based model. However, it should be noted that the process of forensic market-creation (from public ownership, through a gradual blending of public and private provision, culminating in the removal of government-operated forensic science agencies), is typical of any sector which has been exposed to ‘new public management’ techniques, and processes of economic rationalisation.

This is not a recent phenomenon. The construction of consent to these processes of commercialisation began in the early-1980’s, the point at which the Home Office was opened up to discourses of ‘modernisation’ and ‘economic rationality’, and its character transformed by self-negating management techniques, which valorised the concepts of ‘economy, efficiency and effectiveness.’²⁸⁸ By the end of that decade the ethos of ‘customer relations’ - central to commercial organisation – had begun to influence the practices of all government agencies, and the turn towards processes of economic rationalisation began to influence, and alter, the field of forensic science provision, which slowly became reconfigured around new goals, interests and incentives. Thus, the normative goals of a public sector agency – the Forensic Science Service - were gradually subsumed by the quantitative indices of marketised service delivery, marked by entrepreneurial innovation, value for money, choice, and communication between stakeholders.

²⁸⁸ Lawless, C. (2010). *A Curious Reconstruction? The Shaping of ‘Marketized’ Forensic Science*. CARR Discussion Paper 63

The Forensic Science Service: Transition and Closure

In the decades preceding marketisation, forensic science provision in England and Wales had been achieved solely through the publicly-funded Forensic Science Service (FSS) (and a small number of ‘in-house’ police laboratories). This organisation, acting under the aegis of the Home Office, operated several facilities throughout the country; work was distributed across seven main laboratories, distributed from London to the Midlands and the North of England. The FSS provided scene-of-crime and forensic investigation services to police forces in England and Wales, as well as to the Crown Prosecution Service, HM Revenue and Customs, HM Coroners' Service, Ministry of Defence Police, British Transport Police and worldwide forensic services. It also maintained a research laboratory at Aldermaston (previously the Central Research and Support Establishment), where the FSS developed ‘low copy number’ (LCN) techniques, advanced DNA profiling, and established the National DNA Database (NDNAD).

From its inception, the FSS operated as a publicly-owned service. However, profound shifts in public policy and management were to bring about an emphatic re-organisation of the provision of forensic services. Further, the developing discursive framework of ‘added value’ service delivery - as vigorously promoted by the government’s Audit Office – would carry serious implications for the governance of the publicly-funded Forensic Science Service. Prior to 1987,

‘...the FSS was funded centrally so the Police didn’t have to pay directly for any of their requested work. This resulted in forces often submitting very large numbers of items from each case, often waiting months for results.’²⁸⁹

In 1987 an accounting firm, Touche Ross, was commissioned to draft a report on police scientific support, concluding that police management of scientific support services was ‘generally poor’. However, the Touche Ross report also explored the scope for organisational changes, and new funding methods, within the FSS. Following the recommendations of the report, the FSS introduced direct charging to police forces.

²⁸⁹ King, D, Stangoe, C & Cooke, L. *Scrutinising Forensic Services* (2012), CPD Presentation to 25 Bedford Row

Restructuring and DNA Analysis

With the advent of direct charging, the costs of forensic services became visible to operational forces (henceforth to be regarded as ‘customers’). Further, the FSS aligned itself with a more ‘business-oriented’ approach to service delivery, with a particular focus on ‘forensic strategy’; advocating more careful triaging of submitted items, and agreeing target dates for court reporting. This involved a more customer-facing approach. Nonetheless, during this period, it was still the scientists who determined what forensic examinations and analyses to make, in collaboration with the Police.²⁹⁰

The majority of FSS employees interviewed were able to provide evidence to support the view that they regarded ‘pre-codification’ forensic analyses carried out by the FSS as being both comprehensive and contextual. A lead biologist described the process;

‘...essentially what would happen is that you would have almost a service provision, so in the FSS we dealt with pretty much everything...whenever there was a case that came in the door there would be a huge bag of exhibits and the police would essentially say ‘can you forensic those please’ and we would say “...this is the overarching strategy, we’ll start with Test A, we’ll do Test B,C and D” and then once we’ve done that, our work hasn’t impacted on the work of someone else, so we then hand over the case to that individual, and they’ll do their Tests 1, 2 & 3 and once they’ve finished that work we can then shave off part of it into toxicology, or some other department, and...after a few months of...very clever science, you write a very large report that says...we’ve done this to death: these are the opportunities available, these are the findings that we’ve got, and if necessary, if all of this falls down, we’ve actually retained material in these departments so we could... go down [an alternative] avenue if you wish.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

²⁹⁰ King, *ibid.* at page 5

This typical response, illustrating a standard FSS workflow, highlights the exhaustive nature of forensic investigatory processes, as carried out within the FSS. A lack of supervening concerns regarding economic costs, or value, on the part of the investigatory authorities, reputedly allowed for the submission of a large amount of initial samples. Further, the investigation, evaluation, and reporting process, are presented as comparatively exhaustive (to a degree which might later be conceived of as excessive, and surplus to ‘customer requirements’). Another notable feature of these claims was the holistic nature of the investigation and analysis, which was not – at that time - solely dependent on DNA-profiling techniques. DNA profiling is thus viewed as contributing to a palette of forensic practices, with no evidence of the privileging of one method over another. The informant also highlights the possibilities for recursion, and review, at a later stage, in order to take account of updated contextual information. In summary, the response suggests a significant degree of forward planning, a high granularity of inference, contextual awareness, and flexibility, allowing for the compilation of exhaustive reports, written by expert forensic scientists. Further, it should be noted that that the investigatory authorities did not direct the course of the FSS examination, at this time: nor did they participate directly in the formulation of a forensic investigatory strategy.

Notably absent from this expert’s response were concerns regarding the over-arching importance of turn-around-times (TOTs) or the imposition of economic efficiencies. Rather, the report of the investigation, and comparatively rigorous forensic evaluation, appear to conform to normative representations of scientific method. They are indicative of universalism, insofar as the truth claims are subjected solely to pre-established impersonal criteria. They are communalist insofar as the ‘customer’ does not dictate the course of the investigation. And they are disinterested insofar as they are free from institutional motivations.

Indeed, such responses were routinely encountered, and may thus be regarded as typical of expert perspectives of non-marketised forensic scientific analysis. Indeed, there were clear and notable similarities between the description of exhaustive forensic analysis offered above – by a former employee of the FSS - and the contemporary observations of forensic

scientists working within the publicly-funded forensic sector in Northern Ireland, as indicated below:

‘Where I would see...the big change is in what’s requested in the first place. And that’s not altogether a bad thing because, back in days of yore, where the police weren’t, in any sense, paying for it, a truck would hiss to a halt outside, the doors would open, a hundred items would come out, and the forensic strategy would be ‘forensicate that!’ ‘Well, what is it you want?’ ‘Everything.’ ‘Well, that’s alright for you to say but I’ve got another fifty cases...’ And a consequence of that was that we were reporting cases months, and months, and sometimes years after they came in. And how much of that output remained valuable at that stage? Who knows. So [the introduction of pricing and an appreciation of evidential value] has focussed the police onto trying to get the best return, and, of course, DNA - bit of a buzzword - tends to be one of the things they reach for first, though actually, not always sensibly. But that’s what people think...’

(Interview with Lead Scientist: Forensic Science Northern Ireland, 2015)

To return to the process of organisational reform within the FSS, in addition to managing internal change, the FSS’ was - in the mid-1990s - faced with further challenges. Its monopoly on forensic science delivery in England and Wales came to an abrupt end when two private forensic companies (LGC, and Scientifics Ltd.) emerged, and began to compete directly for FSS’ business. These companies had originated in the public sector, and were joined - in 1996 - by the first fully private company, Forensic Alliance.²⁹¹

During this period the Forensic Science Service had undergone a degree of reformation in order to bring it into line with the emergent market realities. Indeed, the FSS made it clear that the commercial considerations of the new forensic market were paramount in reshaping the relationship between FSS forensic experts and the requirements of the criminal justice system:

²⁹¹ Lawless *op cit* pp. 3-6.; Lawless, C.J. & Williams, R. *Helping With Inquiries or Helping With Profits? The trials and tribulations of a technology of forensic reasoning*. *Social Studies of Science* (2010), 40, 731-755 at pp. 736-8

‘It is the belief of the FSS that the perception of such value for money should be that of the customer. These initiatives have the aim of not only providing better value for money, but also of achieving improvement through a genuine partnership in which the customer has a greater participation than hitherto in decisions about what work is done in the laboratory.’²⁹²

The degree to which these changes altered the reported nature of FSS service delivery, and ethos, may be gauged by comparing the FSS ‘mission statement’ from 2001, in which the agency defined its role in terms of a commitment to crafting a ‘safer and more just society’, with later versions, which referred to the need to;

‘retain and reinforce our leading position as the principal provider of forensic science to the UK criminal justice system (UKCJS), and use this platform to become the leading provider worldwide, thereby enhancing long term shareholder value.’²⁹³

The alterations to policy and management - characterised by marketisation, and productisation - were accompanied by deeper structural changes. The FSS had been awarded Trading Fund status by the Government, in 1999. Thus, the service was able to recoup funds, and to declare a profit, in the short term. However, as new competitors emerged, each contributed to a reduction in the FSS’ market share, and profits declined. The McFarland Review, in 2003, found that the Service was too heavily burdened by overhead costs, and was thus unable to meet clients’ needs. The Review recommended a further change, to GovCo (Government Company) status, as a preliminary stage prior to restructuring as a Public-Private Partnership.

The later McKinsey Review, of 2008, examined the sustainability of the forensic science market as a whole, concluding that the market was underperforming, and was in need of urgent reform. It also noted that the costs of restructuring the FSS would be significant. As a result, the government announced its plans to wind down the FSS, following the advice

²⁹² Cook, R., Evett, I.W., Jackson, G, Jones, P.J. & Lambert, J.A. *A Model for Case Assessment and Interpretation Science & Justice* (1998) 38 151-156 at p. 152

²⁹³ See Lawless and Williams, *op. cit.*, at p.737.

of the House of Commons Science and Technology Committee in December 2010. The service was eventually closed in 2011. With the closure of the FSS, forensic science provision in England and Wales became fully marketised, with work (including the 65% market share of the defunct FSS) now to be shared between fifteen private companies.

The Forensic Science Market

The dissolution of the FSS having been completed, the forensic science sector now comprised a rudimentary market, which had emerged during the latter stages of FSS rundown; a market comprising a diverse number of commercial Forensic Science Providers of varying sizes, boasting varying specialisms, and displaying varying abilities. The sector was, from the outset, dominated by four large companies, who together accounted for the largest share of the market. These were Key Forensic Services²⁹⁴, Cellmark²⁹⁵, Environmental Scientifics Group²⁹⁶, and LGC Forensics²⁹⁷. These four companies also comprised the founding commercial members of the Association of Forensic Service Providers²⁹⁸, with the stated aim of furthering the interests of the forensic services industry. The four large providers offered a wide range of forensic services. The remainder of the market consisted of medium-sized, and niche, organisations, such as ROAR, Principal Forensic Services²⁹⁹, Manlove Forensics³⁰⁰, Randox, and Hayward Associates Forensic Science (which provides only DNA-profiling services and specialises

²⁹⁴ <http://www.keyforensic.co.uk> (in insolvency as of 2018).

²⁹⁵ <http://www.cellmarkforensics.co.uk>

²⁹⁶ <http://www.esg.co.uk/services/forensic-services-overview/>

²⁹⁷ <http://www.lgcgroup.com/sectors/forensic-science/> (rebranded EuroFins as of 2017)

²⁹⁸ <http://www.afsp.org.uk/node/33/>

The non-commercial members are Scottish Police Authority Forensic Services and Forensic Science Northern Ireland.

²⁹⁹ <http://www.principalforensicservices.com/>

This company is noteworthy as it employs the current UK Forensic Science Regulator, Dr. Gill Tully.

³⁰⁰ Now ArroGen Forensics, merging with Forensic Access in 2018.

in criminal defence work).³⁰¹ In addition, it should be noted that each of the forty-three police forces in England and Wales operated their own private testing laboratories, a state of affairs which subsists to the current day.

Procurement and the NFFA

The creation of a rudimentary forensic science market, and the introduction, by the FSS, of direct charging to customers, heralded an emphatic turn towards commoditisation within the forensic science sector. Therefore, in response to the imperatives of progressive marketisation, the FSS began to restructure service delivery. From this point forensic services began to be organised in terms of the provision of products, which began to be defined by; category of expert activity, chargeable units of time, cost, standards, and expected outcome. The demand side experienced similar commercial re-structuring, and in 2006, the government announced a pilot procurement exercise. The exercise was initially limited to three police forces. However, this pilot project quickly grew to involve fourteen police forces in England and Wales, a group which came to be known as the ‘West-Coast Consortium.’ The resulting SWNWW Tender (encompassing South Wales, North Wales and the West of England) established fixed prices for a range of standardised and codified forensic products, which were to be purchased from forensic science providers (FSPs) on a bulk basis. Meanwhile, on the customer side, purchasing of forensic services shifted, from police Scientific Support Managers (most of whom had been Scene Of Crime Officers with experience of quality assurance and financial management in relation to forensic science) to police procurement departments. As will be shown, informants report that the introduction of this codified system for the purchase of fixed-price forensic products carried serious implications for the provision of forensic science services. Prior to the West Coast Consortium Tender police forces had submitted items to their forensic provider,

‘...in discussion with a scientist, and the scientist then decided, using their skills, independence and experience, on what items to examine, using what techniques and what analytical technique, if any.’³⁰²

³⁰¹ <http://www.haywardforensics.co.uk/>

Following communication between the investigatory authorities, and the forensic science provider, a ‘turn round time’ (TRT) would be agreed, based on practical considerations (e.g. case complexity, supporting evidence, offence type, and court date). The work would then be charged on an hourly basis, with a degree of fixed-price charging in respect of analytical tasks. However, the competitive tendering process introduced by the West Coast Consortium Tender was largely customer-led. It required FSPs to quote substantial efficiencies in the turn around times (TRTs) for both analysis, and the evaluation of forensic samples. In addition, the tendering process saw the introduction of a range of standardized, and codified, forensic products. Rather than develop the codes in tandem with scientific experts, it was the police forces themselves who drew up the codes, using ex-forensic submissions administrators. Thus, under ACPO (Association of Chief Police Officers) guidance, the police created a ‘menu’ of forensic products, and provided forensic scientists with instructions on when and how they were to be applied.

An example is as follows:

‘OIBF (Body Fluids) - DNA (Deoxyribonucleic Acid) Crime Scene Stains – Standard: To process recovered biological samples/material using the most appropriate means to successfully obtain the optimum Short Tandem Repeat (STR) Second Generation Multiplex Plus (SGM+) profile for :- Comparison against an individual’s DNA profile and/or submission onto the United Kingdom DNA Database (NDNAD).’

With the publication of the tender document, forensic providers were required to rapidly reorganise their service delivery models to fit with the new regime: a process which required a thorough examination of each of the listed products, and attendant protocols, in order to determine the necessary business, and operational, restructuring in order to deliver the product in accordance with the accompanying protocol. Additionally, providers were required to ascertain an appropriately competitive price to submit for each code. The codification process thus imposed new challenges on providers, not least due to the fact that some of the products were not clearly defined, leading to diverse interpretations - and

³⁰² King, D, Stangoe, C & Cooke, L. (2012), *Scrutinising Forensic Services* : CPD Presentation to 25 Bedford Row at page 12.

ongoing disagreements - between customers and providers. This will form the subject of further discussion, *supra*.

Returning to the initial tendering process, forensic experts began to express concerns regarding the way in which the pilot project was allowed to increase in size and complexity. Untrammelled growth presented the Consortium with significant challenges when attempting to evaluate, and compare, each of the tenders against the requirements of the fourteen individual forces involved. This led to consequent delay, and the process - which had been estimated to last a few months - took eighteen months to reach completion. During this time, providers were precluded from approaching police forces to solicit further work, and market development therefore came to a halt, leading to increased tension between customers and providers. As the market began to stagnate, and pressures grew, commercial managers within the provider companies began to involve themselves in service delivery, taking control away from forensic scientists. This is reported as having led to diminishing morale amongst forensic scientists, who also harboured concerns over the quality of service delivery.

Contracts under the SWNWW tender were finally awarded in January 2008, with FSP's awarded contracts under a series of lots, each corresponding to a particular forensic activity (e.g. Lot 209, Questioned Documents). Under the contract, single forensic service providers were tasked with providing services to various police forces. These contracts were generally arranged on a large-scale 'volume' basis - normally in terms of tens of thousands of units, each unit corresponding to a forensic product - with the open market structure allowing forces to change providers with relative ease. Conversely, police forces might typically have contracts with a variety of providers, in order that the latter provide a range of different services. One provider may provide DNA-profiling information, another may do work relating to the analysis of footwear impressions, and a third may provide computer, and telecommunications, services. Thus, different elements of a complex case would inevitably be sent to different providers. Further, it is alleged by a number of practitioners that, since the market structure actively precluded communication between rival companies, the articulation of rich contextual detail that had been shown to be essential to providing accurate results, was impacted. Whilst the productised model of

delivery was limited to so-called volume crime, it is nonetheless the case that routine work on high-volume crime may throw up the same complexities and difficulties as those relating to serious crime. However, the ability to fully investigate these complexities would henceforth be impacted to a significant degree by organisational capabilities and budgetary constraints.

Returning to the initial tender, this provided the stimulus for further restructuring of the FSS, the organisation having lost a significant amount of work to LGC Forensics and Cellmark Forensic Services. Meanwhile, Key Forensic Services³⁰³ were tasked with providing assistance with initial resource problems across the industry. However, the previous decision to allow the tender to grow in size, and complexity, was to lead to further problems. The tender had been intended to be a small pilot, the results of which were to be analysed carefully, before the next round of tendering was instituted. Thus, improvements and modifications had been planned to be taken into account in order that lessons learned from any problems encountered during the pilot tender could be absorbed. However, due to the long delay in the tender evaluation and award process, there was insufficient time to consider operational feedback from both the forensic science providers, and the police forces, before the next round of tenders were instituted.

The NPIA/NFFA

As outlined above, problematic contingencies became structurally embedded in the standardised procurement procedures, and were expressed in the subsequent tendering process. This latter process came under the control of the National Policing Improvement Agency (NPIA) and became known as the National Forensic Framework Agreement (NFFA). The National Forensic Framework Agreement represents a government attempt to implement standardisation measures in respect of the services offered to the police by the new body of FSP's. It was launched in August 2008. The agreement sought to bring much-needed organisation to the system of police procurement of forensic services whilst ensuring compliance with overarching European Union requirements regarding transparency. A dozen FSP's including the FSS, participated in the original agreement. The

³⁰³ Cellmark, LGC, and Key Forensic Services comprise the top tier of marketised forensic science provision in the UK.

structure and content of the NFFA was broadly similar to that of the West Coast tender. Under this agreement, in August 2008 twelve FSPs - including the FSS – were to take part in the initial NFFA tender. The introduction of the NPIA/NFFA also allowed small private forensic science suppliers to bid for particular lots (such as DNA crime scene stains or sexual offence casework). This enabled niche providers to bid for contracts in areas, which had previously been dominated by full-service providers, whilst providing customers with a greater degree of choice and flexibility.³⁰⁴ Whilst the government were able to introduce a level of standardised practice across the market, implementation difficulties are reported as contributing to a further set of problems.

Forensic productisation - Implementation and Resistance

As Lawless has previously observed, the NFFA ‘placed cognitive practices of evidence interpretation alongside mechanical and technical procedures’, allegedly leading to opposition, and resistance, from forensic scientists. Further, scientists raised concerns regarding what they regarded as the partial, and incoherent, manner in which standardisation had been implemented.

During the data collection process, a significant number of respondents highlighted the difficulties faced by FSP’s, when attempting to negotiate the standardised forensic product system. In particular, they noted that whilst there had been a degree of standardisation with regard to products, the process was incomplete, and was characterised by deep meso-level diversification with regard to the application of those standards. Specifically, it was claimed that each of the forty-three police force ‘customers’ wished to apply the codes in a bespoke manner which would maintain, and serve, the latter’s unique force identity.

‘[The codes] are broadly similar but...they’re incompatible. The turn-around times, the delivery of the report, the way in which the report findings should be delivered, whether it’s an SFR, an abbreviated statement, all of these change between force,

³⁰⁴ Lawless, C (2016) *Forensic Science: A Sociological introduction* (Routledge: New York) at page 71

even within the same consortium. So, you're effectively re-inventing the wheel for every customer.'

(Interview with Lead Scientist: Tier Two FSP, 2015)

'[Police] procurement dictate the codes. So, for example, 'mixed sample' is A6. A6 is broken into different tiers but it's an over-simplification of the job and there are too many levels. Further, the police can manipulate the codes. So, an A6 for the Met and an A6 for Cambridge may mean different things, as they tender individually. There's no direct comparison.'

(Interview with Lead Biologist: Tier One FSP, 2015)

Standardisation under the NFFA, occurring at force level, thus led to a multitude of standards being enforced between different force areas, Forensic scientists associated such problems as being directly related to the non-unitary nature of policing in England and Wales:

'The only driving force behind police forces coming together to tender for work was cost, but what they didn't do was change their own internal procedures, or lose their own force identity, because they've all got their own management, their own Chief Constable, their own ACC, their own forensic... Avon and Somerset may want an SFR sent to a CJSM account sent to an individual by post. [Conversely] if you're working in Devon you [compile] an abbreviated statement, but only for footwear...'

(Interview with Managing Director, Tier Two FSP, 2015)

However, the problems also extended beyond England and Wales, to allied jurisdictions within the United Kingdom.

'Our product coding system is based on that original ACPO / NPIA coding system... The codes don't necessarily fit the request or the item. It doesn't easily fit the processes we do and [the product codes] have been adjusted over the years. So, each lab interprets them in a different fashion. Each lab adjusted [the codes] according to their own protocols and interpretation.'

(Interview with Lead Scientist: FSNI, 2015)

Further, scientists highlighted concerns relating to the ways in which productisation now afforded individual police forces with the means to direct forensic strategy within the context of a criminal investigation, often in the absence of supporting contextual information.

‘You might have an item from a suspect’s jumper. The jumper has three obvious dark brown stains on the sleeve that appear to be blood. So the police tell you to test those stains to tie them to the victim. But the stains could be from the suspect - he may have had a bleeding nose. And beside those large stains may be a small stain more consistent with low-velocity splatter. That may be the crucial item to test that ties the suspect to the victim.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

Biologists were especially concerned that laboratory testing processes had become visible to the police, through productisation, but that the latter lacked the necessary expertise to understand when and how to use forensic products. Conversely, scientists felt less able to approach investigations in a rigorous, scientific manner. In practical terms, this was often related to a lack of provision of necessary contextual information.

‘In practice, the police have budgets and scientists have turnarounds. You need thinking time...or experience [to carry out a thorough analysis]. So, when time is short, the tendency is just to do what the police ask. You have targets to meet. You have to complete a number of allocations.’

(Interview with Lead Scientist: Tier One FSP, 2015)

Such problems were reputedly exacerbated by poor communication between forensic science providers, and the investigatory authorities, compounded by the supposed incommensurability of each agency’s role.

“If you are needing further information you can only contact certain named people. Often they will be named on the contract. Ideally, you contact the budget holder, who has to sign off on the work. Otherwise you don’t get paid. You have to provide an estimate. The estimate has to correspond to product codes. So the codes allow the police to control budgets and compare providers.”

(Interview with Managing Director: Tier One FSP, 2015)

“The problem is that police procurement are monitoring for performance, and scientists are carrying out the work governed by different criteria. The key is good communication between the different layers.”

(Interview with Lead Scientist: Tier One FSP, 2015)

Lastly, scientists reported encountering implementation problems within the police force, directly related to the ‘triaging’ of forensic investigations.

“The code system doesn’t apply to serious crimes such as murder. They are charged under a bespoke system according to an hourly rate.” You may have an item from a jumper that’s been taken from a suspect in a homicide. The police may try to put that item through under a volume crime code. The police assume that it’s the same test. So there has to be a triaging process of monitoring submissions from the police.”

(Interview with Lead Scientist: Tier 2 FSP, 2015)

This triaging process will form the subject of further discussion, *supra*.

Triaging of forensic investigations

Since the majority of products allotted during the tendering process were assigned a fixed price, forensic providers were forced to allocate work to their scientists as directed by the investigative authorities, categorising work according to particular product codes. Thus, the triaging of cases could be seen to be a direct response to (or was at least heavily influenced, and facilitated by) the introduction of categories defined by non-expert ‘customers’ from outwith the forensic-scientific domain, who themselves were propelled by financial

considerations. Further, the tight turn round times associated with each product process significantly reduced the time available for expert interpretation and evaluation, whilst putting pressure on scientists to deliver particular results.³⁰⁵ If testimony is accurate, then it may be claimed that a reduction in ‘thinking time’ meant that scientists faced a significant loss in the primary resource necessary in order for them ‘to use their skills and experience to look at a case and determine what techniques to use, and to carefully examine the results, interpret them and to write a clear and robust statement.’³⁰⁶

As demonstrated above, scientists discerned further problems related to the shift in administrative control, from the forensic-scientific expert, to the ‘customer’; primarily the fact that the ‘customer’ was now able to dictate which product was to be used. Although the scientist retained the ability to recommend the use of alternative - or additional – products, these requests were increasingly viewed as purely advisory and were often outweighed by cost concerns. Conversely, some scientists expressed a reluctance to suggest viable alternatives, as these might diminish the provider’s contracted ‘turn round times’. Therefore, it may be concluded that the introduction of commoditisation led to perceptions of a significant loss of scientific autonomy in the setting of the forensic strategy necessary for case evaluation and investigation,³⁰⁷ to that extent that larger providers increasingly began to follow customer recommendations, even where these were perceived to be mistaken, or merely inefficient.

‘It is dependent on the contract...the wording of that contract, what falls under [the contract], or the scientist’s interpretation of what that is... some scientists previously have read a certain code to me in a source-level only interpretation...and especially because of the perceived price difference between a lower code and a higher code, they don’t get that added value... I’m not going to give them that activity level interpretation because they’re not paying for it, but really, my view is that [I should].’

³⁰⁵ Arbitrary three or four day ‘turn round times’ are both common in, and unique to, the UK forensic market and do not reflect the time taken for a case to reach court. Equivalent analyses may take up to ninety days in the United States.

³⁰⁶ King, et al. *op. cit.* at page 16

³⁰⁷ Productisation might therefore be seen as having a negative impact on the scientist’s ability to carry out Casework Interpretation and Analysis, given that the CAI process relies on communication and reflexivity.

(Interview with DNA Reporting Scientist: Tier One FSP, 2015)

One interviewee (a lead biologist) discussed the ways in which commoditisation might create issues for expert forensic analysis,³⁰⁸ providing the example of a common assault, following which the police submit one blood-stained item of clothing - taken from a suspect - to the forensic science provider. The investigating authorities request that product 01BF (a DNA test for body fluids) be used. The forensic scientist examines the item, and submits one blood stain for DNA analysis. The DNA is found to ‘match’ that of the alleged victim.³⁰⁹ A report is produced in those terms, stating that a DNA profile was obtained, and found to ‘match’ that of the victim.

Given the above scenario, the report will necessarily be limited to statements regarding the source of the material, since no parallel interpretation of the possible causes of particular blood patterns has been carried out. Therefore, the reader will not know how much - or little - blood was present on the examined item, or how it could have come to be on the item. In addition, no attempt will have been made to look for the presence of damage, or other evidence that might help the court to determine what has occurred, and which may allow the scientist to furnish propositions relating to the activity which led to the staining, as well as the source.³¹⁰

Such limitations as may result from the sole use of product 01BF derive from the fact that this product was designed to be used in simple cases, such as burglaries - or car thefts - where answers to the question of ‘who’, rather than ‘how’, are regarded as being generally sufficient. Nonetheless, this product is reported as being routinely used in more complex cases, in which, it is claimed, the interpretation of evidential material should proceed on the basis of a more thorough, and nuanced, analysis.

³⁰⁸ See also King, et al. *op. cit.* at page 18

³⁰⁹ Although the term ‘match’ is used, for ease of description, it should be noted that this term is abjured by many scientists and academics, who highlight the fact that DNA profiling - operating on a genuinely scientific basis - relies on statistical probabilities, rather than claims of ‘match’ and ‘non-match’, as typified by the ‘pattern identification’ techniques, such as fingerprinting and ballistics.

³¹⁰ For a discussion of the hierarchy of propositions see Evett, *et al.*, on The Case Assessment and Interpretation (CAI) Method. Cook, R., Evett, I.W., Jackson, G, Jones, P.J. & Lambert, J.A. *A Model for Case Assessment and Interpretation Science & Justice* (1998) 38 151-156

In addition, it should be noted that the codification, and commoditization, of forensic scientific products, under the West Coast Consortium Tender, extended from substantive forensic activities such as testing and analysis, to the writing of forensic reports. The tender introduced a product called an ‘abbreviated’ (or ‘short form’) statement, for use with all forensic products.³¹¹ This product was significantly cheaper than a full evaluative statement due to the fact that the ‘short form’ statement contained comparatively little information. The abbreviated statement was limited to only that information which the investigating authority, and forensic scientists, considered to be important. Hence, a complete list of case items was not provided, and interpretation of the results - if present - was not thorough. Nor was the interpretation able to be conducted with any regard to the overall context of a case.³¹²

As with the design of simple products, such statements were designed to be used in reasonably straightforward cases, such as burglaries or car thefts. In such cases, a DNA profile will be obtained and the abbreviated statement written, giving the basic DNA result (which will often be a full DNA profile attributable to a particular individual).³¹³ There is a section at the end of many of these abbreviated statements stating that a full witness statement should be requested prior to the case going to court. However, it is reported that this requirement is frequently overlooked.

Thus, the codification process, in tandem with the introduction of short form reporting, may - according to the preponderance of reports - be seen as delivering efficiencies through promoting the stratification of criminal investigations - at an early stage - into ‘simple’ and ‘complex’ cases: a division which is reflected in the pricing of forensic products, and which may prove potentially determinative when allocating resources. However, since the

³¹¹ The commoditisation of forensic reports followed the introduction, by the Crown Prosecution Service, of ‘staged reporting’ (also known as Streamlined Forensic Reporting) for cases involving DNA. See Richmond, K (2017) *Streamlined Forensic Reporting: ‘Swift and sure justice’?* Journal of Criminal Law, 82(2), 156-177

³¹² Abbreviated statements should be distinguished from Streamlined Forensic Reports. The latter are frequently compiled by non-experts and contain no interpretation.

³¹³ King, *et al*, provide anecdotal evidence of problems which may arise from the use of abbreviated statements: ‘...we have seen examples where upon examination of the DNA profile the result is actually a mixture of DNA from which the profile of the major contributor has been deduced. In these cases there has been no comment on the presence of DNA from any other individual.’

interposition of processes of ‘triaging’ may determine the amount of resources allocated to forensic investigation - thus affecting the depth of investigation, and the nature of its conclusions - the potential must also exist for problems to arise in relation to the initial misrecognition of cases (e.g. when the concise approach is taken to a case requiring deeper analysis and thorough evaluation). Such difficulties may, it is claimed, be compounded by the lack of availability of clear criteria with which to demarcate alternative levels of seriousness, and their subsequent analysis.

Conclusion

As the data has demonstrated, the creation of a rudimentary forensic science market, (subsequent to the introduction, by the Forensic Science Service, of direct charging to customers) is reported as having facilitated the process of informal standardisation of forensic processes. It is further reported that, by making forensic investigatory processes visible to institutional agents within the criminal justice system, forensic providers were able to deliver a degree of efficiency. In addition, it is claimed that this process enhanced the ability of the investigative authorities to dictate the course of the investigatory strategy, and to request the use of particular products, within the context of particular levels of evaluation. The standardisation, and productisation, of forensic processes is thus viewed as having facilitated ‘triaging’, and enabled criminal justice agencies to assign samples to different intensities, and modes, of forensic investigation, largely determined by the offence type. Given that each force had particular needs, this model led to perceived inefficiencies, and an added perception that the process allowed ‘inexpert’ investigators within the CJS an inordinate amount of control over matters, which traditionally had fallen within the ambit of forensic science.

Scientists further reported that the convergence, and transplantation, of standardised products and practices had created tensions, which were overcome through the modification of subsisting practices, alongside site-by-site adaptation, and the use of bridging strategies. Informant’s responses demonstrated the persistence of these modified local practices, and the continued importance of tacit expert knowledge. Crucially, scientists also testified to the degree to which they believed that partial standardisation had

served to create greater levels of variation, especially with regard to the delivery of the product. This was seen as having flowed directly from the inability of the forty-three individual forces to agree to standard operating procedures, and protocols (albeit that these might remain flexible enough to accommodate the particular needs of each force).

Further, informants demonstrated how the influence of codification was perceived as having shaped the subsequent process of ‘triaging’ which set material samples on a particular evidential trajectory, and which structured the resulting analysis in terms of depth, level of expertise, and the examiner’s ability to take account of contextual factors. They testified to the ways in which overarching governance structures were held to have influenced the work of expert practitioners, and considered the degree to which these influences could affect the ability of forensic scientists to carry out an exhaustive – contextually rich – evaluation, which conformed to the standard requirements of the Case Assessment and Interpretation process.

Lastly, informants illustrated the ways in which processes of standardisation and productisation articulated the concept of customer ‘value’, reputedly creating tensions between forensic scientists, and institutional agents within the criminal justice system, and which were viewed as carrying deeper implications for both the criminal justice system, and the forensic science sector.

In closing, it is claimed that - if informant perceptions are accurate - the foregoing empirical study may potentially carry significant implications for our understanding of the development of standards within emerging markets. It highlights the necessity of drafting standards as part of a comprehensive process involving all relevant stakeholders. Indeed, the empirical data raises concerns regarding the difficulties which may arise when lead agencies (or international corporations) control, and direct, the standardization process, crafting solutions – and shaping products – which are viewed as having been tailored to providing efficiencies primarily to their members. Thus, it is probable that problems may be encountered when monopolies (or oligopolies) define standards in a way which delivers disproportionate benefits to one group. Such problems are amplified when the standardisation process is enacted against a background of market volatility, in the absence of formal, meso-level organisation.

The obstacles engendered by the incomplete, or partial, drafting of standards may potentially lead to further difficulties, related to implementation, and adaptation. The data from the instant study reveals the awkward complexities of implementing forensic products, intended for utilization within a structured investigatory process, which were viewed as having been developed in the absence of rigorous and transparent complementary protocols governing their implementation. The implications are that partial standardization does not in, and of, itself create uniformity. The outcome will depend on additional factors which relate to the ability of those tasked with implementing the standard to do so, and which will largely determine whether a standard can ultimately be followed, absent of adaptive processes.

Further, the chapter demonstrates that the subject of standards—their production, distribution, and adoption—is of central importance, not solely to Science and Technology Studies scholars, but to those from the humanities and social sciences, particularly law. The study demonstrates the increasing relevance of qualitative socio-legal studies of standardisation, and testifies to their capacity to unearth rich descriptions, revealing the contingency of the standardization process, and of subsequent strategies of adaptation.

Chapter Five: Expertise

Chapter Summary

The focus of this section is on the restructuring of forensic expertise through marketisation and commodification. The chapter explores the perceived benefits of marketisation. In order to provide answers to the research questions, particular attention is paid to the divergence in approaches to forensic analysis brought about by the stratification of the forensic market. The chapter follows from the preceding discussion of the tendering process, which charted informant perspectives on the reported influence of historically contingent factors on the development of codification. It focusses on the perceived influence of codification, as having shaped the process of ‘triaging’ which sets material samples on a particular evidential trajectory, and which structures the resulting analysis in terms of depth, level of expertise, and the examiner’s ability to take account of contextual factors. It explores the perceived effects of overarching governance structures on the work of expert practitioners, and considers the degree to which these are seen to affect the ability of forensic scientists to carry out an exhaustive – contextually rich – evaluation, which conforms to the requirements of the Case Assessment and Interpretation process. It also explores the process of market restructuring, and the perception of ‘de-skilling’, a perception challenged by a number of professionals from allied criminal justice agencies. The chapter demonstrates the ways in which restructuring is perceived by forensic DNA profilers as having resulted in a loss of expertise. If such perceptions are accurate, then how are the resulting tensions and paradoxes resolved? It illustrates the ways in which productisation, and the concept of customer ‘value’, has created tensions between forensic scientists, and institutional agents within the criminal justice system. The discussion leads to a consideration of whether, and to what extent, subsisting theories of expertise offer an

understanding of these processes. Again, the analysis is explicitly limited to the perceptions of informants, absent of any strong causal determinations. Further, it should be noted that the processes outlined in this chapter are not presented as being unique to the forensic science, and criminal justice, sectors. As Mirowski and van Horn demonstrated, these phenomena influence ‘the sphere of corporate scientific research’ more generally.³¹⁴

Pre-codification forensic analyses within the public sector

The majority of forensic scientists in Tier 1 and Tier 2 FSP’s in England and Wales reported previous employment experience within the Forensic Science Service. Informants employed by Tier 1 providers tended to be less senior, having joined the FSS during the organisation’s later GovCo incarnation. Nonetheless, all previous FSS employees were able to provide evidence to support their view that pre-codification forensic analyses carried out by the FSS were both comprehensive and contextual, as outlined in the previous chapter.

Notably absent from this expert’s response were indications of the over-arching importance of turn-around-times (TOTs) or the imposition of economic efficiencies. Rather, the investigation, and comparatively rigorous forensic evaluation, appear to conform to normative representations of scientific method. They are indicative of universalism, insofar as the truth claims are subjected solely to pre-established impersonal criteria. They are communist insofar as the ‘customer’ does not dictate the course of the investigation. And they are disinterested insofar as they are free from institutional motivations.

The responses elicited suggested that both the FSS, and FSNI could claim a similarly exhaustive approach to investigation, evaluation and reporting. Both agencies made similar claims i.e. that the English and Welsh police forces, and PSNI, were not significantly concerned with directing the course of the investigation through the selective collection of material samples. The respondents indicated an awareness of what they regarded as the possible inefficiencies of such a system, both in terms of economic, and evidential, value. Further, the respondents suggested that the perception of inefficiency (at least on the part of

³¹⁴ Mirowski, P. & van Horn, R. *The Contract Research Organisation and the Commercialisation of Scientific Research* Social Studies of Science, Vol.35, No. 4 (2005) pp.503-548 at p.505

the customer) led directly towards a privileging of DNA profiling techniques and a shift towards a more customer-directed investigatory strategy. The responses lacked the detail to make any substantive comments regarding the extent of this shift in emphasis. However, in light of the respondents' later comments on the importance of scientific method, and the perception of a continuing ability - on the part of FSNI - to carry out holistic, and contextual, analyses, it would not be unreasonable to infer that FSNI informants perceive a lesser degree of customer-led restructuring, of the type which has been reported in England and Wales (RQ1).

Triaging, and the privileging of DNA profiling techniques

The above responses suggest that the intensity of investigation and evaluation - and the concomitant granular of inference - carried out within the public sector, by both the FSS and FSNI, represent a high water mark. Further, that DNA-profiling techniques formed part of a diverse array of forensic practices. Ex-FSS employees went on to explain the ways in which DNA profiling technologies began to be privileged, at the expense of similar bio-identification techniques and craft practices. This was facilitated by investment in DNA technologies, and based on an appreciation of the ability of such techniques to deliver quick, conclusive results.

‘DNA at the time was pretty expensive because we were at the beginnings of technology - big machines, big chemistry, lots of expertise, loads of training - you know, reporting was specialist because it was interpretation, so although it was very, very good wins it was pretty cost inefficient I suppose in terms of the person buying the test. So then, you invest in that area, you reduce costs, you decrease turn-around time, you increase capability, you increase sensitivity, you put a robot in a room, and suddenly that gold standard of evidence is commoditised and it allows people to spend ten pounds on the test and [to derive evidential] value from that ten pounds.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

Both Tier 1 and Tier 2 forensic scientists indicated that the focus on DNA profiling techniques occurred at the expense of similar bio-identification techniques, partly as a

result of budgetary constraints in relation to volume crime investigations. Investigators began to neglect peripheral investigatory practices such as fibre analysis, which began to be used viewed as useful only as part of a ‘fact-finding mission rather than an interpretative science.’³¹⁵ The investigative authorities began to perceive DNA profiling techniques as the primary means through which valuable forensic results could be fed into the investigation at an early stage. Therefore, under pressure from Senior Investigating Officers - concerned with the potential loss of investigative opportunities, and the availability of ‘real-time’ results derived from DNA profiling techniques - forensic investigations became less systematic. A lead forensic scientist described the changing investigatory process:

‘[The FSS] was moving towards being able to service that requirement. You would get items in, you would examine them quickly for blood, take the blood, put it in for DNA, get a DNA result, and link that back to the individuals for whom we had a reference sample (or put it on the database). And that’s the same for semen, saliva, urine, hair: ‘screen for body fluid, chuck it in for DNA, tell me who’s involved’; obviously these are things that DNA doesn’t say, but that was how it was interpreted.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

The perceived need to provide real-time results in respect of serious crimes, with comparatively rapid turn-around-times, led to the stratification of forensic-scientific investigatory processes:

‘We had a standard route and a premium route and the police would pay per test. Now the premium route would be sub forty-eight hours and at the time that was a very fast route and effectively the reason that it cost more is because they were, in a sense, paying for the whole gel... you’d assign a cost to that and it would be in the thousands of pounds for a premium.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

³¹⁵ Interview with Lead Scientist: Tier One FSP, 2015

The response indicates a divergence based solely on time, with investigators able to commission a rapid, or standard, evaluation. Crucially, responses indicate that the divergent approach became entrenched throughout the process of marketisation, and was extended to cover, not merely the rapidity of response, but the intensity and scope of the investigation. This led to the 'triaging' of cases at an early stage. Serious crimes (e.g. murder, robbery, and serious sexual offences) would automatically follow the premium, or 'bespoke' route, characterized by a lack of budgetary constraints, and charged at an hourly rate according to the time and expertise allocated to the investigation and evaluation (RQ1)(RQ2)(RQ4).

'The code system doesn't apply to serious crimes such as murder. They are charged under a bespoke system according to an hourly rate.'

'There are 'spec cases'. These are cases requiring speed, involving a quick hit routine. They tend to be volume crimes. Then there is major crime which is dealt with more strategically. But there is a creep. The police may have a jacket from a murder case and they may stick it through as a 'spec case' under the rationale that 'it's the same test'.'

(Interview with Lead Scientist: Tier Two FSP, 2015)

Alternatively, less serious offences - which collectively fell under the heading 'volume crime' - would be charged on a cost-per-test basis. The volume crime route is characterized by economic efficiencies and constraints, limited opportunity for the development of investigative strategies, and direct intervention by the investigative authorities. Respondents suggested that the introduction of triaging influenced two elements of the investigatory process in particular: strategy setting and reporting.

Following the introduction of triaging, strategy meetings were no longer deemed necessary, or economically viable, in respect of volume crimes. The result is that the forensic strategy for volume crime investigations is now set by the 'customer' (i.e. the police) prior to contacting the forensic service provider:

‘The strategy on many items that came in now has already been set by the police. They’ve set the strategy in order to say ‘we want to submit that for testing’...’can you recover DNA from this and put it on the database?’ So, the dialogue between the scientist and the strategy-setting person is lost.’

‘Context plays a part in both collection and sampling. Ideally, there’s disciplinary collaboration and you develop a case strategy before beginning.’

(Interview with Lead Scientists: Tier Two FSPs, 2015)

Respondents indicated particular problems due to the fact that the individual officer responsible for setting the forensic strategy is normally also the budget-holder. As such, the commissioning officer may only be willing to pay for one test, with no opportunity for discussion as to the suitability of this approach. This leads to significant problems where forensic scientists require further contextual information. This is exacerbated by the codification of forensic-scientific analyses.

‘If you need further information you can only contact certain named people. Often they will be named on the contract. Ideally, you contact the budget holder, who has to sign off on the work. Otherwise you don’t get paid. You have to provide an estimate. The estimate has to correspond to product codes. So the codes allow the police to control budgets and compare providers.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

The majority of forensic scientists interviewed, in both Tier 1 and Tier 2 FSPs, indicated that the introduction of codification and triaging had led to tensions between the investigative authorities and the forensic practitioners. This was perceived as resulting in a loss of necessary contextual information. In reality, the entire responsibility for interpreting contextual information has – in respect of volume crimes – passed from the forensic practitioner to the investigative authority. This has also led to the diminishment in the role and influence of Tier 1 forensic practitioners (RQ1).

‘In practice, the police have budgets and scientists have turnarounds. You need thinking time...or experience [to carry out a thorough analysis]. So, when time is

short, the tendency is just to do what the police ask. You have targets to meet. You have to complete a number of allocations.’

‘You can’t just say, ‘well actually, the pattern of blood-staining is important, so I’m just going to go ahead and do that’, because if you do that, you don’t get paid. And if you go back to the customer and say ‘d’you know what, I’ve even done this for free, they go ‘well that’s not the question I asked you to answer.’ So, it completely cuts off that scientific process in some instances.’

(Interview with Lead Scientists: Tier One FSPs, 2015)

The above responses suggests a significant degree of path-dependency, with a non-permeable division between the standard tests associated with volume crime, and more complex testing strategies formulated in relation to serious crimes. Tier 2 providers indicated that there still exists the possibility for recursion and review, but suggested that ‘the process is not as open as it used to be.’ Crucially, Tier 1 providers indicated that there is very little opportunity to question the forensic strategy, or to enter into any form of discussion with the ‘customer’, in respect of the analysis of volume crimes. Indeed, one respondent outlined an extreme iteration of attenuated volume crime reporting, whereby the absence of a budget allocation for essential interpretative work might lead directly to the failure of the forensic test (RQ1)(RQ2)

‘For a volume crime job usually it will be: ‘A sample has been recovered from the crime scene. Can you load it onto the National DNA Database?’ And that will come with a known cost. There’ll be no thinking, no interpretation *per se*. And what’s happened then is that the providers have had to develop, not only the way they report cases, but the way that they deal with results that come out the other end, because if you had a DNA result that was mixed, for example, then there’s an element of interpretation there. So unless the result meets a number of criteria that are open to computer designation, computer interpretation, with a human being coming in and just verifying it, [providing a] quick win, then the result wouldn’t be carried forward. So, unless it meets a certain number of criteria it would be deemed to have failed, when we’re working on a commoditised test.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

Case Fragmentation and quoting

A particular concern - amongst both Tier 1, and Tier 2 forensic scientists - was the degree of site-specific specialisation introduced through the tendering process. Respondents indicated that stratification had led directly to the segmentation of forensic analyses, which became fragmented, separated, and geographically distributed

In assessing the problems associated with case fragmentation it was necessary to distinguish between the organisation, and specialisation, of forensic investigations, at the meso-level, and site-specific differentiations with regard to micro-level scientific processes and protocols. The majority of respondents indicated the existence of heterogeneous communities of practice, as distinct from fragmented investigations: Many of the respondents had worked for a number of forensic providers, and were able to speak to differences in culture and approach between laboratories.

‘Within one protocol, different labs may develop different communities of practice.’

‘Individual labs will develop their own culture and that may affect the strength they tend to place on results. You can get a reputation for interpreting the evidence ‘strongly’. That applies within FSPs to individual labs and scientists.’

‘People coming in would bring different practices, so you do get ‘site by site variation.’

‘The Met may collect samples, process some in-house, send others to an FSP, with nobody getting an overview. The work becomes less interpretative.’

‘Forensic scientists aren’t getting enough *context from the police and this is getting lost* through the fragmentation of services.’

(Interviews with Lead Scientists: Tier One and Two FSPs, 2015)

Scientists related further concerns, associated with the consolidation of the market, and the subsequent growth of an oligopoly of Tier 1 providers, resulting in functional and geographical specialisations within a single organisation. One forensic scientist provided a typical example, in order to illustrate the problems associated with fragmentation.

‘A case in Nottingham centred around the discovery of a torso on a beach. The killer had dismembered the corpse, and taken parts to the beach, where he’d thrown them into the sea. The accused was the victim’s boyfriend and the victim and accused lived apart. Both of them owned cats. So, in court we had DNA, blood distribution, hair, fibres, fingerprints, toolmarks, and animal hair. The prosecution experts worked in different departments of one firm but didn’t know about each other’s evidence.’

(Interview with Managing Director: Tier Two FSP, 2015)

Forensic scientists working within the lower tier of provision highlighted the relative strengths of their holistic, and contextually-rich, analyses, as compared to those carried out by Tier One providers (RQ1)(RQ4).

‘The defence scientists are the only ones who get to see the evidence as a whole and do the Bayesian work...The defence has the advantage of seeing what all the [Tier 1] FSPs are doing. We get good training and have to make an extra effort.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

This was in notable contrast to scientists working in the public sector provider, FSNI, who displayed an awareness of the advantages derived from a holistic approach to forensic analysis, particularly when these remained centralised at one site. A further negative consequence of triaging, and professional and organizational specialization within Tier 1 FSPs was the tendency, when writing reports, for scientists (or administrators) to quote colleagues, without having carried out an analysis in their own right. One forensic scientist expressed concerns regarding the adoption of Tier 1 DNA profiling reports by the Metropolitan Police in-house laboratory:

‘They’re trying to develop a procedure where the Metropolitan Police can use the reports, or the outputs, of the DNA scientist and can incorporate that into their

statement. So, with the Met lab, one scientist is simply quoting another scientist, and that is not necessarily made clear. But, by any other name, that's hearsay.'

'Many police forces have an in-house team called the Evidence Recovery Unit. So, for the Met, the ERU send the recovered samples to LGC or Cellmark. They profile them and send the results back on a results table. The Met scientist hasn't seen the actual result or the reference sample.'

(Interview with Lead Scientist: Tier Two FSP, 2015)

Quoting was deemed to be widespread, if not endemic, and was seen as directly related to the functional specialization, and segmentation, of forensic practices, within, and between, Tier 1 providers. Particular concerns were raised regarding the loss of context (RQ1)(RQ2)

'It's a bit of an issue. We are in a situation where [a DNA profiling match report from another practitioner] is then taken into their own statement, which is written in a particular way - about what they did, they examined a t-shirt for blood, they found blood, the DNA matches, but it doesn't provide any context as to whether there is a robust link *between* the DNA and the evidence that they saw. So, if the DNA is weak, or limited, that context is lost.'

(Interview with Lead Scientist: Tier Two FSP, 2015)

Mixtures and Low Template DNA

At this stage, it should be re-iterated that the basic DNA profiling protocols, on which the above perceptions are based, has been subject to thorough validation and accreditation procedures, and has established its scientific underpinnings (see subsequent chapters). However, the same degree of trust in the accuracy of results cannot be extended to un-validated processes, such as those involving minute traces of 'low template' DNA, especially where these involve the interpretation of 'DNA mixtures' drawn from a number of individuals. The occurrence of DNA mixtures has risen sharply since the introduction of sensitive testing protocols (such as DNA-17 and Globafiler-24, both of which replaced SGM Plus). These are now capable of picking up trace amounts of 'low template' DNA,

and has led to the routine reporting of mixed DNA profiles. Tier 2 providers maintained that they did not ‘put a statistic’ on very low amounts of DNA, preferring to use these for intelligence purposes. However, they indicated that this practice was not widespread.

‘DNA-17 is a result of the Prum regime. It standardised tests across Europe. There is a choice of microsatellites and DNA-17 can cover all areas in Europe. In Scotland they went directly to Globafiler which tests 24 areas and has a global fit. Originally they weren’t allowed to upload to the NDNAD even though the 17 necessary satellites are contained in the Globafiler 24. But that’s now changed. Each new test is more sensitive, so in a commercial market a threshold is applied and anything below [the threshold] is discarded. But there’s a lot of useful information there. The frequency dataset for SGM-17 was developed by the FSS. When commercial companies set up they had to develop their own datasets. That’s one area that would have benefitted from standardisation. The same test can give different results depending on the company’s dataset.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

Further, Tier 2 respondents raised concerns regarding the alleged practice of a particular Tier 1 provider, which routinely deliver results which they termed a ‘non-weighted Dlugosz’. This practice bears a contradictory appellation, which would appear to contradict the ruling in *R v Dlugosz*.³¹⁶ (RQ3).

‘With mixture analysis you have to frame propositions very carefully. In certain cases you have to work through all of them. It depends on what the defence propositions are saying. Sometimes you are never given an alternative scenario, for example in ‘no comment’ cases. “For two person samples you can use Bayes. Then the hypothesis becomes important. If the sample is a mixture of more than two people *Dlugosz* says we can use words instead of stats. We can provide a verbal evaluation. It’s back to the CSI approach. It’s much more subjective so you really need experience.”

³¹⁶ *R v Dlugosz* [2013] EWCA Crim 2

‘There is also an issue with Cellmark over what’s known as a ‘weighted’ and ‘non-weighted Dlugosz.’ *Dlugosz* says that you can express an opinion about very small amounts of DNA but that has to be weighted. Cellmark produce results which are not weighted. This is wrong. They call it a ‘non-weighted Dlugosz’ but that is a contradiction in terms.’ “The ‘non-weighted Dlugosz’ is an attempt to standardize across the company in order to have a common approach.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

The above testimony reveals concerns amongst Tier 2 providers with regard to the alleged practices of Tier 1 providers within the forensic science market in England and Wales. However, it should be reiterated that such concerns relate to challenges faced by DNA profiling practitioners across all jurisdictions. Further, that such concerns may reveal long-standing problems in relation to the scientific nature of DNA profiling. The review of the NAS report, and subsequent literature, *infra*, supports the assertion that it was not widely believed that DNA profiling techniques were dynamic - rather than static - in nature. Nor that these advancing techniques - having proven their scientific underpinnings – should continue to be subject to fundamental testing and validation studies, or be required to submit to processes of accreditation, in the same manner as non-scientific ‘first generation’ pattern identification techniques.

Such views were dealt a severe blow by the publication of the results of the ‘DNA (MIX05 and MIX13) studies.’³¹⁷ These results - drawn from an inter-laboratory study conducted by the National Institute of Science and Technology (NIST) - had been subject to a delay, which has itself drawn criticism from practitioners and allied criminal justice agents. The study involved over one hundred laboratories, which were provided with DNA samples involving mixtures. MIX05 was undertaken in 2005, and required sixty-nine laboratories to interpret DNA data from two-person mixtures, drawn from four hypothetical sex assaults. The MIX13 study, conducted in 2013, provided 108 laboratories with data representing

³¹⁷ Butler, J.M., Kline, M.C. and Coble, M.D. (2018) *NIST interlaboratory studies involving DNA mixtures (MIX05 and MIX13): Variation observed and lessons learned*. Forensic Sci. Int. Genet. 37: 81-94.

five ‘crimes’, in increasing difficulty, in scenarios involving up to four contributors, and related individuals.

The results from the overall studies showed concerning degrees of variability across the results delivered by the participating laboratories. Of particular note were the results from MIX13, case five, which purported to provide a DNA mixture from an item of clothing left behind after a bank robbery. The mixture of touch DNA was drawn from four individuals. However, due to the complex nature of the mixed sample, this initially appeared as a mixture of only two people. The labs were provided with reference samples taken from two of the four likely contributors, along with that of a fifth person. The fifth person was not in the mixture, and had not been in contact with the item of clothing.

When the results were reviewed, it became apparent that seventy-four laboratories, out of one-hundred-and-eight, had wrongly included the fifth person in their mixture interpretation. A further twenty-six labs delivered ‘inconclusive’ reports, of varying levels of error. Thus, only seven laboratories correctly excluded individual number five from the four-person mixed sample. Even then, different reasons were given, from ‘allelic drop-out’ to ‘PCR inhibition.’

Most were using the method of combined probability of inclusion, otherwise known as CPI, an FBI-approved method of separating out mixtures. However, in the instant study, further concerns were raised regarding the use of computer algorithms to de-convolute mixed DNA profiles., especially with regard to validation.

‘There are two different types. Cellmark uses David Balding’s computer system. LGC developed LiRa. These systems can deal with two or more people. For a while Balding’s system wasn’t validated but it is now. There are differences between the systems but the same system can deliver different answers depending on how the question is formed.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

These concerns serve to illustrate the degree of scepticism amongst Tier 2 providers with regard to the scientific validity of cutting-edge DNA profiling techniques.

Commercialisation and the restructuring of forensic expertise

A second aim of the empirical research was to gauge whether, and to what extent, the emergence of an emphasis on economic efficiency and codification - achieved through competitive tendering, and productisation - had impacted on the framing, and exercise, of forensic-scientific expertise. Further, to outline the effect of progressive marketisation on routinised forms of forensic analyses, with an attendant restructuring of forensic personnel. One forensic scientist indicated that the managerial preoccupation with quantitative performance monitoring models and service agreements, led directly to the reframing of forensic roles and practices.

A number of experienced forensic scientists began by describing the nature of training and expertise within the Forensic Service Service. The emphasis was on careful interpretation, contextual evaluation, and the development of skills and forensic expertise. The structured FSS career path began as a trainee examiner.

‘The examiner is entry-level. The examiner’s work is directed by the reporting scientist. The reporting scientist knows the scenario and writes instructions to the examiner to carry out particular tests. The reporting scientist writes the report then presents it in court.’

The FSS responded to the introduction, and rapid development, of bio-identification techniques based around DNA fingerprinting (and later profiling) by initiating a ‘fast-track’ scheme. This involved 18 months of intensive training as an examiner, after which the trainee became a reporting scientist. Respondents spoke of a culture of collegiality based upon mentoring and peer-review.

‘Peer review is so important. It’s not just about finding mistakes but asking ‘what more could you do? This is where laboratory culture comes from; apprenticeship, checks and counter-balances. The quicker the work, the less checking, and that affects laboratory culture.’

Nonetheless, in 2002 FSS working patterns changed. The service began to segregate cases into ‘homicide’, ‘sex’, and ‘hit report’ (or ‘volume crime’, including ABH and GBH), which, from that point, were serviced by three discrete teams. Respondents indicated that

functional separation did not lead to de-skilling due to the potential for constant training and development (RQ4).

‘At the FSS the way we were trained was different. We were trained to be careful, building context into [the interpretative process]. That takes thinking time. That thinking time has been removed and when there are problems forensic sciences get blamed.’

Ex-FSS employees outlined the restructuring process:

‘[The FSS] went public-private partnership, then we went through to different stages. And in fact we were transforming in a very big way when we were closed, but the market had already started to change because private companies set up that were competing for the same...work...and they were building themselves up as a business, and so therefore they already knew about efficiencies and technologies, and they had backing from people with money, so if you put a government department up against a newly formed commercial provider there’s no chance, because [the government department is too unwieldy].’

(Interview with Lead Scientist: Tier Two FSP, 2015)

‘Out of that hundred people, the amount of expertise in that hundred people was over a thousand years of expertise. So, you can do the maths and we had people that had been with us for a couple of years and people that had been with us for forty years. However, the brain drain was enormous. Because the people who were thirty, forty years’ experience just retired, took early retirement, and they got redundancy. The only reason we didn’t get redundancy is because we were deemed to be aligned to the Metropolitan Police.’

The restructuring of the forensic-scientific market, and the introduction of triaging, contributed to the loss of experienced forensic scientists, and the stratification of forensic investigations and evaluations. The short-termism associated with peripatetic forensic contracts, competition between providers, and the spatial organization of the market,

militated against the retention or recruitment of established, and experienced, personnel, the majority of whom were relatively immobile (RQ4).

‘[Experienced forensic scientists] are a dying breed and...arguably we’re quite expensive. You know, we’ve been around a little while, we’ve got up to a certain level of salary that we try to maintain if possible, and so it means that, when forensic providers are tendering for work, they can only have a small portion of people who are expensive and the rest of them have to be cheap, new recruits.’

‘With the tendering process there are huge shifts every few years. Some staff follow the tenders but the companies don’t recruit at a senior level. So there is a large loss of staff to other parts of the industry and to teaching.’

‘Redundancies (in the FSS and LGC) mean there is a huge loss of experience across the industry, especially amongst senior staff.’

(Interviews with Managing Director and Lead Scientists: Tier One and Two FSPs, 2015)

A number of experienced forensic scientists also expressed concerns regarding the scientific ability, values, and training, accorded to trainees subsequently recruited to the forensic sector. This concern was encapsulated by the managing director of a second Tier 2 forensic provider: ‘My biggest worry is that people aren’t getting the necessary breadth of training. They are too niche-focussed.’ Another forensic scientist expressed concerns regarding the triaging process (RQ3)(RQ4).

‘I can give you examples of [stratification], because there are entire units now made up of people who service volume crime, and they typically will be led by someone of experience, but their reporting staff won’t have the breadth of experience that you would expect in a homicide team, so they’ll be trained to report DNA results up to a particular level, and anything beyond that they would say is ‘uninterpretable’.’

(Interview with Lead Scientist: Tier Two FSP, 2015)

In this example, the perceived loss of expertise was directly attributed to the failure of forensic analyses. More importantly, the response indicates that the potential for ‘trainees’ to develop skills and experience in interpretative and evaluative reporting has been sacrificed in order to service the needs of routinised, non-contextual DNA profiling. The restructuring of forensic practice in alignment with hierarchical forms of accountability entails a different role for experienced forensic scientists, who are tasked with reviewing routinised process rather than engaging in critical reflection: ‘There are very set guidelines when ‘calling the profile’ but evaluation is more mentored. When it comes to interpretation that can be influenced by senior staff.’ The displacement of expertise also entailed a much-reduced role for experienced staff, with little opportunity to exercise their skills (RQ1)(RQ2)(RQ4)

‘Younger trainees coming into the industry are getting training but that training is basic. They don’t know what they don’t know. That never gets rectified as they progress. So as checkers and peer-reviewers they also lack the appropriate skills.’

‘You have less experienced staff combined with pressures to do work quicker and a pressure from the police, and it leads to a factory-line approach just to get the results out.’

‘The job I trained to do is long gone.’

(Interview with Lead Scientists: Tier Two FSPs, 2015)

Further, one informant provided an example of the way in which a piece of DNA evidence, which is very strong on the source level, may be neutralized at the activity level:

‘If there is no pattern, and it’s only a...bloodstain, and it’s perhaps in the form of a handmark, and the victim’s got a bleeding nose, then suddenly you’re in a situation where you’ve completely neutralised the evidence. (DR)

Problems relating to the lack of reliable data on DNA transfer and persistence are compounded by the increasing sensitivity of DNA-testing protocols, which now regularly pick up results from ‘touch DNA’, shed by (multiple) individuals, and transferred from

person to person and between surfaces.³¹⁸ The following extended discussion from a field research interview highlights the difficulties posed by ‘transfer and persistence’:

“[When dealing with activity-level propositions] we’re onto ‘how’, ‘where’ and ‘when’. And this is ‘transfer and persistence’. This is the bit that nobody thinks about. Because the SFR said, ‘one in a billion’, and the name of the individual who they got off the database.” (HT)

Interviewer: So much concentration on what you can prove with numbers and just overlooking the simple question of...

JM: ...the question of transfer and persistence....Because nobody’s thinking of this question and, arguably, there’s no real, tenable, useful data on transfer and persistence. So, if you’re provided with a reasonable avenue for DNA, from an individual, to be on something, then it goes into the hat. Because you can’t ‘weight’ transfer and persistence.

Interviewer: It varies from individual to individual as well as...

JM: ...condition to condition, surface to surface, you know, there’s just so many variables that, the fact that they’re his gloves may mean that he’s been wearing them every day and he’s still only a minority contributor...It can pretty much wipe out DNA, that question.

It may be argued, therefore, that ‘transfer and persistence’ issues pose a serious threat to the ongoing utility, and legitimacy, of DNA profiling evidence: a threat which has elicited a creative rejoinder.

The perception of de-skilling was not shared by one QC (and former CPS strategy advisor).

³¹⁸ Jamieson, A. (2011). Case note: LCN DNA analysis and opinion on transfer: R v Reed and Reed. *The Int. J. Evid. Proof* 15, 161–169. ; Meakin, G., and Jamieson, A. (2013). DNA transfer: review and implications for casework. *Forensic Sci. Int. Genet.* 7, 434–443. ; Steensma, K. *et al.* (2017) An inter-laboratory comparison study on transfer, persistence and recovery of DNA from cable ties. *Forensic Science International: Genetics* , Volume 31 , 95 - 104

‘All I noticed was the conversations about it and the noise around it and, I suppose I have to declare that, although I’m not a massive fan of everything to do with market forces, I suppose being a barrister I do believe that if you’re good enough you’ll survive, and I don’t accept, I’m afraid, and I know it’s a lot of people’s personal experiences, it’s what they experienced therefore it’s their reality, but I don’t accept that that equals a brain drain. I would challenge that and the reality that I observed was that those very senior folk at the top end of the business, if you like, went off and created their own business.’

(Interview with QC and former CPS strategy advisor, April, 2015)

Whilst the respondent challenged the assertion that restructuring had led to de-skilling, the response is founded solely on anecdotal experience restricted to the higher echelon of the forensic market. Further, the respondent acknowledges the loss of Tier One practitioners to Tier Two companies, albeit managed by the same.

‘I’d really rather see some less emotive data about where these people did go, rather than [listen to] the frustrations of those who wanted to just be migrated from company to company without having to demonstrate that they had the skills that were worth being taken forward. [The loss of staff due to competitive tendering] didn’t actually happen that often. There were a few, there was like a handful of really key times when it happened to a core bunch of people. And, each time, the howl of anguish got louder.

(Interview with QC and former CPS strategy advisor, April, 2015)

The respondent later challenged a further assertion, with regard to skills and training afforded to less experienced employees.

‘I think Fordism has a lot to answer for in terms of the shortfall of personal satisfaction. However, that kind of unit approach also generates greater success in business planning, and interest from investors, so I just wonder whether that unit based approach is [a negative feature] or a natural side effect of a market place and of market forces.’

(Interview with QC and former CPS strategy advisor, April, 2015)

The respondent was candid about the fact that the deskilling of the profession of forensic science was necessary, and articulated a viewpoint that encouraged the segmentation of forensic scientific into separate tasks that would be assigned to different individuals with different skill sets, educational backgrounds, expectations, and roles. The relative ignorance of some of these forensic technicians was deemed as unproblematic. Training would not focus on the development of expertise so much as on the ability to follow certain routines and protocols. The restructuring of training, if it did benefit the Tier 1 company, would benefit it at the level of volume crime rather at the expense of interpretative analysis.

Triaging and Forensic Science Provision in the public sector

As the ‘preferred local supplier to the Criminal Justice System in Northern Ireland’ – and the sole public sector Forensic Science provider in the United Kingdom - FSNI operates from a single, centralised compound situated in the Province. Both FSNI, and its main customer, PSNI, share the same premises in order to ensure the security of FSNI and its staff members. However, these two agencies are largely autonomous, and enjoy a high degree of administrative, structural, and functional separation.³¹⁹

Nonetheless, proximity between these separate agencies allows FSNI to provide an ‘on-call service’ to PSNI, enabling scientists to rapidly attend crime - or fatal accident - scenes in order to support the recovery of evidence for forensic scientific investigation.

A priority service also allows for urgent analysis of samples, such as DNA samples taken in an alleged sexual assault. These are processed within a very short timescale: often within 24 hours. FSNI’s Reporting Officers also interact with criminal justice agencies at the opposite end of the evidential trajectory, advising the Public Prosecution Service for Northern Ireland (PPS) on the meaning of scientific evidence and providing expert witnessing services to the courts in any subsequent prosecution. In addition to providing

³¹⁹ FSNI governance structure and institutional arrangements may be contrasted with that of Scottish Police Authority (SPA) Forensics, which operates as a police support service from within the Scottish Crime Campus (a Police Scotland compound in Gartcosh, North Lanarkshire).

integrated forensic scientific provision, the FSNI site is also host to the Northern Ireland DNA Database (NIDNAD).

Thus, an array of related, and disparate, parallel, contemporaneous, and successive, forensic activities are carried out at a single location. The agency notes the effect that such integrated structure and close communication can have on efficiency and quality.

FSNI currently employs approximately 200 staff, all of whom are civil servants. Of these 200, roughly 65 per cent are scientists directly involved with casework. 80% of the forensic work carried out at FSNI is categorised a 'serious crime'. Thus, the workload and depth of experience of FSNI scientists differs from that of many of their mainland counterparts, whose workload comprises mainly 'volume crime.'

The majority of the day-to-day work involves the recovery, analysis and evaluation of evidential samples submitted in connection with a range of criminal investigations. These range from 'routine' cases involving fraud, burglary and car crime through to murders, sexual – and other violent - offences, firearms, explosives, arson and assault. FSNI also provides material analyses for cases involving the possession, and/or supply, of drugs and, where necessary, toxicological analyses in support of the State Pathologist's Department, in order to help determine the cause of death.

Due to the integrated and heterogeneous nature of forensic science provision, and the concentration on serious crime, the agency describes itself 'a leader in several forensic disciplines' listing particular expertise in a range of forensic practices including: the imaging of latent (invisible) finger prints, explosives and microchemistry. The agency's portfolio of forensic specialisms also includes: firearms, fires, physical methods, biology, drugs and toxicology, road traffic collisions and the recovery of electronic data from computers and mobile phones.

The recovery and analysis of DNA from exhibits is a central activity, and may encompass a multitude of interrelated activities. FSNI imposes functional separation on DNA profiling activities, with incoming files directed towards one of two discrete workstreams - 'DNA' or 'Biology' - depending on the availability of contextual information. In circumstances where there is a known person of interest, or the sample process is investigative, or there is

an actual biological stain (e.g. blood, semen), DNA recovery and analysis is carried out by the Biology team. Where there is solely a sub-source sample for loading onto the DNA database, the work is carried out by the DNA team.

The volume is separate. In many respects the volume is separate and the volume is a simple swab coming in the door and it's going to the database, or the simple swab coming in the door where they have somebody arrested for it, and it falls into this group [indicating simple cases]. The volume – the true volume – is, as I say, the database cases coming through the door. But a proportion, because a person is known, or a person is suspected, it comes to us.

(Interview with Lead Scientist: FSNI, 2015)

Thus, each team is physically and managerially separated from the other and employs different personnel, though informants are keen to highlight the benefits of proximity and communication. The custodian of the NIDNAD describes one of the purported advantages of parallel integration:

‘There are pros and cons, but certainly it allows for greater agility, in that, if [the Biology team] is working on a case, and needs database searching done, there it is, it's not having to go generate forms and send them off and wait for something to come back and enter into some kind of discourse, and one of the principle advantages that we have found down the years in having the local database is, because it is inherently smaller, that actually allows greater flexibility in how you can use it.’

(Interview with Lead Scientist: FSNI, 2015)

Of the samples received by the Biology team, 67% are categorised as ‘bio-DNA only’. The other 33% is categorised as joint and require investigatory inputs from other teams. The cases received by the Biology team can be further categorised according to type:

Case Types (FSNI Biology Unit)	Percentage of work received (average 2012-2014)
Simple cases ³²⁰	32-33%
Sexual offences ³²¹	17%
Complex / Serious ³²²	50%

Table 4 : FSNI Case Types

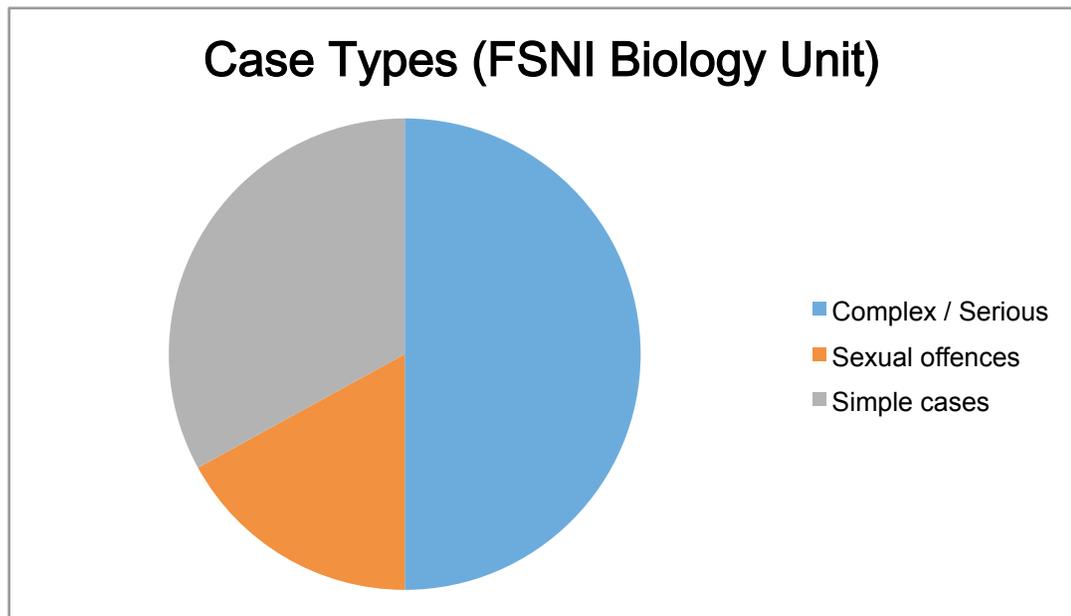


Figure 1 : FSNI Case Types³²³

³²⁰ Assault, GBH, burglaries, robberies and thefts.

³²¹ (Attempted) rape.

³²² Explosions, Firearms and (attempted) murders.

³²³ Case Types (average over three-year period up to September 2015). Source: Lead scientist, FSNI Biology Unit

Typically, forensic DNA casework is initiated through the delivery of either a file, or an evidential sample, from PSNI or a similar customer:

‘We get a file, we get an item delivered. And that’s the first thing we know telling us about the incident. And that then generates a case number... This is coming from the Police. So, along with that comes... a docket, which is what they have agreed to work on.’

(Interview with Lead Scientist: FSNI, 2015)

Customer expectations may be conditioned through the introduction of systems of codification and productisation, which render laboratory processes visible and legible to non-scientific institutional actors.

‘The story coming in is brief and tells us what the police want us to do in the case. In terms of assessment we would look at this and... may adjust the strategy and adjust the products accordingly.’

(Interview with Lead Scientist: FSNI, 2015)

‘We can recommend things. In the simplest case it’s their choice what they want to send in. It is financial in some respects. They have more information than is provided to us so they’re making that initial decision.’

‘[PSNI] state “I want this done. It will sort out what I need to take to court.” Sometimes, we feel there’s glaring issues, that what they’re suggesting, in their strategy, wouldn’t cover that in court. So we ask them, “what else do you have?” We would recommend sending that in. So although most of it, in the routine cases, is coming in already decided, we will assess it, and adjust it if need be.’

‘So they’re making decisions of what they want done on that item. So [PSNI] are sending a particular item in and their decision-making process is: I want you to do... recover DNA and analyse it.’

(Interview with Lead Scientist: FSNI, 2015)

Informants spoke of increasing specificity in customer requests:

‘It really is case-dependant and it has changed over the last year.³²⁴ It’s become that they are making [specific requests]: I want you to take X and Y only.’

(Interview with Lead Scientist: FSNI, 2015)

The convergence, and transplantation, of standardised products and practices may create tensions, which are overcome through the modification of - and adaptation to - subsisting practices (alongside the use of bridging strategies). Informant’s responses demonstrate the persistence of modified local practices and the continued importance of tacit expert knowledge. (RQ1)(RQ2)(RQ4).

‘Our product coding system is based on that original ACPO / NPIA coding system... The codes don’t necessarily fit the request or the item. It doesn’t easily fit the processes we do and [the product codes] have been adjusted over the years. So, each lab interprets them in a different fashion. Each lab adjusted [the codes] according to their own protocols and interpretation.’

(Interview with Lead Scientist: FSNI, 2015)

Subsisting theories of expertise struggle to account for these interdisciplinary translations. As will be discussed further below, Collins and Evans taxonomy of expertises is limited by its focus on discrete bodies of esoteric scientific endeavour. However, if forensic expertise is a product of intrinsic, and extrinsic, collaborations between forensic scientists, and a heterogeneous body of institutional actors within the criminal justice system, it follows that the extent, and proper categorisation, of both contributory, and non-contributory, experts should be gauged. Given the interpenetration of regulatory protocols, alongside standardised products and auditing practices, these may become obfuscated and difficult to discern. In order to resolve this problem, it will be necessary to concentrate on the focal points of interaction between institutional actors: in particular, the ways in which contributory forensic experts are able to influence the progress of investigations through communication with the investigating authorities. As a lead reporting scientist explains:

³²⁴ Partly as a result of the introduction of the ICP scheme.

‘Ours is a cost recovery exercise, we are not a profit-making organisation. So our products are agreed up front at the beginning of the year, how many we will do. So it’s a question of how [the customer] uses those products, and if they use them correctly, or that what they’re sending in to us actually equates to the correct product, so there is things like that have to be checked when they come in.’³²⁵

(Interview with Lead Scientist: FSNI, 2015)

However, FSNI informants stressed that, as a centralised forensic science provider engaged in a diverse array of activities, they retain the agility to move between different forms of reporting in response to case demands and increasing complexity.

‘The movement is very largely in one direction. Cases rarely become simpler. Triaging does occur but that happens outside of here in the Authorisations Unit.’

(Interview with Lead Scientist: FSNI, 2015)

While FSNI demonstrate a high degree of structural integration, and agility, in relation to complex and serious crimes, many forensic investigations proceed from a foundational body of rudimentary categorisations, which themselves result from processes of productisation and codification. Thus, the investigators interactions with contributory experts are delineated solely by the interposition of forensic ‘products’ capable of conveying particular outputs. The enactment of forensic expertise under these conditions is, to all intents and purposes, ‘black-boxed’. Therefore, errors, and categorical misattributions, are managed, and corrected, solely by the contributory experts, through a process of recursion and review (RQ2)(RQ4).

‘...we would redo the strategy, or we would look at the strategy ourselves to see that the items they’ve sent in equate with what their request is, and what our understanding of the incident is.’

(Interview with Lead Scientist: FSNI, 2015)

³²⁵ Compare England and Wales where market FSPs stated that they would carry out the customer’s instructions in low level cases even if they deemed the strategy inappropriate.

However, the exercise of contributory expertise can be curtailed by the interposition of arbitrarily-defined borders and limitations. The permeability of these borders is largely dependent on the seriousness of the offence.

‘Some of the restrictions might be that, if there’s a lot of blood there and we’re restricted to two samples then we might not find what we need to find on the item, so if it’s a complex blood staining we’re using our blood pattern analysis to say okay I’ll take these two because if this incident has occurred it’s most likely to have come from the particular person in this instance rather than the wearer.

And because of using the interpretative strategies in terms of pattern analysis we generally get this okay, but if there’s two samples we’re allowed we generally say okay one of them is actually Mr X’s DNA profile on this garment so in terms of that we’re saying, “the blood’s there - I need to choose two samples.” The choice of two samples isn’t entirely random therefore the chance of getting a different profile, apart from the wearer, is quite high.

(Interview with Lead Scientist: FSNI, 2015)

Thus, at the lower end of the investigatory spectrum, recursion and collaboration are circumscribed by limitations imposed on the basis of efficiency. Forensic strategies follow standard expectations, are conceived and developed unilaterally by the investigative authorities - and require forensic intervention only when they deviate grossly from standard practices, or are misconceived to the extent that evidential failure may be predicted (RQ1)(RQ4)

So, again it’s case dependent. In a quick, simple, I suppose in volume crimes it happens more...

We have, in our processes - and we do have to keep reminding [PSNI] that our agreement is, that we will, if there’s multiple blood there we will take two stains...And there’s an agreement with [PSNI] that they will actually allow us to do that. It is getting more restricted at the moment but what I’m saying is, because of the

multiple people that are bleeding, the two samples is not going to objectively tell me that there is, or is not, a contact with this particular person.’

(Interview with Lead Scientist: FSNI, 2015)

Given their reliance on pre-defined products and the desire to achieve particular outputs, it would be difficult to attribute the investigative authorities with interactional expertise. This relative lack of expertise may derive from the strict administrative, and functional, separation between PSNI and FSNI, which ensures that the investigative authorities are not exposed to processes of enculturation within the forensic-scientific domain (even if their aims, and activities, overlap - to some extent - with those of FSNI).

The internal process of enculturation is achieved through training, and the internalisation of a diverse array of skills.

It’s a staged approach, it’s the training aspect of it that you take them through the *processes* in the simpler cases first, it’s easier training for them. Because this is taking them through to ‘court-going’ in a simple enough case.³²⁶ It’s never simple, going to court, but in a small one-or-two-item case, so that they learn procedures of getting it in the door, of liaising with the police, checking their products, they learn the *procedures* on the simpler cases before they progress onto the more complex ones.

(Interview with Lead Scientist: FSNI, 2015)

Further, the central importance of procedural conformity in forensic investigation permeates the training process:

‘...because it’s procedures, and the way for them to learn procedures, and you don’t have to worry too much about the examinations and the process because you’re learning the booking-in procedures, booking-out procedures, reporting procedures in the process.’

³²⁶ In the following chapter we compare the skills of inexperienced administrative reporters engaged in the SFR process, who lack the ability to deliver, and communicate, comprehensive forensic analyses and evaluations.

(Interview with Lead Scientist: FSNI, 2015)

When asked to define their role, informants replied with reference to externally-imposed duties, originating from the legal field: ‘We are there to assist the court: to find if there is any evidence and to explain it. My thinking is: ‘If I can’t eliminate it, how can I explain it?’

(Interview with Lead Scientist: FSNI, 2015)

Such responses resonate with Lawless’ theory of forensic scientific endeavours, as adjunctive activities which follow structural norms of integration and are largely subsumed within the criminal justice and investigatory process.³²⁷ However, the evidence from FSNI points to a far more substantial role.³²⁸ Nonetheless, even if the role of FSNI forensic scientists were to be merely adjunctive, the agency operates within a rhizomatic network of criminal justice institutions, whose combined efforts lead to the co-production of contextually rich forensic-scientific truth claims.

Thus, the introduction of ‘efficient’ measures of proportionate, and economically efficient, modes of forensic reporting is indicative of the re-ordering of meso-structural elements within the forensic-scientific domain, in response to the macro-structural changes which shape the delivery of forensic truth claims. However, the resilience of the FSNI integrated governance structure, has ensured that re-ordering has been less dynamic than that brought about by marketisation - and the introduction of Streamlined Forensic Reporting - in England and Wales.

The Contest and Communication Narrative – silos and transfer of expertise

The data discussed above provides only partial support for the contest and communication narrative advanced by Lawless, Kelty, and members of the Judiciary.³²⁹ To recap, this

³²⁷ Lawless, C.J. *Policing Markets* (2011) *British Journal of Criminology* 51, 671-689 at p.673

³²⁸ All FSNI scientists are educated to postgraduate level in an appropriate scientific discipline.

³²⁹ Lawless, C. (2010). *A Curious Reconstruction? The Shaping of ‘Marketized’ Forensic Science*. CARR Discussion Paper 63; Lawless, C. *Policing Markets; the Contested Shaping of Neo-Liberal Forensic Science*.

popular explanation for the interdisciplinary co-production of forensic-scientific knowledge claims is predicated upon a belief that institutional agents from the legal and scientific fields are ‘siloes’ within their respective domains. ‘Siloing’ refers to the phenomenon whereby particular centres of organization and activity become isolated in terms of their constituent processes and systems. These centres of organization become self-referential in terms of their conceptualisations, leading to a lack of communication with other centres and a lack of understanding of the needs of other systems. It occurs when domains, departments, or management groups, do not share information, goals, tools, priorities and processes with other departments. Or it may occur when the networks which facilitate the sharing of goals, are attenuated or unavailable. The phenomenon may therefore refer to either an intra-disciplinary, or a homologous, process, occurring across disciplinary boundaries.

The data reveals scientific informants speaking predominantly of processes of intra-disciplinary fragmentation and stratification, and external control, which do not necessarily equate to autonomy and isolation, or lend support to the assertion that enhanced communication would lead to greater interdisciplinary understanding. The process of ‘siloes’ has both descriptive, and a normative prescriptive, dimensions. Therefore, even if it does accurately describe the co-production of forensic-scientific knowledge claims, the degree of divergence may be so deep as to thwart mutual understanding and enhanced interdisciplinarity. Further, the presence of acute power asymmetries and the instrumental uses of forensic science. – as evidenced in the research data may render any attempts impossible.

This is not true of the entire market. Tier 2 FSP’s claim to maintain an overview similar to that enjoyed by the FSS, and the evidence shows that such claims are not without merit. Likewise FSNI, who do not merely enjoy greater autonomy. Although FSNI are customer-focussed they offer a more contextual and holistic service.

British Journal of Criminology (2011) 51, 671-689; Kelty, SF; Julian, R; and Ross, A. *Dismantling the Justice Silos: avoiding the pitfalls and reaping the benefits of information-sharing between forensic science, medicine and law*. Forensic Science International ; Jul 10;230(1-3): pp.8-15; Thomas, LCJ. 2015 *The legal framework for more robust forensic science evidence*. Philosophical Transactions of the Royal Society B 370: 20140258 at page 1.

However, it is particularly true of the changing governance structures, and the reconstruction of forensic expertise, in respect of Tier 1 marketised providers in England and Wales. Loss of autonomy can be related to a number of complex processes of economic rationalization, productisation, and fragmentation, all of which make forensic processes visible to the customer. Within the market, these problems are exacerbated when applied to routinised analyses of so-called volume crime. The shift from a tripartite relationship, based around joint strategy-setting and co-production, and involving communication between the CPS, the FSP, and the police, to one of direct control from the ‘customer’ with a loss of CPS input, has displaced expertise, and allowed for direct customer control.

These disparities are facilitated by the lack of a shared conceptual framework, terminological fluidity, and a lack of expert understanding of other agencies needs. As a QC indicated,

‘I think there’s a lot of language used where people assume that they understand what they’re saying and meaning but in fact they don’t understand what each business structure within that journey actually means by it... It’s simply that there are a number of walls, if you like, not just silos, but walls, that stop people from thinking laterally about what the market actually is.’

The final sections of this chapter place the main conclusions of the study in theoretical perspective. In light of the problems highlighted in the foregoing discussion, these sections attempt to formulate a theory which can provide better insights into the role of forensic-scientific expertise within the criminal justice system. The sections begin with a review the subsisting theories of interdisciplinary expertise, and critiques both Edmond and Mercer’s theory of ‘hybrid sets’, and Collins and Evans’ theory of contributory expertise. The chapter concludes by proposing a new, relational theory of expertise, born from – and more consonant with – the empirical data.

Interdisciplinary theories of expertise

Despite the ubiquity of the term ‘forensic science’, it is questionable to what extent the standard body of forensic identification techniques which compose the practice of forensic-

scientific expertise, matches the criteria that sociological theorists - such as Collins, and Evans - have generally associated with the conduct of research in the physical and biological sciences. It is also questionable whether, or to what extent, 'forensic science' can be said to meet Mertonian norms and Kuhnian demarcation criteria. Skepticism with regard to the status of forensic-scientific practices is not new. Forensic science has been the subject of long-standing criticisms, which have tended to make unfavourable comparisons between the traditional collection of forensic practices, and conceptions of 'normal science'. When judged against the standards of normal the forensic disciplines are frequently characterised as little more than 'a loose array of police crafts graced with the aura of science'³³⁰, and seldom viewed as proceeding in accordance with idealised conceptions of timeless, universal rationality.

What, then, is the role of the specialist forensic practitioner within the criminal justice system? Kruse states that 'the contribution [of the forensic scientist] to the biography of forensic evidence is to turn the material form of the traces sent to them into a meaningful symbolic form.'³³¹ However, this practice of sequential translation may be shown to be founded upon a commitment to demonstrably ambiguous principles: primarily, the assertion that objects are unique (and the corollary, that it is possible to capture the uniquely identifiable features of any object, whether or not tied to an ineradicable bodily substrate).³³² Attempts to mobilise the concept of 'uniqueness' have attracted criticism on both the philosophical, and practical, levels.³³³ Cole, in particular, has questioned the utility

³³⁰ Lynch, M., Cole, S.A., McNally, R. & Jordan, K. (2008) *Truth Machine: The Contentious history of DNA Fingerprinting* (Chicago: University of Chicago Press) at page 4

³³¹ Kruse, C. (2016) *The Social Life of Forensic Evidence* (University of California Press: Oakland, California), at page 70

³³² Only DNA-profiling techniques can be said to have approached this criterion, albeit on probabilistic terms. See Cole, SA & Lynch, M. (2010) *DNA profiling versus fingerprint evidence: more of the same?* in Hindmarsh, R. & Prainsack, B. (Eds.) *Genetic Suspects: Global Governance of Forensic DNA Profiling and Databasing* (Oxford: OUP, 2010)

³³³ Cole SA (2009) *Forensics without uniqueness, conclusions without individualization: The new epistemology of forensic identification*. *Law, Probability and Risk* 8(3): 233–255.

of the concept and, in light of such criticisms, it may be more accurate to define forensic-scientific practice in terms of the management of particular forms of uncertainty.³³⁴

Nonetheless, if the collection of techniques generally associated with forensic-scientific practice invites an invidious comparison with existing conceptions of ‘pure’ science, it may yet be argued that these techniques constitute an applied science. Lynch, *et al.*³³⁵ maintain that this appellation is equally questionable, asking: ‘to which branches of basic research do the fingerprint examiner, and handwriting analyst, apply?’

A more serious criticism flows from the assertion that forensic science does not constitute an autonomous field of scientific endeavour. It is answerable to initiatives, and evaluations, which emanate from external institutions, actors, and agencies (both public, and private), beyond the forensic-scientific field: agencies, whom it exists to serve. Further, that the production of forensic artifacts occurs in conformation with a set of routine practices which are highly normalised, and performed by agents who are ‘not trusted to stand on their own two feet.’ In light of these criticisms, forensic practices have frequently been viewed as a ‘subnormal science’³³⁶: one which is characterised by ‘limited objectives, and little, or no, orientation to discovery.’³³⁷ Crucially, the ‘adjunctive repertoire of services’³³⁸, of which these ‘sciences of the particular’ are composed, are not ‘unified by their adherence to universal epistemological principles.’³³⁹ Rather, analytical activities are conducted under the gaze of exogenous quality control regimes and become intrinsically limited through their adherence to routine procedures.

Forensic science may be shown to remain answerable to multiple social interests and agendas. However, this need not serve as a determinative criterion by which to judge the

³³⁴ Kruse, *Op. cit.* see note 2

³³⁵ Lynch, M., Cole, S.A., McNally, R. & Jordan, K. (2008) *Truth Machine: The Contentious history of DNA Fingerprinting* (Chicago: University of Chicago Press)

³³⁶ Lynch, *Op. Cit.* note 1 at page 6

³³⁷ Lynch, *ibid.* at page 7

³³⁸ Lawless, C. *Policing Markets; the Contested Shaping of Neo-Liberal Forensic Science.* British Journal of Criminology (2011) 51, 671-689 at page 682

³³⁹ *Loc. Cit.*

status of forensic practice *qua* science, since - as STS scholars have demonstrated - external accountability is also a defining feature of even research science. Mirowski and van Horn highlight similar levels of regulation and normalisation in the conduct of clinical trials by contract research organisations to that experienced by forensic practitioners.³⁴⁰ The justifiable intrusion of extrinsic regulatory norms (and concomitant reduction in a capacity for internal governance) also affects the work of university researchers: particularly those whose work involves human subjects.

Arguments regarding the status of forensic science would appear to be underpinned by a commitment to disciplinary purity, which may be at odds with emergent realities. It is posited that the concept of disciplinary purity may itself be paradigmatic, and thus open to review and refutation, in light of existing developments. Such a possibility is hinted at by Mercer,³⁴¹ who highlights the resilience of realist, and positivist, epistemologies - particularly within the legal system - and the concomitant tendency to attempt to show that 'there is ultimately a straightforward boundary that can be drawn around science and law to stop the distortion of scientific facts.'³⁴²

In counterpoint, both Edmond, and Mercer, highlight the necessary co-production of forensic-scientific knowledge claims: claims, whose genesis cannot be attributed solely to the application of laboratory expertise, and whose application cannot be stated to have been shaped solely by the requirements of legal procedure.³⁴³ They posit the emergence of 'scientific method discourses', which result in the formation of 'hybrid sets.' According to their concept, the formation of a 'hybrid set' is a dynamic and fluid process, through which institutional actors from varying epistemological backgrounds come together to shape the form of forensic-scientific truth claims.

³⁴⁰ Mirowski, P. & van Horn, R. *The Contract Research Organisation and the Commercialisation of Scientific Research* Social Studies of Science, Vol.35, No. 4 (2005) pp.503-548 at p.505

³⁴¹ Mercer, D. (2002) *The Intersection of Sociology of Scientific Knowledge and Law: Some themes and policy reflections*, Law, Text, Culture Vol. 6. At p.9

³⁴² Edmond, G. & Mercer, D (1998), *Trashing 'Junk' Science* Stanford Technology Law Review 3

³⁴³ Lawless, C (2016) *Forensic Science: A Sociological introduction* (Routledge: New York) at page 3; see also Mercer, *Op. Cit.* at note 12 ; Edmond, G (2001); *The Law Set ; The legal-scientific production of medical propriety* Science, Technology and Human Values, 26(2), 191-226; Lynch, *et. al.* at p.45

Applying Edmond's concept of 'hybrid sets' to Collins and Evans theory of expertise (in the context of forensic-scientific controversy relating to DNA 'fingerprinting'), Lynch contends that the 'core-set' were temporarily joined by a 'law-set', an 'administrative set', and a 'literary set', all of whom participated in a dynamic - and amorphous - process of adjudication and legitimisation. However, Lynch's illustration may be no more than an instantiation of the banal assertion - as previously demonstrated by the STS corpus - that 'politics is never absent from the centre.'³⁴⁴ Further, it should be highlighted that the creation of 'hybrid sets' was seen to have occurred in the context of a controversy relating to forensic research science, rather than as a result of its routine application.

Returning to Collins and Evans, it is reiterated that the utility of their theory of expertise diminishes significantly, when applied outwith the context of research science. The authors' normative focus forecloses discussion of scientific co-production. Further, their category of 'meta-expertises' fails to assist in the recognition of emergent forms of interdisciplinary knowledge. Attempts to apply this static theory to the interdisciplinary co-production of forensic-scientific knowledge claims – particularly instances when such activities cross epistemological boundaries – may lead only to the perception of a shifting, and abstruse, ecology of expertises.³⁴⁵

By way of example, it might be postulated that the forensic scientist is a contributory expert in the field of forensic practices (be they craft practices, such as 'ballistics', or scientific practices, such as DNA casework). However, it remains unclear whether such a specialist should be categorised as a contributory, or merely interactional, expert within the broader scientific field. It is similarly unclear whether the forensic practitioner's interactions with the criminal justice system should be classed as contributory, or interactional, or both, given the degree to which such interactions are shaped by the procedural norms, and evidential requirements, of the legal field.

³⁴⁴ See Collins, H. & Evans, R. 2007, *Rethinking Expertise* (University of Chicago Press: Chicago)

³⁴⁵ Lynch, *et al*, at page 44

It is posited that Mercer's concept of hybridization - a chimera born from 'the social and epistemological dynamics of law-science intersections'³⁴⁶ - affords greater traction than that posited by Collins and Evans. Further, that it can be developed - and extended - to cover all expert practices, in accordance with the general theory of relational expertise outlined in the previous chapter. To restate the argument, expertise is located in the ability to reflexively account for heterogeneous perceptual, cognitive, and epistemological contexts. Under a generalised theory, this ability renders disciplinary boundaries permeable to expert discourses, and facilitates the interdisciplinary co-production of knowledge claims through the expert's ability, not to overcome idealized conceptions of 'law' and 'science', nor to replace them with nuanced understandings of the social construction of forensic discourses, but to account for the co-existence of these conceptions within the complex matrix of social and epistemological relations which define the forensic-scientific field. Thus, the emergence of Edmond and Mercer's 'hybrid sets' may simply be viewed as a normal consequence of the contextual adaptations of forensic-scientific expertise, as outlined in the previous chapter.

³⁴⁶ Mercer, *ibid.* at note 12

Chapter Six: Efficiency

Chapter Six

Introduction

The deployment of measures of economic rationalisation across the criminal justice system have led to notable efficiencies within the forensic science, and criminal justice, domains, which were welcomed by a number of informants. However a proportion of respondents also highlighted concerns relating to the introduction of reportedly instrumental approaches to the construction of forensic DNA evidence: approaches which allegedly dispense with expert scientific evaluation and purposefully limit the amount of contextual information available to either the prosecution, or the defence. This chapter outlines the process which led to the introduction of these procedurally novel - but scientifically attenuated - form of scientific reporting.

The chapter outlines the way in which expert scientific inputs, and evaluations, may potentially be limited by a mode of forensic reporting (and case construction) which forecloses contextual discussion and considers the implications of the introduction of streamlined forensic reporting (SFR) for forensic DNA-profiling experts, and the criminal justice system.

Discussion is placed in both a theoretical, and a practical, perspective. It is argued that the development of SFR can be traced to a crisis of governmentality brought about by a confrontation between scientific expertise and legal pragmatism: a crisis, which precipitated the subsequent restructuring of forensic roles. It is further demonstrated that SFR is widely perceived as detracting from the quality and content of expert scientific opinion, potentially limiting the court's ability to arrive at sound determinations on

questions of fact. This raises concerns over the potential for SFR to contribute to miscarriages of justice.

SFR and Abbreviated (or ‘Staged’) Forensic Reporting

The Streamlined Forensic Reporting scheme was not the first attempt by the CPS to create a more efficient form of forensic reporting. Indeed, SFR was built upon a prior initiative - ‘Staged Reporting’³⁴⁷ - introduced by the CPS Prosecution Team in 2004. It is therefore helpful for the purposes of explication to preface a discussion of SFR with an outline of the scheme’s immediate predecessor. The Staged (or abbreviated) Reporting initiative set out ‘to minimise unnecessary work and delays by focusing on the matters relevant to the case in question’³⁴⁸ and was intended to dovetail with changes to the ‘CPS Prosecution Team Charging Guidance’ policies, which had not previously allowed a suspect to be charged on the basis of a DNA match report alone. However, that policy changed with effect from 1st August 2004.

‘The new policy will mean that a suspect may now be charged on the basis of a DNA intelligence match, derived from the scene of the crime, and a sample of DNA kept on the National Database providing there is some further supporting evidence.’³⁴⁹

The Prosecution Team DNA Guidance embedded Staged Reporting into the process of criminal case file preparation. As with its direct descendant, SFR, the introduction of Staged Reporting was justified with reference to the CrimPR (in addition to the Criminal Justice Act 2003). Under the Staged Reporting scheme,

‘an initial abbreviated statement is provided by the scientist simply to confirm the validity of the NDNAD match report, with a full statement only being requested

³⁴⁷ CPS, *Legal Guidance on Streamlined Forensic Reporting*, Available at:

<https://www.cps.gov.uk/legal-guidance/streamlined-forensic-reporting-guidance-and-toolkit>

³⁴⁸ Nuffield Council on Bioethics (2007), *The Forensic Use of Bioinformation: Ethical Issues* (Cambridge Publishers: Cambridge), at page 65

³⁴⁹ CPS (The Prosecution Team), *Guidance on DNA Charging*, 16th July 2004

where the actual issues identified require full evaluation...This change provides a significant opportunity to improve the turnaround times for analysis in the laboratories and the provision of statements by the scientists, as well as greatly reducing the costs of forensic science evidence.’³⁵⁰

The crucial difference between Staged reporting and Streamlined reporting was that, under the former scheme, the forensic report was produced by a qualified scientist, who might appear in court on the strength of the report, whereas the Streamlined Report (at least in its most common form, SFR1) ‘is not a statement upon which the maker of the statement is necessarily qualified to give evidence.’³⁵¹ Further, whilst the staged report condenses ‘the headlines of the [scientist’s] working out’³⁵² and can easily be elaborated upon³⁵³, the SFR report is often limited to a single sentence. Staged Reporting is comparatively transparent as to its limitations, candid with regard to the need for contextual information, and open about the underlying methodology used and the personnel involved.³⁵⁴ Thus, the relational nature of scientific evidence - directly addressed by the Staged Reporting process - may be hidden by the SFR process.

Following the introduction of Staged Reporting in 2004, the Forensic Science Service - by that point one of several forensic science providers within a relatively undeveloped market - noted some encouraging trends. During the 2005/2006 financial year the service received 1,887 requests for abbreviated statements based upon NDNAD match reports. These resulted in 175 requests for a full evaluative (or ‘complex’) statement. The cost of a full evaluative statement was, at that time, around six times that of an abbreviated statement (£600 and £100 respectively). Prior to the introduction of Staged Reporting, all 1,887

³⁵⁰ NDNAD, *The National DNA Database Annual Report 2005-2006*, at page 10

³⁵¹ See CPS ‘*Streamlined Forensic Reporting Guidance and Toolkit 6*’ 2015. Available at :
<https://www.cps.gov.uk/legal-guidance/streamlined-forensic-reporting-guidance-and-toolkit>

³⁵² Interview with lead DNA reporting scientist, Oxford, July 2015.

³⁵³ In contrast, the streamlined report is opaque with regard to its methods, and attenuated in its conclusions, providing no platform for elaboration.

³⁵⁴ Staged Reports contain a Technical Note explaining the scientific procedures used. This is absent from the Streamlined Report.

statements would have been fully explicated, at an estimated total cost of £1,132,200. Thus, as a consequence of using Staged Forensic Reporting, the financial costs were reduced to roughly £293,700 (£188,700 plus £105,000). This equated to a saving of £838,500 (74%).³⁵⁵

The FSS also noted significant savings in time and resources, resulting from the introduction of Staged Reporting. The time taken to produce a full evaluative statement (average 6 hours) dropped to one hour in respect of abbreviated statements.³⁵⁶ The Staged reporting scheme led to demonstrable efficiencies and, it should be noted that it subsists: abbreviated reports are still routinely produced by some Forensic Science Providers, and are actively sought by a number of Police Forces in preference to full evaluative statements. However, the use of abbreviated reports is far less common than that of streamlined reports.

Background: The Ministry of Justice Efficiency Program

Although not the first attempt to create an efficient mode of forensic reporting, Streamlined Forensic Reporting is nonetheless an innovative evidential procedure. As with its predecessor - staged reporting - SFR was introduced across England and Wales for the purpose of better case management with regard to the use of forensic evidence. Thus, the SFR scheme, as originally envisaged, was organized around modest, and achievable, goals.

It was first introduced in 2008 by the Association of Chief Police Officers (ACPO) Criminal Justice Business Group, in partnership with the Metropolitan Police Service (MPS). The scheme proceeded on the basis of a series of local pilot programs in Streamlined Forensic Reporting. The initial pilot - at Woolwich Crown Court in London - was restricted to cases involving fingerprint identification, firearm and ballistic results, and DNA database matches. The forensic science provider was directed to produce a short forensic report for all cases involving these evidence types. These reports, known as

³⁵⁵ NDNAD, *The National DNA Database Annual Report 2005-2006*, at page 10

³⁵⁶ *Ibid.*

Streamlined Forensic Report Stage 1 (or SFR1), were restricted to initial key findings. The reports were not intended to be presented at trial (being limited in scope, frequently based on an incomplete analysis, and possibly inconclusive). Rather, they were intended ‘to elicit an agreement or to enable the defence to simply identify the real issues for trial.’³⁵⁷ In the event that the case went to trial, an extended SFR Stage 2 report was presented, usually in witness statement format.

Following this year-long pilot, the evaluation found fewer discontinued cases, and an increase in early guilty pleas (with attendant savings). As a result, the SFR initiative was extended. By November 2011 it included all London Courts (with the exception of the Central Criminal Court). A second review followed, focussing on cases processed through Wood Green Crown Court before and after SFR implementation. Similar effects to the Woolwich pilot were noted:

- Early Guilty Pleas increased from 61% to 84%
- Guilty pleas before trial increased from 71% to 87%
- Total guilty outcomes increased from 79% to 91%
- Abandoned trials reduced from 9% to 2.4%
- Additional requirement for forensic evidence reduced from 42% to 2%
- Discontinued cases reduced from 18% to 5%.³⁵⁸

However, the scheme was then brought within the Ministry of Justice’s ‘Criminal Justice System Efficiency Program’. The Efficiency Program sought ‘to [modernise] the CJS by reducing or removing the movement of paper, and people, around the system.’³⁵⁹ It is the implementation of the scheme through this program - whose aims were to minimise bureaucracy, and to reduce unnecessary costs and delays in the criminal justice system -

³⁵⁷ CPS, *Legal Guidance on Streamlined Forensic Reporting*, Available at:

<https://www.cps.gov.uk/legal-guidance/streamlined-forensic-reporting-guidance-and-toolkit>

³⁵⁸ *Ibid.*

³⁵⁹ Ministry of Justice *Defence Practitioner FAQ*, Version 3.92 (14th May 2012)

which radically altered its character. The Government White Paper, *Swift and Sure Justice*,³⁶⁰ set out the objectives of the program:

‘From a so-called ‘system’ which operated in silos, we are moving to a criminal justice service where police, prosecution and courts work more effectively together. None of these reforms will compromise historic legal rights or important principles of justice. Rather the reverse: justice must be swift, sure and seen to be done, or it is not done at all.’³⁶¹

The target of reforms were cases which the Ministry of Justice categorised as ‘low-level, straightforward and uncontested...where a quick response is appropriate’.³⁶² Such cases were to be dealt with ‘promptly and efficiently.’ The Ministry recognised the critical role which forensic evidence plays in bringing offenders to justice. Hence, its support for, and adoption of, the Streamlined Forensic Reporting (SFR) scheme.

The MoJ noted the success of the pilot projects, and catalogued the potential benefits which could be gained from the nationwide introduction of streamlined reporting. These included:

- A lower risk of discontinuance, likely to be due to case papers being better prepared and the defence being informed of the evidence at the earliest stage;
- An improvement in the early guilty plea rate, resulting in fewer cases coming to trial unnecessarily, helping to ease the pressure of trial dates and associated costs, and;
- A reduction in the number of cases requiring additional forensic evidence, saving time and costs associated with gathering this evidence.³⁶³

Thus, the primary objective of Streamlined Reporting came to be reframed in economic terms, which focussed on the reduction of ‘costs and delay associated with forensic evidence where such evidence adds no value to the administration of justice.’³⁶⁴ The CPS

³⁶⁰ Ministry of Justice. (2012) *Swift and Sure Justice: The Government’s Plans for Reform of the Criminal Justice System*. (Cm 8388). London: TSO.

³⁶¹ *Ibid.* at p.4

³⁶² *Ibid.* at p.5

³⁶³ *Ibid.* at pp. 33-4

³⁶⁴ This is one of a series of *circulus in probanda* deployed in support of the SFR initiative. These are discussed (*infra*).

then set out to actively promote the adoption of SFR across the criminal justice system, with a target date for implementation by March 2013. As a result of these efforts, streamlined forensic reporting was introduced throughout England and Wales on 2nd April 2013.

The SFR implementation process received active support from both ACPO Criminal Justice and the CPS. The national project was led by Neil Rhodes, Chief Constable of Lincolnshire Police (and ACPO TAM Director of Strategy and Policy: SFR). The SFR governance structure is now dispersed across multiple agencies, including; the Forensics Portfolio Board, Forensics Delivery Board, SFR Virtual National Board, SFR Issues and Consistency Group, and a small number of SFR Expert Networks aligned to categories of SFR evidence (DNA, Footwear, Drugs and Digital). The SFR program also falls within the remit of the Forensic Science Regulator (FSR) and the UK Accreditation Service (UKAS).

Initially, the scheme was limited to cases involving forensic DNA matches. However, individual police forces were free to introduce SFR for other forensic categories, on their own cognisance, leading to the use of SFR for cases involving DNA matches, EDIT (Evidential Drug Identification Tests), Simple Drug tests, Simple Toxicology tests, Firearms Classification, Footwear, and IIoC (Indecent Images of Children). There are further plans to extend implementation to include forensic casework.

Criminal Procedure Rules

The second objective of Streamlined Forensic Reporting - as determined by the CPS - is to ease compliance with the requirements of Criminal Procedure Rules (CrimPR). The purpose of the Criminal Procedure Rules is to ensure that criminal cases are dealt with justly (as laid out in Part 1³⁶⁵). Reaching just determinations in criminal cases entails, *inter alia*, acquitting the innocent, convicting the guilty, dealing fairly with the prosecution and

³⁶⁵ Part 1, *Criminal Procedure Rules 2015*. Ministry of Justice. A third - unstated - objective to SFR was referred to in interviews with members of HMIC: streamlined reports have been designed to act as an evidential agonist in cases where the accused exercises his (or her) right to silence. This objective receives relatively little attention in the supporting documentation but carries far-reaching implications for the conduct of criminal cases.

defence, respecting the interests of witnesses, dealing with cases efficiently, and taking in to account the complexity of the issues at hand.³⁶⁶

In order to meet the overriding objective of the CrimPR, Part 3 places a further duty on the court³⁶⁷, to actively manage criminal cases. ‘Active management’ is achieved through the early identification of real issues and the early identification of the needs of witnesses.³⁶⁸ Part 3 also places a duty on the court to ensure that evidence (whether disputed or not), is presented in the shortest and clearest way.

A similar duty is placed on the individual parties under Rule 3.3, which requires that each party must actively assist the court in fulfilling its Part 3 objectives. This entails both parties entering into active communication at the earliest opportunity (and no later than the day of the first hearing) in order to establish whether the defendant intends to plead guilty or not guilty, and - in the latter instance – the parties must determine which matters are agreed, and which are likely to be disputed.

Part 19 (previously Part 33) of the CrimPR places a similar duty on experts to help the court to achieve its overriding objective. This duty is not limited to expert witnesses but extends to all of those experts summoned to prepare evidence for criminal proceedings.³⁶⁹ The duty is fulfilled by giving opinion which is unbiased, objective, and within the expert’s area of expertise. Part 19 also places a special duty on experts to actively assist the court to fulfil its duty of case management under Rule 3.2, in particular by complying with any direction made by the court.

In the absence of direct statutory implementation, the Criminal Procedure Rules are imputed to provide a clear rationale for the implementation of SFR, Therefore, the SFR objectives must be read as facilitating compliance with the CrimPR. Indeed, the CPS state that the second objective of Streamlined Reporting (Stage 1):

³⁶⁶ Part 1 CrimPR 1.1(2)(a)-(g).

³⁶⁷ Specifically, the Magistrate and Crown Courts, including Appeals from the Crown Court under s.3.1(2)

³⁶⁸ CrimPR 3.2 (2)(a) and (b)

³⁶⁹ CrimPR, Part 19.1(2)

‘To provide a stronger basis for Stage 2 forensic reporting through compliance with Criminal Procedure Rules, rules 3.2 and 3.3, which set out the Court Case Management requirements for the early identification of real issues.’³⁷⁰

The degree to which the SFR program conforms, or departs, from the requirements of the CrimPR, in practice, will form the subject of further detailed discussion, below.

Supporting Case Law

In addition to citing the need for regulatory compliance, the introduction of Streamlined Reporting was justified with reference to case law. The supporting documentation listed a cluster of cases, which were cited in support of the scheme’s stated objectives, and went so far as to include excerpts from leading cases. These were to be found in earlier versions of the SFR1 form (MG22b) itself. However, in later versions these excerpts been removed.

In particular, attention was drawn to both *Balogun v DPP* [2010] EWHC 799, and *R v Chorley Justices* [2006] EWHC 1795, which were cited in support of an assertion of the duty of full defence disclosure, and to iterate the duty owed by both parties to identify the real issues at the earliest opportunity (as laid out in the CrimPR).³⁷¹ Support was also drawn from *R v Reed, Reed & Garmson* [2009] EWCA Crim LR 2698, paragraphs 128-131 of which emphasise the importance of adherence to Rule 33 CrimPR (now Rule 19). Further reference was made to *R v Weller* [2010] EWCA Crim LR 724, paragraphs 16-18 of which discuss identification of salient issues; also, *R v Butler, Henderson & Oyerderin* [2010] EWCA Crim LR 1269, paragraphs 209-214 on case management; the leading case of *R v T* [2010] EWCA Crim LR 2439 on the duty of expert witnesses to reveal their underlying methodology; and *R v Olu, Wilson & Brooks* [2010] EWCA Crim LR 2975, which deals with the SFR Schedules at paragraph 45. These excerpts will form the subject of further discussion, below.

³⁷⁰ CPS, *Legal Guidance on Streamlined Forensic Reporting*, Available at:

<https://www.cps.gov.uk/legal-guidance/streamlined-forensic-reporting-guidance-and-toolkit>

³⁷¹ See Form MG22(b) and Beckwith, J. *Digital Forensics Specialist Group SFR 23rd* September 2014. Available on website of the Forensic Science Regulator.

Streamlined Forensic Reporting - Outline

As stated above, the goal of the Streamlined Forensic Reporting scheme is to achieve better case management through saving time, and resources. However, there are other notable differences between SFR, and standard forms of forensic reporting, which make the scheme unique. The most significant of these is that, ‘SFR1 is not a statement upon which the maker of the statement is necessarily qualified to give evidence.’³⁷²

Beyond that statement, it is difficult to find a consistent description of SFR(1) within the guidance notes³⁷³, in the supporting documentation³⁷⁴, or on the form itself.³⁷⁵ SFR(1) is, variously described as: ‘evidence’; ‘a summary of conclusions’³⁷⁶; ‘staged reporting’; ‘not staged reporting’; ‘an abbreviated form of reporting’; ‘information’; ‘a forensic statement’; ‘not a statement’; ‘a forensic report’; ‘not a witness statement or an expert’s report to which Criminal Procedure Rule 33 applies’; ‘(proportional) forensic evidence’; ‘a summary of forensic evidence’; ‘forensic evidence, when agreed, for the purposes of s.10 of the Criminal Justice Act 1967’; ‘a vital enabling tool’; ‘a key case management tool’; ‘a visual prompt to the prosecution and the defence’; and ‘a summary of expert evidence that is served for the purposes of securing an admission.’³⁷⁷

Purposive definitions of the Streamlined Forensic Reporting are thus diverse, and frequently contradictory. Nor are such definitions fixed, being provisional on both the identity of the user, and the purpose for which the report is used. ‘For the police

³⁷² CPS ‘*Streamlined Forensic Reporting Guidance and Toolkit 6*’ 2015. Available at :

<https://www.cps.gov.uk/legal-guidance/streamlined-forensic-reporting-guidance-and-toolkit>

³⁷³ *Ibid.*

³⁷⁴ CPS, *Legal Guidance on Streamlined Forensic Reporting*, Available at:

<https://www.cps.gov.uk/legal-guidance/streamlined-forensic-reporting-guidance-and-toolkit>

³⁷⁵ *Ibid.*

³⁷⁶ *Ibid.*

³⁷⁷ All descriptions are taken from the CPS and ACPO guidance, and toolkits, on Streamlined Reporting. Conflicting descriptions may be found within a single document.

investigator [SFR1] is simply used as the initial forensic report... When SFR enters a pre-trial Court Case Management hearing, it becomes a Court Case Management tool.³⁷⁸ Thus, SFR1 may be characterised as a legal chimera designed, not solely to provide determinative answers, but to flexibly serve a multitude of purposes.

Attempts to explain the nature of the forensic science provision cluster around a small number of themes. The legal and forensic-scientific professions form accessible analytic categories, and have been a long-standing focus of socio-legal research, particularly in regard to their organisation, practices, and interactions. ‘Neo-Weberian’ perspectives have tended to focus on the composition of particular professions, (through processes of inclusion and exclusion, as determined by intrinsic interests). Related studies explore the ways in which these expert communities reconstitute themselves, through the resolution of controversies and challenges.

Further intra-disciplinary studies have highlighted the ways in which members of the scientific professions resort to distinctly social practices in their efforts to distinguish science from non-science. The focus on ‘boundary work’ as a constitutive practice, shaping forensic science as both a discipline, and profession, may serve to explain the interactions and negotiations between law, and science. Scholars of expertise share an interest in processes of negotiation. They posit the creation of ‘hybrid sets’ of legal and scientific actors, whose temporary alignment allows for the resolution of controversies in ways which satisfy the respective interests of competing domains.³⁷⁹ Thus, Mercer³⁸⁰ argues that ‘there is ultimately a straightforward boundary that can be drawn around science and law to stop the distortion of scientific facts.’³⁸¹ Both Edmond and Mercer highlight the necessary co-production of forensic-scientific knowledge claims: claims, whose genesis cannot be attributed solely to the application of laboratory expertise, and whose application cannot be

³⁷⁸ *Ibid.*

³⁷⁹ Lynch, M., Cole, S.A., McNally, R. & Jordan, K. (2008) *Truth Machine: The Contentious history of DNA Fingerprinting* (Chicago: University of Chicago Press);

³⁸⁰ Mercer, D. (2002) *The Intersection of Sociology of Scientific Knowledge and Law: Some themes and policy reflections*, Law, Text, Culture Vol. 6. At p.9

³⁸¹ Edmond, G. & Mercer, D (1998), *Trashing ‘Junk’ Science* Stanford Technology Law Review 3

stated to have been shaped solely by the requirements of legal procedure.³⁸² Thus, they posit the emergence of ‘scientific method discourses’, which result in the formation of ‘hybrid sets.’ According to their concept, the formation of a ‘hybrid set’ is a dynamic and fluid process, through which institutional actors from varying epistemological backgrounds come together to shape the form of forensic-scientific truth claims.

The ‘hybrid set’ theory would appear to allow for the temporary merging of science, and law, on a number of levels: cognitive, normative, and epistemological. However, other theories remain sceptical with regard to this possibility. The autopoietic perspective exhibits a similar focus on the ways in which discrete fields exchange cognitive information (through the process of structural coupling). However, autopoiesis forecloses the possibility of epistemological negotiation between discrete scientific and legal fields, both of which retain operational, and normative closure.

During data collection, the overwhelming majority of scientists expressed a desire to discuss Streamlined Forensic Reporting. These informants tended to be critical, citing the lack of information provided on SFR1 reports as a particularly problematic feature. Deficiencies were noted in terms of both the procedural form, and scientific content, of the reports. The majority of expert informants were skeptical about the ability of the SFR process to meet its stated aims (delivering efficiencies by encouraging discussion and focusing on the ‘real issues’):

‘An SFR1 is done early in a case. Typically it will be done in a ‘spec case’. [The report] is not done by a scientist. The sample goes to the evidence recovery unit [or the Forensic Science Provider]. A profile is obtained. The profile is loaded onto the NDNAD. The police DNA Unit are informed if there has been a match. They compile the SFR1.

(Interview, Tier 1 Forensic Scientist, 2015)³⁸³

³⁸² Lawless, C (2016) *Forensic Science: A Sociological introduction* (Routledge: New York) at page 3; see also Mercer, *Op. Cit.* at note 12 ; Edmond, G (2001); *The Law Set ; The legal-scientific production of medical propriety Science, Technology and Human Values*, 26(2), 191-226; Lynch, *et. al.* at p.45

³⁸³ All of the informants quoted in this chapter are forensic DNA experts. The cohort includes the following: operational senior scientists, lead scientists, managing director, head of operations, research and development

‘...it’s designed – let’s be honest – to encourage a plea.’

(Interview, Tier 2 Forensic Scientist, Oxford, 2015)

‘SFRs were meant to standardise reporting. They were supposed to save time and money by simplifying the process and to highlight areas of disagreement. They are meant to encourage an early guilty plea.’

(Interview, Tier 2 Forensic Scientist, Oxford, 2015)

‘There is a big push for a guilty plea - it’s really like a commercial negotiation. A guilty plea saves a huge public spend.’

(Interview, Tier 2 Forensic Scientist, Oxford, 2015)

Lack of information with regard to ‘chain of custody’ was also cited as a particular source of uncertainty and confusion:

‘On the SFR there is no mention of the lab who did the work or what scientist did it.’

(Interview, Tier 2 Forensic Scientist, Oxford, 2015)

‘In one case different swabs went to two different firms.’

(Interview, Tier 2 Forensic Scientist, Oxford, 2015)

‘In another case different swabs went to different reporters with a different URN³⁸⁴. So again there was a loss of context. The Met may have an overview but not at the raw data level.’

(Interview, Tier 1 Forensic Scientist, 2015)

implementation manager, principal forensic biologists, and chief reporting officer. They are all currently employed by Forensic Science Providers in England, and together represent a cross-section of the forensic science market, including both Tier 1 and Tier 2 providers. The majority of those interviewed had over ten years’ experience (frequently having spent time within the now defunct FSS). Others had received training solely within the commercial market.

³⁸⁴ Unique Reference Number

These examples, from forensic scientists working in ‘defence-oriented’ (Tier 2) laboratories, reveal procedural concerns arising from tensions between the reviewing laboratory and the police, as well as with those who carried out the initial analysis. One scientist drew attention to a specific example of procedural irregularity. This involved the comparison of DNA samples with ‘expired’ reference profiles, in contravention of the overarching regulations.³⁸⁵ The scientist viewed this as essentially an interpretative - rather than a procedural - lapse.

‘Pre-2005 barcodes reflect DNA1 and DNA2³⁸⁶...barcodes beginning 95... or below need a second sample to be taken. They’re no longer allowed to be used in court yet they are slipping through. These are factual errors.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

Another scientist indicated that source-level attributions were being presented on the basis of sub-source analysis, providing a further example of poor evaluation based upon an inappropriately restrictive level of analysis.

‘With SFRs there’s no record of where the swab was taken from. They swab a stain then state that the DNA came from blood but they haven’t done the KM³⁸⁷ test, so we can only say that it’s biological material.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘The danger is that the division between the stain and the DNA result means that one may not be related to the other. There’s no context.’

(Interview, Managing Director and Tier 2 Forensic Scientist, Oxford, 2015)

Informants were asked whether the deliberate separation of tasks between the forensic analysis of the sample, and the subsequent compilation of the report by a police

³⁸⁵ See ACPO (2005) *DNA Good Practice Manual: 2nd Edition*. London: The Stationery Office, and The Police and Criminal Evidence Act (PACE) 1984, Code of Practice D

³⁸⁶ These were the earliest forms of DNA collection kit.

³⁸⁷ Kastle-Meyer presumptive test for blood.

administrator, represented a particular form of ‘case fragmentation’. Their responses highlight concerns over the potential for the division of labour to restrict forensic evaluation, and legal fact determination.

‘The work is done by an administrator. The administrator hasn’t seen anything but paperwork. She hasn’t seen the profiles. And the scientist who created the profile hasn’t seen the reference profile and compared it.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘Many police forces have an in-house team called the Evidence Recovery Unit. So, for the Met, the ERU send the recovered samples to LGC or Cellmark. They profile them and send the results back on a results table. The Met scientist hasn’t seen the actual result or the reference sample.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘The Met may collect samples, process some in-house, send others to an FSP, with nobody getting an overview. The work becomes less interpretative.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘With the Met lab, one scientist is simply quoting another scientist, and that is not necessarily made clear.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

The propensity for unqualified administrators to quote forensic scientists was highlighted as a particular problem. A defence scientist produced a vivid illustration of the ways in which separation of tasks, quoting, and incorporation of passages between reports, may prove misleading.

‘So, this individual [indicating the original examiner] has not had DNA experience... and talks about ‘the sample that *we* submitted for DNA’. She understands that a mixed DNA result was obtained, which had at least three people in it ... so, she’s essentially paraphrasing the wording from the original scientist. This result, this

statement, doesn't give us any context on the strength and limitations of this DNA result. It just basically cuts-and-pastes from the scientist's statement.'

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

'So, they're now trying to develop a procedure where the Metropolitan Police can use the reports, or the outputs, of the DNA scientist and can incorporate that into their statement. But, by any other name, that's hearsay.'

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

Informants highlighted further problems. The increased sensitivity of analytical protocols has resulted in an increase in the reporting of mixed profiles.³⁸⁸ These profiles require careful evaluation. However, scientists indicated that the interpretative process was now overly-regulated, and formulaic, and that streamlining had reduced the procedure to one whereby outputs were interpreted according to a rigid, tabulated, administrative procedure. This led to inaccuracy.

'Where there is a major/minor sample, the scientist is not able to compare the two samples. The administrator has a table which s(he) consults. So the report is often factually inaccurate with regard to match probability.'

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

Discussions with DNA experts also unearthed more general concerns over the loss of expertise in the SFR process, and the concomitant loss of contextual evaluation.

'The NDNAD was never designed to be an evidential tool. The use of SFRs mean that some [defendants] are cornered. The SFR statement is portrayed as facts and [the defendants] aren't fully informed that they aren't facts.'

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

'SFR1 is all factual and reads in a way that sounds very bad for the accused but it lacks context.'

³⁸⁸ Profiles derived from the DNA of two, or more, individuals.

(Interview, Managing Director Tier 2 Forensic Scientist , Oxford, 2015)

‘You are asking someone to plead on the basis of incomplete information. Even if it is complete, nowhere does it tell them about the limitations of the evidence. It’s a one-size-fits-all solution.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

Crucially, informants highlighted concerns that a complete absence of contextual, or explanatory, information made the SFR1 extremely difficult to challenge. During interviews with legal practitioners, magistrates, barristers, and solicitors, all echoed these concerns. Further, they proposed that SFR dovetails with a prosecution strategy which seeks to establish links on the sub-source and source level whilst foreclosing discussion of exculpatory information on the activity level.

Interviewer: And would you say the SFR presents things in a very factual way due to the lack of contextual information?

‘Absolutely. Cannot agree more. And in fact, there’s obviously a very strong cohort of individual scientists usually, who feel that they’re misleading because a) they don’t allow a scientist to talk about the context because they’re very formulaic and b) they don’t provide any sort of context to the findings.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘depending on how that’s put in interview, there’s such a massive preconception in the general public about what DNA evidence means, whether it’s fair to the defendant to just put that to him or her and how open that is left to them to contest it and realise what it does actually mean and what options they’ve got at that point.’

(Interview, Tier 1 Forensic Scientist , Warrington, 2015)

‘Because there is no technical note, and so little information, it’s very hard to challenge. A lawyer wouldn’t know what to challenge and a defendant couldn’t get the funds to challenge it.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘...it must be difficult for a defence lawyer...to themselves understand the technicalities or to be able to get the legal aid, to...challenge it because there’s just so little there. So how do you explain what they want?’

(Interview, Tier 1 Forensic Scientist , Warrington, 2015)

‘SFR1 works well for ‘volume crime’ but where do we draw the line? There’s a grey area. Vulnerable individuals may plead guilty on the strength of the SFR1 and these may never be picked up. Especially where they are on legal aid.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

Informants raised more general concerns regarding the loss of expertise, and resulting confusion, resulting from the introduction of SFR:

‘Nobody knows their roles when it comes to SFRs.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘The police are directing scientists to do a basic task but there’s more to interpretation than numbers. The problem isn’t limited to the police. The lack of awareness about SFRs among solicitors is a worry.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘With SFRs they’ve taken the expert out of the process. Previously, the expert had an overview. Now, its only when the defence gets it that we have the necessary overview.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘So, yes, as I say, I think the purpose of them and why they’ve come about is for very good reasons but because of the lack of understanding of all of the stake holders in it that’s where it falls down. And it isn’t fit for purpose.’

(Interview, Tier 1 Forensic Scientist , Warrington, 2015)

Informants further posited that the MoJ were relying on common perceptions regarding the probative value of DNA-profiling ‘matches’, rather than engaging in a more costly probabilistic and contextual scientific evaluation. These responses are listed, before the discussion turns towards their relevance to answering the research question.

‘They are relying on the reputation of DNA but with none of the science underpinning it.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘If its purpose is to identify at an early stage the issues which are going to be contested, it needs to contain, all of the issues which could possibly be contested, which isn’t necessarily the statistic attached to the DNA profile. And there is that pre-conception amongst the general public that DNA is fact [probative]...and so for a defence scientist to say, ‘well I know you’ve got this big number on your SFR1, but I want to look at it more closely’ but then the budget holder for the legal aid says ‘well it’s DNA’: what are you going to contest?’

(Interview, Tier 1 Forensic Scientist , Warrington, 2015)

When summing-up their views on the SFR process, informants concluded that the scheme was factually misleading, and did not deliver the efficiencies that are its stated aim:

‘The idea behind it, I can understand entirely and yes and I think, you know, the purpose is noble, and it’s fine to try and achieve that, but it’s entirely dependent on everybody’s in the process’ understanding of the purpose of that document and what it means, and what the flaws in that is, and I think where there is a lack of understanding, which the defendant is not likely to have, then that’s where it falls down.’

(Interview, Tier 1 Forensic Scientist , Warrington, 2015)

‘The SFR model is good but that model dictates there’s going to be an error rate, and how do we mitigate that? At some point [in the design of the process] it has been accepted there will be a significant error rate.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘The cost to the court is excessive as a host of reporters get called to court so the cost to the criminal justice system actually increases.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘SFRs reduce time but the styling is very misleading. There’s a dilution effect.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

‘There is a long way to go before SFR is safe.’

(Interview, Tier 2 Forensic Scientist , Oxford, 2015)

RQ: ‘In what ways, if any, has marketisation influenced the ways in which expert forensic biologists evaluate DNA profiling evidence in England and Wales?’

SFR1 reports are not sufficiently robust to meet the requirements of a genuine expert witness statement, and are therefore not intended for presentation in court. The report is intended to convey only the bare minimum of evidence necessary for charging purposes. However, they are intended for production at pre-trial case management hearings and are designed to dovetail with other CPS initiatives, particularly the 'Early Guilty Plea Scheme' and the 'Stop Delaying Justice Initiative'.³⁸⁹

The ‘key findings’ presented on the SFR1 are brief: typically, they may be comprised of only one sentence, confirming a ‘match’ between a DNA sample and a reference profile. The findings are not generally accompanied by any contextual information, nor by a technical note explaining the procedures from which the findings were derived. Crucially, they contain neither an evaluation, nor a thorough interpretation, of the purported ‘evidence’.

On the basis of these findings alone, a suspect may be charged. The defence may then be invited to a pre-trial hearing. At the hearing, the key findings will be presented, and the defence may be invited to agree the content of SFR1 - presented as Form MG22 (B) - as an

³⁸⁹ The SFR scheme also operated alongside the Criminal Court Charge (abolished on 24th December 2015).

admission of uncontested evidence under Section 10 of the Criminal Justice Act 1967. The accused may then be invited to plead guilty in order to receive the maximum sentencing discount.

In cases where the defence do not accept the content of the SFR1 report presented during the case management process, the CPS guidance places the onus on the defence to identify 'the real issues'. These issues can then be addressed in court through an SFR Stage 2 report (MG22 (C)). The SFR Toolkit states the purpose of SFR Stage 2 as being,

'...to provide further evidence on identified and/or disputed forensic issues emanating from the Stage 1 court case management process. Stage 2 forensic evidence provides stronger and relevant forensic evidence to address the specific case issues that have been raised.'³⁹⁰

However, it should be noted that this SFR Stage 2 report is not a replacement for a full evaluative statement. It is limited solely to a discussion of those issues identified at the earlier stage of the process. Thus, in practice, the Stage 2 report is frequently replaced with a full statement:

'You could get an SFR2 as well but normally you would just go for a full witness statement. With an SFR1, you're going to court without a scientist having seen the report.'

(Interview, Tier 2 Forensic Scientist, Oxford, 2015)

As illustrated in the above responses, the introduction of non-expert streamlined reports has raised tensions between the forensic science community and the criminal justice system, and has attracted criticism from both fields.

The procedural innovations introduced by SFR1, dispense completely with the forensic scientist's ability to conduct an evaluation and interpretation of the DNA profile. Instead,

³⁹⁰ CPS 'Streamlined Forensic Reporting Guidance and Toolkit 6' 2015 at page 7. Available at :

http://www.cps.gov.uk/legal/s_to_u/scientific_evidence/sfr_guidance_and_toolkit/

the task of 'calling the profile' is passed to a police administrator, capable of only performing the most rudimentary interpretation (if any). This transfer of responsibilities is directly related to the process of de-skilling discussed in the previous chapter.

During a validation session, one forensic biologist took strong exception to the suggestion that the transfer of responsibilities to police administrators constituted 'de-skilling' with regard to forensic professionals, arguing that the term did not apply in circumstances where responsibilities were transferred to unskilled administrators within another field. In reply, it is argued that this assertion is wrong. The previous chapter provides ample evidence of the loss of professional cohesion within the forensic-scientific field, and of de-skilling within the forensic field. Further, that these factors, alongside the introduction of standardised forensic products, have led to a decreased reliance on forensic evaluation, and have thus allowed for a transfer of responsibilities away from forensic biologists, to institutional agents within the criminal justice system. That is the very definition of 'de-skilling'. (RQ1, RQ2)

Forensic scientists expressed concerns over the ability solicitors to engage with the evidence, due to the brevity of the report, and the lack of context. During verification interviews, these same concerns were echoed by respondents from both the bar, and the bench. A criminal defence barrister, and a magistrate, both expressed concern over the lack of engagement with, or challenge to, SFR1 DNA reports, by solicitors. The magistrate also expressed frustration that - from the bench - she was unable to direct solicitors scrutinise the evidence. She was therefore forced to accept the unchallenged SFR as evidence in criminal proceedings.

Whilst these responses may be concerning, and may point to problems with the streamlined reporting system, an alternative explanation may be that solicitors are simply delivering the efficiencies that the scheme was designed to introduce. However, that assertion does not bear weight, since the frustration felt by these respondents would suggest that barristers and magistrates are alive to the issues, and limitations, that the defence solicitors are either failing to apprehend, or are unable to overcome.

It may be argued, in that case, that the problem of lack of engagement does not lie solely with SFR1, but is partly due to ‘forensic illiteracy’ on a part of the legal profession. That may be true in some instances. However, if this were the case, then we would expect these problems to predate the introduction of SFR1. However, the data from the Wood Green Crown Court study shows a significant decrease in solicitor’s requests for further forensic information (from 42% down to 2%) following the introduction of streamlined reporting. It may be concluded, therefore, that while a reluctance to engage with the evidence may indeed be a contributory factor, the main drawback with SFR1 is that solicitor are rendered unable to challenge, or engage with, a report whose brevity precludes further scrutiny. In these circumstances, it is difficult to justify the use of streamlined reports in respect of DNA-profiling evidence. (RQ5)

One of the architects of streamlined reporting - a QC and CPS strategy advisor – verified that there were significant problems with the system, along the lines stated above. However, the respondent stressed that these problems could not have been foreseen, and that they stemmed from the point at which the scheme came under the auspices of the MoJ Efficiency program, in 2012. In counterpoint, it must be noted that the data from the Wood Green Crown Court Study, and the prior Woolwich pilot study, were available at that time. Therefore, it may be asked why the significant drop in requests for further forensic information was not the subject of further scrutiny, prior to the rollout of the scheme across England and Wales. Again, it must be concluded that this justification does not stand up to analysis. (RQ5)

Further, the FSS data from prior studies following the introduction of abbreviated (or ‘staged’) reports had demonstrated the ability to deliver significant efficiencies (in, time and resources, and economics), whilst retaining the means for legal practitioners to scrutinise the forensic evidence, and test the case against the accused. Given that savings could therefore already be achieved, and the aims of the Criminal Procedure Rules satisfied, there is little justification for the CPS and MoJ thought it necessary to introduce a novel form of reporting which actively curtails the ability to scrutinise the evidence. (RQ5)

Further concerns have been raised over the utility, and legitimacy, of streamlined reporting. The scheme has not been placed on a statutory basis. Therefore, attempts to clothe the SFR

scheme in law, and to signal legitimacy, have relied upon the selective incorporation of quotes from leading cases, alongside endorsements from high-status members of the legal profession. These have been incorporated into the supporting documentation and the report forms themselves. The earlier versions of the SFR1 form were notable for the inclusion of the following exhortatory, and cautionary, excerpts, taken from Appeal Court cases:

Balogun v DPP [2010] EWHC 799: Leveson LJ: ‘For my part, I do not accept that the spirit or letter of the Criminal Procedure Rules is complied with by asserting that the Crown is put to "strict proof”’

R v Chorley Justices 2006 EWHC 1795. ‘If a defendant refuses to identify what the issues are, one thing is clear: he can derive no advantage from that or seek, as appears to have happened in this case, to attempt an ambush at trial. The days of ambushing and taking last minute technical points are gone.’

These were accompanied by an extract from an open letter by Goldring, LJ, endorsing the SFR process:

‘SFR has high-level, national support. It is supported by the country’s Senior Presiding Judge, Lord Justice Goldring: “In short, everything suggests that SFR can deliver significant benefits to the courts, prosecution and defence. Court time is saved. Unnecessary forensic work is avoided. The defence are better able to focus on the real issues and appropriately advise their clients.”’³⁹¹

These (*obiter*) statements are cited in order to imply that a duty of candid disclosure rests with the defence. Such a duty is indeed carried by the defence, in some instances. However, the Criminal Procedure Rules place a countervailing duty of candour on the prosecution, and require both parties to work together to identify the real issues.³⁹²

³⁹¹ Letter from Goldring, LJ (August 2012), available at: <http://www.cps.gov.uk/legal/assets/uploads/files/Senior%20Presiding%20Judge%20regarding%20SFR%20-%20August%202012.pdf>

³⁹² Criminal Procedure Rules Part 3

*R. v Reed*³⁹³ is also cited in supporting documentation, as authority for the assertion that both parties must identify areas of agreement, and disagreement, within experts' reports. The case concerns itself with the regulation of the conduct of parties with regard to expert witnesses, under Rule 33 (now Rule 19) of the CrimPR. However, it is questionable to what degree this case may be applied to the SFR1 reports, given that these are specifically not *expert* witness statements.

A further aspect of the *Reed* judgment may have a more direct bearing on the use of Streamlined Forensic Reports. *Reed* states unequivocally that the real issue when dealing with DNA evidence is not 'whose DNA is it?' The issue is 'how did it get there?' Given the persuasiveness of this judgment, it is difficult to see how a form of reporting - which purposefully avoids discussion of forensic DNA evidence on the 'activity level' - can be of any utility when attempting to focus on 'the real issues'.

Further, the supporting documentation states that SFR1 may be used to provoke further discussion. However, it could be argued that a partial, and incremental, approach to the disclosure of evidence in criminal investigations runs contrary to both the Practice Directions, and the 'spirit and letter' of the Criminal Procedure Rules alluded to in *Balogun*. Given the above, it is questionable to what extent the SFR scheme can be held to conform to the Criminal Procedure Rules.

As stated above, Part 3 of the Criminal Procedure Rules places a duty on the court to ensure that opinion evidence (whether disputed or not), is presented in the shortest, and clearest, way. The SFR guidance, and supporting documentation, both justify the brevity of streamlined reporting with reference to this rule. However, it is debatable to what degree brevity and clarity can be conflated. During field data collection many scientists, and legal practitioners, expressed the view that the 'evidence' communicated on the SFR1 form is, in fact, disproportionately brief, and hence unclear. Indeed, excessive brevity may be especially problematic when dealing with scientific evidence, which is both relational, and highly dependent on context. To require experts to jettison context may be detrimental to the needs of witnesses, contrary to the Criminal Procedure Rules 3.2 (2)(a) and (b).

³⁹³ *R v Reed, Reed & Garmson* [2009] EWCA Crim LR 2698

Admittedly, SFR1 procedures may sidestep this duty, since it is not a scientist, but rather the (non-expert) compiler of the report, who is frequently called as witness. Again, it is difficult to see how this inefficient approach, which may obfuscate the real issues, can be reconciled with a requirement to candidly explore these issues (in compliance with both the spirit, and the letter, of the Criminal Procedure Rules)

It may be argued that the Streamlined Forensic Reporting scheme is not only procedurally - but also conceptually - flawed. Attempts to justify the process rely on a series of logical fallacies, not least the use of circular reasoning:

‘[The purpose of SFR Stage 1 is to] provide a stronger basis for Stage 2 forensic reporting through compliance with Criminal Procedure Rules....’³⁹⁴

‘[The purpose of the scheme is to] reduce costs and delay associated with forensic evidence where such evidence adds no value to the administration of justice.’³⁹⁵

‘Not guilty files and contested cases are to be built according to real issues.’³⁹⁶

‘[SFR1 is intended to create an] improvement in the early guilty plea rate resulting in fewer cases coming to trial unnecessarily.’³⁹⁷

‘[SFR] is a two stage process of which the purpose is to deliver forensic evidence proportionate to the needs of the real issues in each case.’³⁹⁸

³⁹⁴ CPS, *Legal Guidance on Streamlined Forensic Reporting*, Available at:

http://www.cps.gov.uk/legal/s_to_u/scientific_evidence/sfr_guidance_and_toolkit/sfr_guidance/sfr_q_and_a/index.html

³⁹⁵ *Ibid.*

³⁹⁶ Beckwith, J. *Digital Forensics Specialist Group SFR 23*rd September 2014. Available on website of the Forensic Science Regulator.

³⁹⁷ Ministry of Justice. (2012) *Swift and Sure Justice: The Government’s Plans for Reform of the Criminal Justice System*. (Cm 8388). London: TSO. at page 34

³⁹⁸ CPS, *Legal Guidance on Streamlined Forensic Reporting*, Available at:

http://www.cps.gov.uk/legal/s_to_u/scientific_evidence/sfr_guidance_and_toolkit/

The above examples share certain common assumptions: that the ‘real issues’ may be easily identified; that the procedural outputs - and the inferences derived from an incomplete, and non-probative, form of forensic analysis - are sufficient to determine guilt; and that the system is self-proving. It may even be argued that a degree of pre-judgment drives the SFR process. Indeed the following extract, taken from the SFR Toolkit, appears to address the *ultimate probandum*.

‘Where the forensic evidence *proves* the charged person’s involvement in an offence, SFR 1 should always be included with the Initial Details of Prosecution Case (IDPC) [emphasis added].’³⁹⁹

Further, there are strong indications that the SFR scheme encourages streaming, rather than streamlining. Scientists’ concerns over the ‘triaging’ of cases relate to wider issues regarding the relative autonomy of the forensic, and legal, fields. Previous commentators have tended to view law and forensic science as operating in discrete silos.⁴⁰⁰ Research has therefore tended to concentrate on the negotiations between the two professions, the resulting allocation of epistemic responsibility, the performance of ‘boundary work’, or the temporary creation of ‘hybrid sets’. Lawless and Williams, for example, have addressed the relationship between law and forensic science, exploring how these fields ‘combine in a mutually constitutive relationship to (in)form a mode of production of scientific commodities purchased by the police in support of criminal justice objectives.’⁴⁰¹

These approaches tend to exhibit a common belief that improved communication, and a shared understanding of the respective capabilities, and needs, of both forensic science and criminal justice, may enhance the co-production of knowledge. However, the streamlined reporting scheme does not appear to conform to the ‘contest and communication’ narrative.

³⁹⁹ CPS ‘*Streamlined Forensic Reporting Guidance and Toolkit 6*’ 2015. Available at :

http://www.cps.gov.uk/legal/s_to_u/scientific_evidence/sfr_guidance_and_toolkit/

⁴⁰⁰ See Kelty, SF; Julian, R; and Ross, A. *Dismantling the Justice Silos: avoiding the pitfalls and reaping the benefits of information-sharing between forensic science, medicine and law*. *Forensic Science International* ; Jul 10;230(1-3): pp.8-15.

⁴⁰¹ Lawless, C.J. & Williams, R. *Helping With Inquiries or Helping With Profits? The trials and tribulations of a technology of forensic reasoning*. *Social Studies of Science* (2010), 40, 731-755

Rather, SFR signals an almost complete co-option of scientific processes by the criminal justice system, the concomitant loss of interpretative forensic expertise, and the avoidance of the allocation of epistemic responsibility. It is argued that this instrumental approach to forensic reporting is a result of the disruption, and restructuring, of the forensic profession.

‘We used to have a tripartite agreement between the forensic science provider - the FSS - and the police, and the CPS, and I think we’ve lost that link with CPS now. There’s very little input. Instead of having this triangle where we’re all talking to each other I feel like we’re behind the police, and the police will then talk to the CPS.’

(Interview, Forensic Scientist 2, 2015)

‘Younger trainees coming into the industry are getting training but that training is basic. They don’t know what they don’t know. That never gets rectified as they progress. So as checkers and peer-reviewers they also lack the appropriate skills.’

(Interview, Forensic Scientist 6, 2015)

‘You have less experienced staff combined with pressures to do work quicker and a pressure from the police, and it leads to a factory-line approach just to get the results out.’

(Interview, Forensic Scientist 3, 2015)

As before, these observations can be explained with reference to the processes of economic rationalisation. However, a more nuanced understanding of economic rationality may now be required, in order to account for innovations such as SFR. Scholars of ‘neo-liberalism’, and those who chronicle its effects, have hitherto been content to base their analyses on a relatively fluid understanding of the concept: one which has been used across many domains, to many ends, and is frequently accompanied by ‘considerable imprecision, confusion and controversy.’⁴⁰² Garland argues that processes of economic rationalisation,

⁴⁰² Brenner, N., Peck, J. & Theodore, N. *After Neoliberalization* Globalizations, September 2010, Vol.7, No.3, pp. 327-345

‘...lack a strict logic or tight conceptual structure. Rather, [they form] a ragbag of techniques, models, analogies and recipes for action that are loosely bound up together by their appeal to economic rationality.’⁴⁰³

Lawless and Williams exhibit just such an approach in their explorations of the forensic science market.⁴⁰⁴ It is postulated that this approach may now be of limited utility: it is no longer sufficient to view neo-liberalism as a mere ‘ragbag of techniques’. Rather, it is possible to discern distinct patterns of development, which may appear contingent in emergent phases, but which are comparatively instrumental in later, developed stages. Thus, the effects of contemporary economic rationalisation may be significantly more thoroughgoing in comparison with those previously encountered, and those studies of the forensic market which do not account for these changes may now be outdated.

Economic rationalisation has disrupted techno-social ‘expert’ networks, to be sure. However, the purpose of disruption has been to open the forensic field to reforms focused on the organizational roles, and professional identities, of the individual forensic experts who comprise these networks. Marketisation restructures organisations in a way which renders their boundaries porous, making processes more responsive to instrumental policies, but with the strategic goal of restructuring people.⁴⁰⁵ Thus, productisation, triaging, and marketisation, are merely examples of the adaptation, and reconstruction, of processes, conditions, and which serve as the necessary precursors to the readjustment of roles, attitudes, and behaviours.

⁴⁰³ Garland, D. *The Culture of Control* (OUP: Oxford, 2002) at p.190

⁴⁰⁴ Lawless, C. (2010). *A Curious Reconstruction? The Shaping of ‘Marketized’ Forensic Science*. CARR Discussion Paper 63; Lawless, C.J. & Williams, R. *Helping With Inquiries or Helping With Profits? The trials and tribulations of a technology of forensic reasoning*. *Social Studies of Science* (2010), 40, 731-755

⁴⁰⁵ See Foucault, Michel (1997). *Society Must Be Defended: Lectures at the Collège de France, 1975-1976*. New York, NY: St. Martin's Press. pp. 243–244.

Conclusion

The data demonstrates that a strong link exists between the introduction of measures of economic rationalisation, and the reduction of thinking time - and contextual investigation - on the part of the scientist. These limitations have been aggravated by a tendency to triage cases, and by systematic attempts to avoid activity-level DNA analyses. The study exposes significant problems, related to de-skilling within the forensic scientific field, and a loss of expert evaluation with regard to the construction of DNA-profiling evidence. The study supports the view that the ultimate goal of the economic rationalisation of forensic expertise has been to disrupt, and to reform, the attitudes, and expectations, of forensic science providers, and to reconstruct forensic identities in conformation with economic goals, aligned to the requirements of the investigatory authorities. This disruption of techno-social expert networks has largely been achieved through the instrumental use of novel forms of forensic reporting procedures, of which Streamlined Forensic Reporting is the most extreme example. The study also demonstrates that such modes of reporting carry the potential to limit the quality, and content, of expert scientific opinion and may ultimately affect the court's ability to arrive at sound determinations on questions of fact.

Chapter Seven: Regulation

The previous chapter focused on attenuated forms of forensic reporting, introduced to the criminal justice system through the CJS Efficiency Program. It discussed the introduction of Streamlined Forensic Reporting, and the restructuring of DNA profiling expertise within the marketised forensic science sector. Analysis of the data demonstrated the extent to which the introduction of attenuated forms of expert discourse have been perceived as impinging upon the ability of the DNA-profiling experts to provide a contextual evaluation of the evidence, and of the potential for these attenuated forms of forensic discourse to contribute miscarriages of justice.

The third, and final, discursive chapter in this section follows a similar trajectory. However, the focus of this chapter is on the proliferating array of regulatory interventions, which now structure the processes of marketised forensic science provision in England and Wales. These interventions are indicative of the...

‘...significant (and ever-expanding) space that law has come to occupy. The result is that law is often seen as a ‘thicket’: a complex, fragmented, and cumulative collection of instruments, institutions, and mechanisms that requires ever greater knowledge, time and capital to navigate, thereby imposing disproportionate costs on actors, and requiring inordinate amounts of effort to move through.’⁴⁰⁶

The marketised system of forensic knowledge production in England and Wales, is a paradigmatic example of this form of legal expansion. The sector is notable for the significant degree of internal, and external, regulation, to which forensic science providers have become subject, to the extent that the production of forensic-scientific truth claims, for legal consumption, is now structured around a proliferating array of disciplinary practices, including: inspection, validation, quality control, batch-testing, accreditation,

⁴⁰⁶ Cloatre, E. & Pickersgill, M. (Eds.) (2015) *Knowledge, Technology, and the Law* (London; Routledge) at page 121

monitoring, auditing, certification, sampling, classification, guidance, and the publication of regulatory protocols. As will be shown below, these diverse interventions converge upon the process of DNA profiling, and support Laurie and Harman's assertion, that the introduction of regulation imposes disproportionate costs onto individual forensic science providers.

The Forensic Science Regulator

In the field of forensic science, these regulatory incursions are most closely associated with the work of the Forensic Science Regulator.⁴⁰⁷ The appearance of the regulator could be seen as a response to the development of diverging approaches, and variations in opinion, within a developing forensics market, and the perceived potential for those variances to affect the status, and probity, of DNA-profiling evidence. The introduction of a system of external regulation could thus be viewed as a means to retain market - and public - confidence through external validation.

The office of the UK Forensic Science Regulator was created by the Home Office in 2008. As an independent regulatory body, the FSR was charged with the identification of quality standards, the supervision - and accreditation - of forensic laboratories (in compliance with ISO/IEC 17025 *General requirements for the competence of testing and calibration laboratories*), the determination of procedures for the validation of new technologies, development and maintenance of standards, and the management of complaints. The regulator's powers are non-statutory⁴⁰⁸, despite being sponsored by the Home Office, and are limited to England and Wales (although the forensic science services of Scotland, and Northern Ireland, voluntarily comply with her recommendations). The in-house laboratories of the 43 individual police forces of England and Wales operate outwith the ambit of the OFR regulatory regime, and do not currently require accreditation.

⁴⁰⁷ See, generally, McCartney, C. and Amoako, E. (2018) *The UK forensic science regulator: A model for forensic science regulation?* Georgia State University Law Review, 34 (4). pp. 945-981.

⁴⁰⁸ The Forensic Regulator Bill 2017-19, introduced to Parliament on 8th March 2018, attempts to place the Office of the FSR on a statutory footing.

The regulator's role has evolved, with each of the two FSRs thus far, focusing on different aspects of market regulation. During its earliest phase, the work of the FSR was largely reactive. Thus, the regulator was tasked with addressing concerns over: poor laboratory procedures, which had led to notable instances of contamination,⁴⁰⁹ the perception of an inadequate scientific basis for the interpretation of LCN-DNA⁴¹⁰, and the problems associated with forensic evaluation and cognitive bias.⁴¹¹ In comparison, the incumbent FSR has adopted a relatively proactive stance, propelled by the need to 'establish a baseline of quality across the forensic science market.'⁴¹² Nonetheless, the regulator's underlying duties are not appreciably different. Primarily, the FSR is tasked with overseeing a number of regulatory protocols, as discussed below.

FSR's Regulatory Responsibilities

The following discussion focusses on the regulator's main responsibilities;

International Standards

The regulator is responsible for ensuring that all accredited FSP's conform to certain international standards, in particular ISO/IEC 17020 and ISO/IEC 17025. These are UKAS accreditations, which focus on the quality assurance of forensic laboratory analysis. ISO 17025 lays out the general requirements for the competence of testing and calibration laboratories, and is referable to a wide range of forensic analyses, examinations and testing activities. Accredited elements include continuity of evidence, management of case files and storage of exhibits. In addition, accreditation determines the competence of staff, the

⁴⁰⁹ See, for example, *Report into the circumstances of a complaint received from the Greater Manchester Police on 7 March 2012 regarding DNA evidence provided by LGC Forensics*. FSR, 17 September 2012, Mr Andrew Rennison MSc

⁴¹⁰ Office of the Forensic Science Regulator, *Review of the Science of Low Template DNA Analysis* (2008) London: The Home Office ; Office of the Forensic Science Regulator, *Crime scene DNA: anti-contamination guidance* (2016) London: The Home Office

⁴¹¹ Office of the Forensic Science Regulator, *Cognitive Bias Effects Relevant to Forensic Science Investigations* (2015) London : The Home Office

⁴¹² Office of the Forensic Science Regulator (2016) *Regulator's Codes of Practice and Conduct* London: The Home Office

validity, and suitability of methods, the appropriateness of equipment and facilities, and ongoing quality assurance through internal quality control. A further standard, ISO/IEC 17043, introduces requirements for the competence of providers of proficiency testing schemes. It focuses on understanding and applying standard accreditation processes.

Accreditation

ISO 17025 is an essential component for FSR accreditation, and is therefore a standard requirement in relation to specified functions and processes. First, any FSP processing material samples for loading onto the National DNA Database (NDNAD) must be accredited. This falls within a broader requirement, under the EU Council Framework Decision 2009/905/JHA, of 30th November 2009, which relates to the Accreditation of forensic service providers carrying out laboratory activities. This decision requires FSP's to hold ISO 17025 accreditation in respect of all laboratories carrying out DNA profiling, and fingerprint enhancement. It was agreed that this requirement would apply to all in-house police laboratories carrying out the specified activities, with staged implementation targets between 2013 and 2015 (however - the UK having decided to opt out of EU criminal justice measures - the legal obligation to comply with the Framework Decision is in the process of being removed).

Professional and commercial Standards

The Regulator has worked with a wide range of institutional actors, professional, and representative, bodies, including; the Royal College of Pathologists, the Institute for Archaeologists, the Royal Anthropological Institute, the UK and Ireland Association of Forensic Toxicologists, the Society of Chiropractors and Podiatrists, the Forensic Science Society, and the Fingerprint Society, in order to produce professional standards for those disciplines. The Regulator has also worked with the British Standards Institute to develop a standard (PAS 377) for manufacturers producing consumables (DNA kits, swabs, etc.) used in the collection, preservation and processing of forensic material.

Forensics Procurement Framework

Individual police forces, and consortia, agree contracts for provision of forensic services on a regional basis, as part of the Home Office's forensic procurement framework. Under the forensic framework, contracts require providers to hold ISO 17025 accreditation, and to

meet other quality requirements. This includes compliance with the Regulator’s Code of Practice, and compliance with investigations by the Regulator. Failure to meet these requirements, attracts contractually-imposed penalties, and may lead to the removal of the provider from the framework. The overwhelming majority of laboratories are part of the procurement framework. However, it is important to note that a great deal of forensic provision takes place outwith the laboratory (this includes strategy-setting, interpretation, and evaluation). Further, the procurement framework encompasses only those services which are externally procured by law enforcement agencies (Police Forces, HM Revenue and Customs, National Crime Agency). Thus, the application of the procurement framework is partial, and uneven.

Investigation of Complaints

Potentially serious breaches of quality, on the part of a provider, may be investigated by the Regulator, whose task is to make recommendations to that provider, in order to ensure that the error is not repeated. The Regulator may also investigate issues referred to her by relevant authorities. This including Ministers, and the Judiciary. The following section discusses the regulatory guidance issued by the FSR – guidance which serves to structure the process of DNA profiling.

Forensic Regulator’s Code of Practice and Conduct

The FSR has published a non-statutory Code of Practice and Practice, which applies to all agents (from FSP’s to sole practitioners) tasked with providing forensic services to the criminal justice system. The Code is non-statutory. However, ‘whilst the standards are not yet mandated by law, compliance is not optional.’⁴¹³ This is due to the fact that ‘all individuals reporting scientific, or technical, work to the courts (whether called by prosecution or defence) must now declare compliance with this Code of Conduct.’⁴¹⁴ The

⁴¹³ Office of the Forensic Science Regulator (2016) *Regulator’s Codes of Practice and Conduct* London: The Home Office

⁴¹⁴ *Ibid.*

Code of Practice situates the requirements of ISO 17025, and gives direction on topics such as validation, contamination control, and information security. It also sets out the standards required for any organization, or individual, working with forensic evidence, alongside detail on standards pertaining to the use of ‘occasional experts’, and on infrequently used methods, stipulating that – in those circumstances where agents deviate, or depart, from the requirements of the Code - they are obligated to issue the court with a ‘statement of non-compliance’⁴¹⁵.

The FSR stated, in response to questioning, that this body of regulatory protocols together ‘serve to systematically organize a culture of competence and quality assurance’.⁴¹⁶ The central concept was ‘quality’: quality, it was asserted, goes beyond accreditation. Accreditation, in the FSR’s view, is merely a baseline, onto which is added quality. Further, that ‘accreditation is just an extension of scientific method.’⁴¹⁷ These broad statements require further scrutiny, in light of the recent development of the Regulator’s accreditation process, and the potential for these incursions to shape the process of DNA profiling.

Quality Assurance and *Daubert* criteria

The Forensic Regulator’s assertion - that quality assurance is an extension of scientific method - requires further scrutiny, as it sits uneasily within the body of Mertonian norms that form the dimensions of the scientific method. However, it is possible to argue that her assertion is correct (though the route from scientific norm to regulatory protocol is a circuitous one), and it would appear that the FSR takes the view that this, ‘regulatory’ form of forensic evaluation, comprises an evolved, and enhanced, form of forensic evaluation, as compared to a standard model of a forensic evaluation grounded in scientific method.

⁴¹⁵ Office of the Forensic Science Regulator (2016) *Regulator’s Codes of Practice and Conduct* London: The Home Office

⁴¹⁶ Interview with Forensic Science Regulator (March, 2018) London: The Home Office

⁴¹⁷ *Ibid.*

The starting point for an elaboration, and critique, of the FSR's position, is the Law Commission Report, *Expert Evidence in Criminal Proceedings in England and Wales*,⁴¹⁸ which, in 2011, recommended the introduction of a statutory 'reliability' test for determining the admissibility of expert evidence. The commission recommended that admissibility be assessed by way of an enhanced '*Daubert*' test, of the sort encountered in the US (see below).

Whilst, in the various jurisdictions of the UK, the role of the expert witness is framed fairly broadly, in terms of the expert's ability to assist the court (and such experts may include scientists, individuals with specialist knowledge, and those possessing particular skills)⁴¹⁹, the criteria for admissibility of expert opinion evidence in many American states now differs greatly.

The US Courts used to uniformly follow the Frye standard (*Frye v. United States*, 293 F 1013 (D.C. Cir. 1923), which holds that expert testimony based upon scientific techniques is only admissible when these techniques have become generally accepted within the relevant scientific community. However, following the judgment in *Daubert v Merrel Dow Pharmaceuticals* 509 U.S. 579 (1994), the Supreme Court amended Rule 702 (regarding the use of expert testimony) to introduce an admissibility test. Within the preponderance of US states, all expert opinion evidence must now meet the Daubert standard, measured against five criteria. *Daubert* requires that, in judging the admissibility of expert evidence, the court must look to the underlying methods used, in order to assess:

- whether a method can or has been tested;
- the known or potential rate of error;
- whether the methods have been subjected to peer review;
- whether there are standards controlling the technique's operation; and,

⁴¹⁸ Law Commission, *Expert evidence in criminal proceedings in England and Wales*, 21 March 2011, Law Com No 325

⁴¹⁹ *R v Turner* [1975] 1 All ER 70

- the general acceptance of the method within the relevant community.

Thus, the judge exercises a gate-keeping function, and must now ensure that all expert testimony 'proceeds from scientific knowledge'. Indeed, the *Daubert* criteria may be viewed as a partial incorporation of Mertonian norms, as understood from a regulatory perspective. However, the introduction of the *Daubert* test caused a great many problems for forensic practitioners - particularly friction ridge examiners - whose methods were not consonant with scientific method. Therefore, in 1999, the test was extended to include methods based upon 'technical' knowledge [see *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999)].

Returning to the Law Commission's proposals, the enhanced *Daubert* admissibility test recommended in 2011 failed to make provision for the forms of technological, or 'non-scientific' evidence, admitted in *Kumho*. And, after consideration, the Law Commission's recommendation was rejected by the Government, on economic grounds.⁴²⁰ Therefore the common law rules on admissibility of expert evidence subsist. However, rejection did not spell the end for the 'enhanced *Daubert* test'.

In 2014, the Lord Chief Justice (Lord Thomas) issued a Practice Direction (effective from 7th October 2014), containing the selfsame enhanced admissibility test. Thus, a test 'recognisably derived from *Daubert*', was 'introduced to the courts by [a] somewhat unusual mechanism.'⁴²¹

The Criminal Practice Directions were in turn amended. Direction 19A3 now acknowledges that the Law Commission declined to introduce an enhanced *Daubert* test.⁴²² It states, however, that nothing prevents the courts from assessing admissibility using *Daubert* Criteria. It encourages the courts to do so. However, it goes further, stating that

⁴²⁰ The Government's response to the Law Commission report: "*Expert evidence in criminal proceedings in England and Wales*", Law Com No 325, 21 November 2013.

⁴²¹ See Ward, T. *An English Daubert? Law, Forensic Science and Epistemic Deference* (2015) *The Journal of Philosophy, Science & Law: Daubert Special Issue*, Volume 15, May 29, 2015, pages 26-36 at page 26

⁴²² *Criminal Practice Directions 2015* [2015] All ER (D) 134 (Sep) | CL&J at 19A3

19A4 lists matters with which an experts report must deal in order for such an assessment to be carried out (see 19A4(h) below).

(h) [an expert report] include such information as the court may need to decide whether the expert's opinion is sufficiently reliable to be admissible as evidence;

This may appear unproblematic. Nonetheless, the attempts to ground this procedural innovation in domestic legal precedent are arguably misconceived. The underlying guidance quotes a short passage from *Dlugosz*⁴²³, stating that the court must ensure 'that there is a sufficiently reliable *scientific* basis for the evidence to be admitted.' However, it may be argued that this obiter statement has been taken out of context. The discussion in *Dlugosz* centred around the evaluation of mixed DNA profiles, a singularly 'scientific' evidence type. It is far from clear that the court intended this requirement to apply more widely, to all forms of forensic evidence.

Further, that inclusion from *Dlugosz* is itself founded upon the judgement in *Reed*⁴²⁴, paragraphs 111-2, which specifically refers to appropriate admissibility criteria, to be used when dealing with 'scientific evidence of a *scientific nature*...'.⁴²⁵ It may be readily inferred, therefore, that there are other forms of *non-scientific* evidence, and that these non-scientific evidence types may be judged by other criteria. This distinction has become lost along the way. Forensic practitioners are now faced with the problem of negotiating a common-law, practice-based, set of admissibility criteria, which require that all evidence - scientific, technical, or otherwise – are based upon reliable *scientific* methods (as laid out in *Daubert*).

To return to Rule 19.4, this states that a report 'must include such information as the court may need to decide whether the expert's opinion is sufficiently reliable to be admissible as evidence;' Therefore, in light of the directions above, it may be stated that forensic reports must contain substantive evidence of the conformity of the methods used within the report

⁴²³ *R v Dlugosz* [2013] EWCA Crim 2

⁴²⁴ *R v Reed, Reed & Garmson* [2009] EWCA Crim LR 2698,

⁴²⁵ *Ibid.* Emphasis added.

with scientific method *vis-à-vis* the enhanced *Daubert* criteria. It may be further inferred, that forensic reports must contain substantive evidence of the conformity of the evaluative report itself with scientific method *vis* the enhanced *Daubert* criteria.⁴²⁶ Thus, the introduction of this unorthodox ‘enhanced *Daubert*’ test (following its rejection by the Government) would appear to create a significant hurdle for forensic practitioners who remain unaccredited, or who exercise ‘non-scientific’ forensic techniques. What is more, the legal requirements for admissibility imposed through the Criminal Practice Rules (and associated Directions), are met – within the forensic sector - by a regulatory stipulation on the part of the Forensic Science Regulator.

Regulation and the ‘Enhanced *Daubert*’ Criteria

Alongside the requirements laid out in the Criminal Practice Rules, and associated Directions, the Forensic Science Regulator ‘suggests’, in her guidance that the courts determine the issue of whether expert evidence is ‘sufficiently reliable’ with reference to the presence, or otherwise, of accreditation. Further, that all methods - standard, or non-standard - be validated, and that all validations (whether in reports or as the basis of expert opinion) ‘consider’ 19A5 of the Criminal Practice Directions. As seen above, these Practice Directions are based on the ‘enhanced *Daubert*’ criteria. Therefore, due to the Regulator’s stipulations, the validity, hence soundness, of expert methods are now directly referable to ‘enhanced *Daubert*’ criteria. And validation is inextricably linked to accreditation, insofar as accreditation is itself granted on the ability of the FSP to demonstrate the validity of their methods.

These regulatory incursions are couched in terms of ‘suggestions’ and ‘considerations’. However, departures from these ‘suggestions’ may have far-reaching legal consequences. Since 2016, any forensic expert who departs from the above accreditation, and validation,

⁴²⁶ The evaluation of DNA profiling is not currently subject to a standardisation protocol. However, the FSR Annual Report (19th January 2018), paragraph 1.2, page 16, states that the development of an evaluative interpretation standard is one of the Regulator’s highest priorities.

requirements must now make a Declaration of Non-Compliance to the courts.⁴²⁷ Whilst the declaration has no immediate legal effect, such a declaration must - it has been suggested - be viewed negatively by the court, when judging the question of admissibility. It may be argued that this is deliberate. Indeed, it aligns with the Regulator's statement, that her task involves establishing a 'baseline of quality across the forensic sector', imposed through the 'double-check' of ISO17025 compliance, and 'case by case scrutiny through the Criminal Procedure Rules' (Interview with FSR, 2017).

Taking the above into account, it has been demonstrated that - to the extent that accreditation requires validation in line with (enhanced) *Daubert* criteria - the Forensic Science Regulator's statement - that accreditation is an extension of scientific method - has procedural validity. Nonetheless, it may also be argued, in counterpoint, that the Regulator's reach has only been extended by means of a somewhat abstruse series of categorisations, regulatory incursions, and administrative linkages. The next section considers the implications of these regulatory incursions, for marketised forms of DNA profiling in England and Wales. It also offers a theoretical analysis of these regulatory incursions. (RQ3)

Accreditation and DNA Profiling

It may be argued that the requirement to comply with *Daubert* criteria, through validation and accreditation, is merely an iteration – albeit an administrative, and procedural, one - of the grounding of forensic science in scientific method. In counterpoint, it may be posited that, this being the case, the regulatory stipulations nevertheless articulate an etiolated conception of scientific method: a conception viewed through the lens of institutional logic.

Further, when applied to the work of forensic DNA profilers, it may be argued that these requirements are aligned with – and support – the forms of high-volume, low expertise, forensic DNA reporting that were encountered in the preceding two chapters (for example Streamlined Forensic Reporting). These forms of reporting are based upon well-established

⁴²⁷ Office of the Forensic Science Regulator (2016) *Regulator's Codes of Practice and Conduct* London: The Home Office

scientific methods, to be sure. However, the method of DNA-profiling – at least in its routine forms – has now largely been reduced to a robotised process. It may be posited that this no longer represents an ongoing instantiation of scientific method, having been reduced to a technological process, of the sort envisaged by *Kumho*, but unaccounted for in the ‘enhanced *Daubert*’ schema. It is further posited that it is actually the evaluative element of DNA-profiling which lies at the heart of the scientific reporting process - and it is this articulation of scientific method which is palpably missing from non-expert forms of reporting, such as SFR. Further, it is notable that the evaluative component of DNA-profiling falls outwith the ambit of the accreditation process. This is a crucial omission, which will form the focus of discussion in the following section.

DNA Profiling and the Declaration of ‘non-compliance’

As stated above, the Regulator’s Codes of Practice and Conduct allows for atypical analyses, ‘innovative, or rarely-used methods.’⁴²⁸ However, the DNA profiling scientist who uses methods which have not been specifically validated, and brought within the regulator’s Code of Conduct and Practice, must – when acting as an expert witness – make a Declaration of Non-Compliance to the court. When challenged with regard to the requirement for expert witnesses to make a Declaration of Non-Compliance when using innovative methods (on the grounds that this prevented DNA profilers from making contextual, and holistic analyses, from adapting, or solving new challenges) the FSR robustly defended the current system, stating that:

‘accreditation doesn’t stifle creativity when implemented within a culture of continuous improvement.’

However, this was contradicted by responses from forensic practitioners, of which the following was typical:

⁴²⁸ Office of the Forensic Science Regulator (2016) *Regulator’s Codes of Practice and Conduct* London: The Home Office

‘ISO 17025 might show that sound structures are in place but it doesn’t solve cases. That comes down to strategy.’

The FSR went on to stress the central importance of ‘quality’: quality, it was suggested, goes beyond accreditation. The latter serving only as a baseline, onto which is added the former. In respect of DNA-profilers, the regulator further stated that quality could be derived from a combination of factors: the ideal forensic actor should have ‘proper documentation, and be well-trained professionals’⁴²⁹

In counterpoint, the researcher challenged that quality is actually derived from the ability of a forensic scientist to solve problems using creativity, adaptability, and innovation, in order to utilise contextual information drawn from a palette of forensic techniques (as well as exercising core skills). It is debatable to what extent the ‘Declaration of Non-Compliance facilitates the task of ‘de-convoluting’ mixed DNA samples (now frequently encountered). Or the extent to which a constrained approach, can facilitate the type of high-quality, holistic analysis of the sort championed by FSNI.

The current framework does not adequately engage with these phenomena, and - in reality - these attributes are rendered null by the accreditation process. The regulator concedes that the current framework privileges DNA profilers working conducting high volume analyses. Also that these forensic ‘trainees’ do possess neither an innovative mindset, nor the ability to design validation experiments. It may be posited that they are actively prevented from doing so by the accreditation requirements. Further, it may be posited that these forms of reporting (often carried out by police administrators, marked by quoting, and beset by case fragmentation) are now mere technological processes, in contrast to the high-level evaluations, and contextually rich interpretations. Which are, in reality, more consonant with scientific method.

We might therefore discern two models of forensic DNA profiling provision: one characterised by an autonomous scientific evaluation, which retains the ability to link DNA-profiling evidence to other forms of non-expert evidence. Another, characterised by trainee following rigid standard operating procedures, aligned with the requirements of

⁴²⁹ Interview with Forensic Science Regulator (March, 2018) London: The Home Office

accreditation. Paradoxically, the regulatory model therefore allows trainees – many of whom may not have a scientific background - to facilitate technological processes grounded (or at least superficially) in scientific method, whilst constraining the sort of contextually-driven, genuinely scientific enquiry which is grounded in Mertonian norms (and expressed in the enhanced-*Daubert* criteria).

Further, to the extent that any deviation from the regulatory, to the autonomous, model, may necessitate the issuing of a Declaration of Non-Compliance, and insofar as this Declaration may be used by the court to judge the reliability of evidence, it may be posited that a form of ‘regulatory objectivity, has usurped the function of the trier-of-fact, and displaced a model of autonomous scientific evaluation. The phenomenon, and theory, of regulatory objectivity will be discussed further below. (RQ3)

Regulatory Objectivity⁴³⁰

The attempts, on the part of the FSR, to create an unbroken chain of regulatory accreditation from crime scene to courtroom, has ushered in a model of regulatory forensic provision, which has displaced the subsisting model of scientific objectivity. This reconfiguration demonstrates the tendency for governments to attempt to disperse power by re-shaping public services in the image of the market. Such a reconfiguration entails a different relationship between the marketised services and central government that is indirectly administrative. This ability - to 'govern at a distance' - is a characteristic feature of economic rationality, achieved by subjecting ‘an ever-expanding array of spheres of

⁴³⁰ See Cambrosio, A., Keating, P., Schlich, T. & Weisz, G. *Regulatory Objectivity and the Generation and Management of Evidence in Medicine*. *Social Science and Medicine* 63 (2006), pp. 189-199. See also M'Charek, A. *Technologies of population: Forensic DNA Testing practices and the making of differences and similarities* *Configurations* (2006), 8, 121-158; M'Charek, A., Hagendijk, R. & de Vries, W. *Equal before the law: On the Machinery of Sameness in Forensic DNA Practice* *Science, Technology, Human Values* 2013, 38: 542; Stephens, N., Atkinson, P., & Glasner, P. *Documenting the Doable and Doing the Documented: Bridging Strategies at the UK Stem Cell Bank* *Social Studies of Science*, (2011) 41, 791; Jordan, K. & Lynch, M. *The Dissemination, Standardisation and Routinisation of a Molecular Biological Technique* *Social Studies of Science* (1998) 28: 773; Jasanoff, S. *Procedural Choices in Regulatory Science* *Technology in Society*. Vol. 17 No.3 (1995) pp.279 -293; Myles, L. *Quality Assured Science: Managerialism in Forensic Biology* *Science, Technology and Human Values* (2010) 35: 283; Porter, T. M. (1992) *Quantification and the Accounting Ideal in Science*, *Social Studies of Science* 1992 22; 833; Moreira, T., May, C. & Bond, J. *Regulatory Objectivity in Action: Mild cognitive impairment and the collective production of uncertainty*. *Social Studies of Science* (2009) 35/9 pp. 665 - 690

activity to inspection (or self-inspection), audit, and certification.⁴³¹ Thus, governing at a distance is associated with governing through standards.

In the foregoing sections, it has been argued that two models of forensic investigation, and evaluation, can be discerned. The first, a holistic, and adaptive, form of investigation, which is referable to both scientific method, and an underlying set of (broadly Mertonian) norms, as exemplified broadly by the analysis of DNA profiling evidence in FSNI, and by certain, more extensive, iterations within the forensics market in England and Wales. The latter comprises a comparatively more mechanistic form of investigation, procedurally determined, and limited to a set of regulatory protocols and standard operating procedures. However, while the parent organisation may possess accreditation, its methods validated, and its protocols aligned to regulatory imperatives, the DNA profiling process is often carried out by trainees who do not possess a background in science, and is characterized by a lack of evaluation, and interpretation. Indeed, it should be reiterated that evaluation and interpretation – whilst exemplifying the scientific method - fall outwith the regulatory ambit.

Nonetheless, it might be argued that the differences in approach are merely reflective of variations in laboratory culture, rather than being indicative of deeper structural dissimilarities. Participant's responses did indicate the presence of site-by-site variations, attributable to differences in 'laboratory culture':

‘Individual labs will develop their own culture and that may affect the strength they tend to place on results. You can get a reputation for interpreting the evidence ‘strongly’. That applies within FSPs to individual labs and scientists.’

‘People coming in would bring different practices, so you do get site-by-site variation.’

‘There are very set guidelines when ‘calling the profile’ but evaluation is more mentored. When it comes to interpretation that can be influenced by senior staff.’

⁴³¹ Gibbon, P & Henrikson, L.F. *A Standard Fit for Neoliberalism* Comparative Studies in Society and History (2012); 54(2), pp. 275-307 at p.275

(Interviews with Tier 1 and Tier 2 forensic biologists, April – June 2015)

The above testimony from forensic biologists illustrates the propensity for laboratory culture to influence the construction of DNA profiling evidence. However, it is argued that these variations occur in the context of micro-level interactions, and that there is no evidence that site-by-site variation structures, to any appreciable degree, the meso-level organisation of DNA profiling, nor macro-level governance structures, which retain an orientation towards the normative model discussed above. (RQ6)

The introduction of just such a system, to the forensic sector, has not been achieved without criticism. Indeed, recent comment, emanating from the legal sector, has characterised the Regulator's efforts as constructing a mere 'administrative paper trail'.⁴³² Further, as demonstrated above, the introduction of regulatory practices has also served to obscure the agency, and expertise, of DNA profilers, who must develop 'bridging strategies' in order to reconcile localised practices, and tacit knowledge, with externally imposed standards.⁴³³

Discussions of standardisation owe much to Foucault's theory of governmentality, with its ability to unearth the histories of the mundane techniques through which ideas materialise. The object of analysis for students of governmentality was the 'dominant strategic function' played by this assemblage of technical devices, and the ability to create an 'economy of power'⁴³⁴ from 'a multiplicity of more or less distinct practices, forms of knowledge, institutions and techniques'.⁴³⁵

Expertise is central to the reconfiguration of the 'economy of power', since the ability to govern through standardised performance measures requires the mobilisation of the professional disciplines of accounting, auditing and quality management. These techniques

⁴³² *House of Commons Science and Technology Committee: Forensic science* Second Report of Session 2013–14 Volume I

⁴³³ Stephens, N., Atkinson, P., & Glasner, P *Documenting the Doable and Doing the Documented: Bridging Strategies at the UK Stem Cell Bank* Social Studies of Science, (2011) 41, 791

⁴³⁴ Foucault (1977) at p.63

⁴³⁵ Gibbon, *op. cit.* at p.279

allowed their proponents to evaluate existing arrangements in the public sector through comparisons with idealised private firms, using standardised forms of calculation and monitoring. Through mobile technologies, such as auditing, dispersed sites were subjected to measurement and comparison, just as organisations and subjects were reconfigured to respond to quantitative results and incentives.⁴³⁶

The re-purposing of expertise, and the encroachment of disciplinary techniques and standardised practices into the forensic sector, has had particular effects in those sectors devoted to the production of knowledge. Further, it has fundamentally altered that element most closely associated with expert judgment - objectivity. Cambrosio⁴³⁷ argues that the nature of objectivity has changed over time in response to governmental innovations. He argues that 'different historical periods have produced different types of objectivity that have subsequently persisted either as autonomous forms or in combination with other types of objectivity.'⁴³⁸ Where once the objectivity of a statement could be inferred from the knowledge and experience of its author, 'later periods have tended to privilege mechanical or instrumental objectivity that replaces experts' subjectivity with mechanically produced inscriptions.'⁴³⁹

Daston⁴⁴⁰, too, has charted the emergence of a type of objectivity - absent of any viewpoint or perspective - which 'culminates in the systematic recourse to quantitative measures.' This form of objectivity stands in opposition to earlier forms of historically contingent objectivity, which nevertheless persist.⁴⁴¹ Cambrosio goes further, arguing that regulatory objectivity is not restricted to the establishment of standard measures. In the field of bio-medicine (and, by extension, forensic DNA profiling) it 'incorporates these measures and

⁴³⁶ Rose, N., O'Malley, P. & Valverde, M. *Governmentality* (2006), Annual Review of Law and Social Science, Vol. 2, pp. 83-104

⁴³⁷ Cambrosio, A., Keating, P., Schlich, T. & Weisz, G. *Regulatory Objectivity and the Generation and Management of Evidence in Medicine*. Social Science and Medicine 63 (2006), pp. 189-199

⁴³⁸ *ibid.* at p.193

⁴³⁹ *ibid.*

⁴⁴⁰ Daston, L. *Objectivity and the Escape from Perspective* (1992), Social Studies of Science, 22, pp. 597-618

⁴⁴¹ Daston, L. *The Moral Economy of Science* (1995), Osiris, 10, pp.2-24

the entities measured as a basis for clinical judgment.⁴⁴² Essentially, the *way* in which an expert judgment has been arrived at has come to replace the substance of the judgment itself. This argument may be applied to the instant case, whereby a deviation from accredited protocols – even a deviation which is beneficial, and grounded in scientific method – must result in a Declaration of Non-Compliance, the presence of which may be viewed negatively by the court.

Further, this form of regulatory objectivity, based around standardised practices, has special resonance for the forensic scientist. In the radically deconstructive arena of the courtroom, the ‘non-compliant’ enacting of scientific expertise may be recast as nothing more than an assemblage of ‘subjective, biased, messy, fuzzy, local and arbitrary practices and judgments.’⁴⁴³ In these circumstances, quality assurance operates as a ‘technology of trust’⁴⁴⁴. It ‘bridges time and space, assuring lab managers...and juries that unseen work has been carried out properly. It is, thus, the defining element of an ‘administrative science’ designed at least in part to deal with the threat of legal deconstruction.’⁴⁴⁵ Or, as Porter argues,

‘the form of knowledge resulting from this relatively rigid quantitative protocol is decidedly public in character. Such knowledge is especially useful to co-ordinate the activities of diverse actors, and to lend credibility to forms of belief and action when personal trust is in short supply. Thus, [regulatory] objectivity is a technology of distance.’⁴⁴⁶

⁴⁴² Cambrosio, *op. cit.* at p.194

⁴⁴³ Derksen, L. *Towards a Sociology of Measurement: The meaning of Measurement Error in the case of DNA Profiling* Social Studies of Science, 2000 30: 803 at p.806

⁴⁴⁴ Porter, T.M. (1995) *Trust in Numbers. The pursuit of Objectivity in Science and Public Life*, (Princeton, NJ: Princeton University Press

⁴⁴⁵ Leslie, M. *Quality Assured Science: Managerialism in Forensic Biology* Science Technology Human Values (2010) 35 , 283 at p.298

⁴⁴⁶ Porter, T. M. (1992) *Quantification and the Accounting Ideal in Science*, Social Studies of Science 1992 22; 833 at p.640; Porter, T.M. *Objectivity as Standardization: The rhetoric of impersonality in measurement, statistics, and cost-benefit analysis.* (1992), Annals of Scholarship, 9, 19-59

The data would tend to support the view that regulation serves to shape expertise, and to preserve hegemonic structures. Indeed, it may be argued that a number of influential, high-status lead biologists - who occupied the upper echelons of scientific research at the FSS - transferred to regulatory, and policy, positions, thus preserving established hierarchies during a period of dynamic market restructuring. (RQ3)

‘They could see it coming from 1998/99, that’s why I made that point earlier about being involved in the reflective strategic groups because it then became clear that the methodology around the quality management systems, as [the FSS] progressed further towards government company status, they would need to wrap that additional layer of quality separation around themselves. So they start using that language...’

Further, it was suggested that the transition to regulatory positions enabled those scientists to structure the market to benefit those organisations which have accreditation. Insofar as this is cited as a motive, this assertion is not supported by the preponderance of data, which supports the view that the motive for regulation is enhanced quality, albeit an etiolated form of quality analysis, conforming to regulatory imperatives.

‘The reality that I observed was that...very senior folk at the top end of the business went off and created their own business. Isn’t it interesting how out of that, it produced the current forensic regulator incumbent, so isn’t it interesting how the organisation that was formed by those senior scientists, that the current incumbent came from, keep saying how terribly important compliance with the regulator is, that there’s definitely a common language going on there.’

I think that’s a mantra that those more senior – or seen to be more senior – and who’ve been in the game longer – have wrapped themselves up in, in order to preserve their gravitas and their authority.

(Interview with CPS Strategy Advisor, and Queens Counsel: October, 2015)

Nonetheless, some respondents noted the tendency for accreditation to act as a scientifically meaningless, but prohibitive, economic barrier, which serves to force smaller competitors out of the market.

‘ISO 17025 might show that sound structures are in place but it doesn’t solve cases. That comes down to strategy.’

‘UKAS itself is a commercial monopoly...There’s never usually a UKAS challenge over testing. [UKAS accreditation] fails because accreditation is ongoing and must be supported by all of the other parts of your business, including HR, marketing, etc. It’s too costly [for news FSPs].’

(Interview with lead forensic biologist, and managing director: June 2015)

The above assertion was contradicted by a QC, and former CPS Strategy Advisor;

‘[Accredited standards] are an important aspiration, they are an important target to aim towards, but they are not a binding exclusionary force that should put anybody off attempting to enter the criminal justice system market...And I think we would be a much poorer justice environment without the regulator’s role and the codes of conduct and so forth. But it [should not be] the tail that is wagging the dog.’

‘What does the CJS ask for?’ You see, in relation to expertise it’s just not possible for the prosecution process to say ‘we’re not going to use that expert evidence because it wasn’t ISO 17025.’ They’re not going to say ‘I’m not accepting this because [the FSP is] not 17025.’ They would use that as a very good cross examination tool and say ‘the prosecution’s laboratory has got these bells and whistles on it and your garden shed hasn’t’ but that still doesn’t detract from what it is, is sought, is the end product of the expertise.’

The above response pre-dated the introduction for the issuing of a Declaration of Non-Compliance, on the part of unaccredited FSP’s, or those using non-validated methods. These subsequent developments would tend to contradict the above claims. However, the respondent did concede, on further questioning, that regulation, as currently practiced, is an inefficient, and improper, way to structure forensic DNA profiling activities.

‘Yes, it’s a wee bit like the idea of female genital mutilation, we’ve got it so you must have it, and the mantra goes round. Now, my passion about this is that people do not unpack it - certainly in the preliminary way that I’ve just illustrated in relation to defence practice but secondly they don’t even unpack what 17020 and 17025 looks for – we were doing this work as part of the ENFSI working group back in 2004 and the problem with 17020 and 25 is that it doesn’t deal with the requirements of the criminal justice system. It appears to, and it likes to think it does, and certainly UKAS likes to think it does because this is their lifeblood, to say this is to make sure it’s CJS user friendly but it doesn’t deal with any requirements in relation to disclosure, continuity, unused material, and all of those things which are actually the lynch pin for getting into the criminal justice process.’

Having outlined the ways in which standardisation and regulation may condition the production of forensic-scientific knowledge claims, the next section focusses on the underlying normative factors which drive these processes. (RQ3) (RQ4) (RQ6)

The Normative Basis of Forensic Science

‘There is no error in forensic science - ‘error’ only relates to the forensic scientist.’

(Forensic Biologist and Laboratory Manager; December, 2016)

‘We need to be open about the causes of error in forensic science: human error, faulty instrumentation, or systemic errors.’

(Regulatory Administrator; December, 2016)

These typical responses, from forensic quality assurance agents, disclose an objectivist view of forensic DNA profiling activities, which limits errors to categories generated by human action, and omission, with a particular focus on errors related to measurement and accuracy. The error thus relates to observed, and measured, phenomenon impinging on an independent reality. This approach resonates with, if it does not directly proceed from, an objectivist ontological commitment. To reiterate, the objectivist ontology views reality as a common-sense physical, or perceptual, entity. The objectivist views reality as being

composed of things (e.g. a book) and social facts (e.g. a company), both of which can be observed, described, and measured, and which possess an independent existence, that lies beyond the influence, and reach, of the researcher. In other words, we see what exists, and we can capture it to produce objective knowledge. The main features of objectivism were summarised as follows:

- Reality and truth exist objectively and can be discovered and adequately measured.
- Reality is ‘out there’, has an identity of its own, and exists apart from our awareness.
- Reality is single, solid and uniform: it generates the same meanings for all actors.
- Reality is ‘found’ by the researcher and brought to (social) awareness.
- The researcher should exercise objective detachment and value neutrality.

Therefore, the objectivist views error as being limited to issues such as contamination, cognitive bias, and faulty (or inaccurate) measurement (with regard to instruments and/or users). It is no coincidence that these three categories match the three categories of regulatory incursion taken by the Forensic Science Regulator.⁴⁴⁷ Whilst remaining blind to the socially constructed nature of forensic-scientific truth claims, it nonetheless aligns with a realist epistemology; an epistemology that is based upon broadly ‘Mertonian’ norms. (RQ6). Thus, the discussion closes, as it began, with reference to the ways in which the norms of scientific endeavour continue to shape the trajectory of forensic-scientific knowledge production, in its practical, and regulatory, dimensions.

⁴⁴⁷ XXXXX

Chapter Eight: Conclusions

The governance of forensic science provision, its organisational structure, and the management of individual forensic science laboratories, varies widely between different countries, regions and jurisdictions. However, the provision of forensic science services (including DNA profiling), in virtually all developed countries, is through a system of public-sector provision. England and Wales, alone, have transitioned to a fully marketised form of forensic science provision.

Analysis of the data elicited in the course of this research study provides support for the assertion that the disaggregation of the supply of forensic-scientific services, within England and Wales, has been welcomed by some stakeholders, due to its perceived potential to provide economic efficiencies. However, analysis of the data also revealed that it is a continuing source of tension between certain groups of Tier 2 forensic experts, criminal justice agents, and those who shape science and technology policy.

The dynamic state of the forensic market, alongside the current reliance on short-term contracts, have led to the perception of efficiency, and enhanced customer satisfaction, amongst some criminal justice agents. However, a section of respondents reported that these same processes had led to destabilisation, and insecurity, attendant on an inability to craft long-term strategies. Given the explicitly limited nature of the instant study it is not possible to draw any conclusions with regard to the veracity, or accuracy, of these perceptions. Nonetheless, the data does reveal concerns regarding perceived ‘de-skilling’ across the sector. Such concerns were widespread within Tier 2 companies, but not shared by all respondents, a number of whom reported that the restructuring of forensic-scientific expertise was appropriate, especially as the result of government-led initiatives intended to deliver ever-greater efficiencies.

The empirical data, and following conclusions, cannot provide unequivocal evidence for the assertion that the institutional arrangements which structure the provision of DNA-

profiling services, have transformed the ways in which DNA-profiling experts set about their tasks. However, they do aggregate around particular areas of concern, setting the groundwork for further studies aimed at addressing this issue. For example, it was felt by many DNA profilers and managerial staff that the pattern of development had been volatile, and had supposedly led to widespread ‘de-skilling’; a phenomenon which they saw as particularly affecting Tier 1 FSPs. Further, the same constituency reported reservations regarding the introduction of streamlined reporting, ‘triaging’, and productisation (whether it be through codification, or contractual provision). These processes, they felt, had further constrained - and even dispensed with - the ability of DNA profilers to carry out high-quality contextual evaluations. Respondents from the public sector provider, FSNI, reported a comparative degree of comfort, with regard to these developments, which they viewed as particularly affecting the forensic science market. Nonetheless, some respondents within Tier 1 providers, and allied agents within the criminal justice system, welcomed these same developments.

Whilst the above processes were viewed as having limited DNA profilers’ ability to undertake high quality contextual evaluations, a wide constituency of respondents took a positive view of the constraints imposed through the requirement for forensic DNA profilers submit to various forms of monitoring and regulation; a small number took the view that these quality assurance mechanisms actively prevent forensic experts from creatively adapting, in order to provide more holistic evaluations, or in response to the fresh challenges imposed by transfer and persistence issues. Commercial imperatives have also influenced perceptions of forensic service provision within those regions in which service provision is retained within retain public ownership, with public providers reporting a willingness to embrace new management techniques, to internalise regulatory objectives, and to compete with their privatised counterparts. However, the public sector DNA profiling provider, again, viewed themselves as being less susceptible to these influences, and thus able to deliver a larger proportion of high-quality expert evaluations.

Standardisation

The data has demonstrated that the creation of a rudimentary forensic science market, (subsequent to the introduction, by the Forensic Science Service, of direct charging to customers), was viewed as having facilitated the ‘commodification’ of forensic processes. Through making forensic investigatory processes visible to institutional agents within the criminal justice system, the latter reported that they were now able to dictate the course of the investigatory strategy, and to request the use of particular products, within the context of particular levels of evaluation. These efficiencies were viewed positively. The productisation of forensic processes was further viewed as having facilitated ‘triaging’, and the assignation of samples to different modes of investigation, largely determined by the offence type. However, whilst the customer-led model was viewed positively by members of HMIC, legal practitioners, and some Tier 1 DNA profilers, a proportion of Tier 2 providers reported tensions: given that each force sought to satisfy its particular needs, the current model was seen as breeding inefficiency, and of allowing inexpert investigators within the CJS a seemingly inordinate degree of control over matters which - the scientists claimed - should rightly fall within the ambit of expert forensic scientists.

Further, it was shown that perceptions relating to the standardisation of forensic processes are highly asymmetric. Standardisation and productisation structure forensic outputs, to be sure, but these phenomena are not seen as being matched by standardization of ‘customer’ demands. The study disclosed various examples in which a significant level of meso-structural variation between individual police forces was evident, each of them retaining a strong identity, and demanding individually tailored requirements. This was viewed as leading to inefficiencies in terms of time and quality, which were viewed as having impacted on cost. At time of writing, the forty-three individual forces (and associated consortia) have made no steps towards agreeing standard operating procedures with regard to their forensic requirements, and protocols (albeit that these remain flexible enough to accommodate the particular needs of each force).

Expertise

This study demonstrates that a significant proportion of DNA profilers perceive the existence of a strong link between the introduction of measures of economic rationalisation, and the reduction of thinking time - and contextual investigation - on the part of the scientist. These limitations are seen to have been aggravated by a tendency to triage cases, and by allegedly systematic attempts to avoid activity-level DNA analyses, and contextual evaluations, in respect of particular classes of offence, mainly within the 'volume crime' category.

The study exposes significant concerns amongst practitioners, relating to supposed 'de-skilling' within the forensic scientific field, and a concomitant loss of expert evaluation, with regard to the construction of DNA-profiling evidence. This perception was most prevalent amongst Tier 1 providers. The study also revealed that many forensic DNA profilers take the view that the economic rationalisation of forensic expertise has served to disrupt, and to reform, the attitudes, and expectations, of forensic science providers, who view themselves as having to reconstruct forensic identities in conformation with economic goals, aligned to the requirements of the investigatory authorities.

In comparison to marketised providers, FSNI employees reported a concomitant level of flexibility, adaptability, and an enhanced ability to carry out complex, and contextually detailed evaluations. This, they believed, was due to their governance structure, and the retention of skilled staff members, whose training and background exhibited a grounding in 'scientific method'.

Crucially, the data has demonstrated that forensic practitioners deem it necessary to provide contextual information to support the interpretation of DNA profiles, and subsequent evaluations. The data drawn from this study reveals significant tensions, and concerns, that marketisation in general, and productisation, in particular, have negatively impacted on the ability of forensic DNA profilers to carry out these contextually-aware evaluations. This is seen as having a direct effect on the administration of justice. Once

more, the publicly-funded provider reported that they retained the capacity to provide a significantly more robust service.

Quoting between experts within the forensic market was reported by Tier 2 practitioners as being endemic, and examples were produced in order to support this claim. It was further suggested that, as a result, many forensic DNA reports may contain hearsay, and should not credibly be admitted as expert evidence. Case fragmentation was, again, a widely reported phenomenon amongst Tier 2 practitioners, and once more attributed to marketised production; an allegedly direct result of the tendering process, and of the frequent transfer of forensic activities between providers. This was seen as actively preventing scientists from conducting a holistic evaluation of the evidence. Case fragmentation is not viewed as being linked to specialization, (since all Tier 1 providers may offer similar services.) - rather, it is viewed as a result of the tendering process within the forensic market. Other features were less widely reported, though nonetheless concerning. The reported use of a novel category of report – the ‘non-weighted *Dlugosz*’ was notable in this regard, as was the evidence of incomplete, ‘pseudo-Bayesian’ analyses. Again, these concerns were limited to the forensic market.

Ultimately, the study demonstrates that the perceived loss of the ability to contextually evaluate DNA profiles is viewed as having a significant negative impact on the ability of the CJS to arrive at sound determinations on questions of fact. It is also reported that this leaves the market poorly placed to adapt to new challenges, such as those posed by the sensitivity of DNA protocols, the increasing occurrence of mixed profiles, and the challenges encountered when dealing with issues of ‘transfer and persistence’.

Finally, it was found that the subsisting theory of expertise was unsuited to analyzing the co-production of forensic-scientific knowledge. This points to the necessity to develop subsisting theories of interdisciplinary expertise, as a means to achieve a more comprehensive understanding, and evaluation, of the co-production of forensic knowledge claims.

Efficiency

This study demonstrated that one of the principle causes of the perceived disruption of forensic expert networks is reportedly the introduction of novel forms of forensic reporting procedures, of which Streamlined Forensic Reporting is the most extreme example. Such innovations are welcomed by a number of CJS agents, who speak of the necessity of providing efficient analyses. However, the study also demonstrates that such modes of reporting are viewed by a significant proportion of Forensic Science practitioners as carrying the potential to limit the quality, and content, of expert scientific opinion, and may – it is claimed - ultimately affect the court’s ability to arrive at sound determinations on questions of fact.

The data does not support an assertion that streamlined reporting is viewed as a benign, and apolitical, mode of scientific communication, designed purely to facilitate conformity with the Criminal Procedure Rules (in particular, the requirement for legal practitioners to manage cases efficiently, and expeditiously). Conversely, it shows that, in many instances, these reports are viewed by forensic scientists as leading to the unnecessary dilation of the legal process, with an increase in attendant costs. This study is explicitly limited. Therefore, it is not possible for the instant study to demonstrate whether, and to what degree, the SFR system operates as intended. However, the claim that SFR supports ‘swift and sure justice’ in all instances may, if respondents claims are grounded in fact, be treated with a degree of skepticism.

These perceived problems cannot credibly be attributed to improper implementation. The data demonstrates that forensic scientists believe that similar savings – in both time, and cost - could have been made through the use of abbreviated – or staged – reports – reports completed by a forensic expert, rather than a police administrator.

In addition, the data demonstrates that many Tier 2 scientists cleave to the view that streamlined DNA reporting may pose significant dangers. The allegedly complete abjuration of forensic expertise, and the brevity of the report, are seen as affording no traction in terms of forensic analysis, or challenge. When used at pre-trial hearings, in

alignment with the Early Guilty Plea scheme, it is claimed that SFR could therefore potentially lead to miscarriages of justice (especially when dealing with vulnerable suspects).

Further, due to the inability of police administrators (and low-level trainees employed by Tier 1 providers) to interpret and evaluate mixed DNA profiles, rigid demarcations have been imposed, with many mixed profiles classed as 'indeterminate'. This – it is claimed – may mask a failure on the part of the investigative authorities to fulfill their duty to properly evaluate the evidence. Again, this is a failure by omission, which carries the potential to negatively impact on the criminal justice system, and could potentially lead to miscarriages of justice.

In conclusion, it may be stated that the SFR scheme is not seen as conforming to the aims of the Criminal Procedure Rules. Further, the evidence shows that SFR - in practice – may create tensions regarding the ability of legal practitioners to adequately comply with those rules.

Regulation and Autonomy

Analysis of the data demonstrates that the Forensic Science Regulator's role has evolved, since its inception. Original concerns revolved around the issues of cognitive bias, and the potential contamination of consumables. These reactive concerns have been overtaken by a perceived need to establish a 'baseline of quality' across the forensic market. The primary means of achieving this goal has been through the Accreditation process imposed by the Regulator's Code of Practice and Conduct. This process aligns with recent amendments to the Criminal Practice Directions, both of which serve to impose a new 'enhanced *Daubert*⁴⁴⁸' standard on the criminal justice system. A test through which to measure the validity, and reliability, of expert evidence. However, it may be argued that the new test fails to make a distinction between scientific forensic activities, and non-scientific forensic activities, of the sort contemplated in the *Kumho*⁴⁴⁹ judgement. Further, that the framework relies on an inaccurate reading of the underlying case law, particularly *Dlugosz*⁴⁵⁰, and *Reed*⁴⁵¹. This issue will be explored at length in the following section.

It has been demonstrated that this regulatory framework is seen as aligning most closely with the forms of high-volume, low expertise, forensic DNA reporting conducted by Tier 1 providers (such as SFR) whilst it is viewed as failing to regulate the evaluative, and interpretative, activities of expert DNA profilers which are - in reality - more consonant with the norms of scientific method (and which currently fall outwith the ambit of the accreditation process). Further, it has been demonstrated that the 'declaration of non-compliance' may serve to negatively impact upon the ability of forensic practitioners to exercise scientific creativity, and to conduct contextual evaluations, and basic research.

It was shown that the effects of the restructuring of scientific expertise (mainly afflicting Tier 1 providers) were not necessarily attributable to site-by-site micro-level variations in lab culture. Further, the study demonstrates that the introduction of standardization, and

⁴⁴⁸ *Daubert v Merrel Dow Pharmaceuticals* 509 U.S. 579 (1994)

⁴⁴⁹ *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999)

⁴⁵⁰ *R v Dlugosz* [2013] EWCA Crim 2

⁴⁵¹ *R v Reed, Reed & Garmson* [2009] EWCA Crim LR 2698

regulation, is perceived as having served to persevere established hierarchies within the forensic profession. Finally it was demonstrated that standard accounts of scientific objectivity have been partially displaced by a perceptions of the interposition of regulatory forms of objectivity within the forensic market.

A significant number of respondents from all disciplines claimed that the ISO 17025 standard was largely ineffectual in practical terms, and allegedly did little to advance the aims of forensic DNA profiling, which could benefit from enhanced strategic capacities at the macro and meso-levels. The data supports the assertion that the regulatory framework is viewed as influencing marketised DNA profiling in England and Wales. Further, that regulation is viewed by some providers as imposing disproportionate costs on commercial forensic scientists; the former, in terms of time; the latter, in terms of both time, and cost. Nonetheless, regulation was shown to aid the perpetuation of representations of normative science and rational adjudication.

Further, the attendant theoretical analysis further indicated that an awareness of the socially constructed nature of co-produced forensic knowledge claims could help to overcome the epistemological divergence exhibited by both fields. In conclusion, it is suggested that a greater appreciation of the similarities between both domains may potentially lead to a restructuring of the relationship between law and forensic science; a restructuring based upon greater autonomy and collaboration. Ultimately, it may even be suggested that forensic scientists might be afforded the same level of autonomy allowed of medical researchers; an autonomy that is viewed as the benchmark of problem-solving, progressive scientific endeavour.

Contribution of this study to the literature

This study illuminates the landscape of forensic science provision in England and Wales, since the closure of the FSS in 2010 and the introduction of complete privatisation, as an integral part of the process of marketisation.. The study examines the ways in which DNA profilers working within the marketised forensic sector perceive the key elements of marketisation. These informants provide a hitherto unstudied account of the introduction of standardised practices and commodification of forensic products and services; of the restructuring of forensic expertise and labour conditions; of the streamlining of forensic DNA profiling and the introduction of non-expert reporting; and of the regulation of these processes in an attempt to ensure quality and reliability across a febrile market.

As yet, no researcher has tackled these topics as they come to fruition within a mature forensic market. Nor has any researcher considered how these changes impact on the perceptions of those tasked with upholding the central plank of forensic scientific endeavour. Recent developments add urgency to this study. The collapse of one of the main forensic providers, and its subsequent resuscitation by the Metropolitan police, followed closely by the discovery of criminal practices amongst forensic analysts leading to the collapse of a number of trials. These demonstrate the structural problems which afflict the market and the inability of the regulator to effectively assure the quality of marketised forensic analysis. A sophisticated understanding of the perceptions of DNA profiling is therefore timely, and essential to understanding of what has happened post-2010. As such, this study makes a distinct contribute to the field, and will help to inform debates around the future of marketised provision forensic science in the UK. It will also add to the scholarly understanding of what has happened in the UK since 2010. No other scholarly work has hitherto addressed this.

Implications

Analysis of the data in the preceding chapters reveals concerns relating to the role, and ambit, of the Forensic Science Regulator. These concerns are shared by practitioners, and policy-makers.⁴⁵² The House of Lords Science and Technology Enquiry into Forensic Science⁴⁵³ has asked specific questions relating to the role of the Forensic Science Regulator, and the extent of the statutory powers proposed in the Forensic Science Bill. In light of the conclusions drawn from the discussion in Chapter seven, the failure to address validation problems relating to scientific methods may carry significant implications for the criminal justice system. These problems are not new. Indeed, the thesis closes with a discussion of the selfsame issues which led to the publication of the US NAS report, exactly ten years ago.

The decision to place the Office of the Forensic Science Regulator on a statutory basis has been welcomed by the Regulator, and by a number of forensic practitioners. However, the legal implications of the Forensic Science Bill⁴⁵⁴ – and the proposed ambit of the FSR - deserve closer scrutiny. A potential source of problems may be Section 2, subsections 1-2, which require the Regulator ‘to publish a code of practice about the carrying on of forensic science activities in England and Wales.’ (2)(a) states that the code must specify the ‘forensic science activities’ to which it applies. Meanwhile, sub-section (2)(b) allows that the Regulator ‘need not make provision about every ‘forensic science activity’. For the purposes of disambiguation, s.11 goes on to explain the meaning of ‘forensic science activity’. A ‘forensic science activity’ – according to s.11(1) – is ‘any activity relating to the application of scientific methods...’ This inclusion might prove problematic.

⁴⁵² See the latest committee report.

⁴⁵³ See also the enquiry into biometrics

⁴⁵⁴ See <https://services.parliament.uk/bills/2017-19/forensicscienceregulator.html>

Those academics and practitioners who have kept abreast of current developments in both the forensic science, and criminal justice, sectors may apprehend a potential flaw in the proposed legislation. In its current incarnation, this Bill would appear to be limited only to the regulation of forensic science providers carrying out certain forms of forensic DNA-profiling. The problem stems from the liberal application of the terms ‘science’, and ‘scientific method’. For, whilst DNA-profiling (at least in its routine forms) is, without doubt, a fully scientific forensic technique, many common forensic practices – particularly those involving the comparison of observable features – are not based upon discernible scientific methods. This latter category may include; fingerprint examination, bite-mark analysis, shoemark analysis, toolmark analysis, ballistic comparisons, unvalidated DNA mixture analysis, and hair analysis, to name but a few.

Similar problems relating to the scientific status of common forensic practices were addressed in a US report, in 2016. The PCAST (President’s Council of Advisors on Science and Technology) Report, on *‘Forensic Science in The Criminal Courts’* found that many common techniques were not underpinned by reliable empirical studies that could establish the ‘foundational validity’, or reliability, of the technique. In other words, these techniques are not ‘science’. Until recently, there was no comparable legal requirement in the UK for admissible expert evidence to be based upon scientific method. However, that changed with the introduction of the amended Criminal Practice Directions, and attempts, on the part of the Regulator – using the regulatory guidance, and codes of conduct and standards – to ground forensic quality assurance in scientific method. These developments have gone largely unnoticed (save for some incisive academic comment from Professor Ward), and deserve further scrutiny.

The starting point for an elaboration, and critique, of the FSR’s position, is the Law Commission Report, *Expert Evidence in Criminal Proceedings in England and Wales*, which, in 2011, recommended the introduction of a statutory ‘reliability’ test for determining the admissibility of expert evidence. The commission recommended that admissibility be assessed by way of an enhanced ‘*Daubert*’ test, of the sort encountered in the US (see below). In the various jurisdictions of the UK, the role of the expert

witness has traditionally been framed fairly broadly, in terms of the expert's ability to assist the court (and such experts could include scientists, individuals with specialist knowledge, and those possessing particular skills). However, the criteria for admissibility of expert opinion evidence, articulated in the American courts, differed greatly.

The US courts used to uniformly follow the *Frye* standard (*Frye v. United States*, 293 F 1013 (D.C. Cir. 1923), which holds that expert testimony based upon scientific techniques is only admissible when these techniques have become generally accepted within the relevant scientific community. However, following the judgment in *Daubert v Merrel Dow Pharmaceuticals* 509 U.S. 579 (1994), the Supreme Court amended Rule 702 (regarding the use of expert testimony) to introduce a new admissibility test. Within the preponderance of US states, all expert opinion evidence must now meet the *Daubert* standard, measured against five criteria. *Daubert* requires that, in judging the admissibility of expert evidence, the court must look to the underlying methods used, in order to assess:

- whether a method can or has been tested;
- the known or potential rate of error;
- whether the methods have been subjected to peer review;
- whether there are standards controlling the technique's operation; and,
- the general acceptance of the method within the relevant community.

Thus, the American judge now exercises a gate-keeping function, and must ensure that all expert testimony 'proceeds from scientific knowledge'. Indeed, the *Daubert* criteria may be viewed as a partial incorporation of Mertonian scientific norms. However, in practice, the introduction of the *Daubert* test caused a great many problems for certain types of forensic practitioner – particularly friction ridge examiners – whose methods were not consonant with scientific method. Therefore, in 1999, the test was extended to include methods based upon 'technical' knowledge [see *Kumho Tire Co. v. Carmichael*, 526 U.S. 137 (1999)].

Returning to the UK, the Law Commission's proposals for an enhanced *Daubert* admissibility test, as recommended in 2011, failed to make provision for the forms of

technological, or ‘non-scientific’ evidence, admitted in the US courts through *Kumho*. After consideration, the Law Commission’s recommendation was rejected by the Government, on economic grounds. Therefore the common law rules on admissibility of expert evidence subsist. However, rejection did not spell the end for the ‘enhanced *Daubert* test’.

However, in 2014, the Lord Chief Justice (Lord Thomas) issued a Practice Direction (effective from 7th October 2014), containing the selfsame enhanced admissibility test. Thus, a test ‘recognisably derived from *Daubert*’, was ‘introduced to the courts by [a] somewhat unusual mechanism.’ [See Ward, T. *An English Daubert? Law, Forensic Science and Epistemic Deference* The Journal of Philosophy, Science & Law: Daubert Special Issue, Volume 15, May 29, 2015, pages 26-36]. The Criminal Practice Directions were also amended. Direction 19A3 acknowledged that the Law Commission declined to introduce an enhanced *Daubert* test. It stated, however, that nothing prevents the courts from assessing admissibility at common law using *Daubert* Criteria. It went further, stating that 19A4 lists matters with which an experts report must deal in order for such an assessment to be carried out (see 19A4(h) below).

(h) [an expert report must] include such information as the court may need to decide whether the expert’s opinion is sufficiently reliable to be admissible as evidence;

Thus admissibility becomes inextricably linked to scientific reliability. This may appear unproblematic, at least on the face of it. However, the attempts to ground a procedurally innovative *Daubert* test in domestic legal precedent are arguably misconceived. For example, the underlying guidance quotes a short passage from *Dlugosz*⁴⁵⁵, stating that the court must ensure ‘that there is a sufficiently reliable scientific basis for the evidence to be admitted.’ However, it may be argued that this *obiter* statement has been taken out of context. The discussion in *Dlugosz* centred around the evaluation of DNA profiles, a

⁴⁵⁵ *R v Dlugosz* [2013] EWCA Crim 2

singularly ‘scientific’ evidence type. It is far from clear that the court intended this requirement to apply more widely, to all forms of forensic evidence.

Further, that inclusion from *Dlugosz* is itself founded upon the judgment in *Reed*⁴⁵⁶, paragraphs 111-2, which specifically refers to appropriate admissibility criteria, to be used when dealing with ‘scientific evidence of a scientific nature...’. It may be readily inferred, and rightly, that there are other forms of non-scientific evidence, and that these non-scientific evidence types may be judged by other criteria. This distinction has become lost along the way – forensic practitioners are now faced with the problem of negotiating a common-law, practice-based, set of admissibility criteria, which require that all evidence – scientific, technical, or otherwise – are based upon reliable scientific methods (as laid out in *Daubert*).

To return to Rule 19.4, this states that a report ‘must include such information as the court may need to decide whether the expert’s opinion is sufficiently reliable to be admissible as evidence;’ Therefore, in light of the directions above, it may be stated that forensic reports must contain substantive evidence of the conformity, of the methods used within the report, with scientific method vis-à-vis the enhanced *Daubert* criteria. It may be further inferred, that forensic reports must contain substantive evidence of the conformity of the evaluative report itself with scientific method vis-à-vis the enhanced *Daubert* criteria.

Alongside the above requirements, laid out in the Criminal Practice Rules (and associated Directions), the Forensic Science Regulator ‘suggests’, in her guidance that the courts determine the issue of whether expert evidence is ‘sufficiently reliable’ with reference to the presence, or otherwise, of accreditation (amongst other things). Further, that all methods – standard, or novel – be validated, and that all validations (whether in reports or as the basis of expert opinion) ‘consider’ 19A5 of the Criminal Practice Directions. As seen above, these Practice Directions are based on the ‘enhanced *Daubert*’ criteria. Therefore,

⁴⁵⁶ *R v Reed, Reed & Garmson* [2009] EWCA Crim LR 2698,

the validity, hence soundness, of expert methods are directly referable to ‘enhanced *Daubert*’ criteria. And those, as has been shown, are based upon scientific method.

The above demonstrates another instance of the tendency to view the palette of forensic techniques as being co-extensive with scientific method. However, in the absence of reliable empirical studies that can establish the ‘foundational validity’, or reliability, of the techniques involved, many of these techniques would be unable to surmount the regulatory hurdle.

Similar problems afflict the current Bill. The Forensic Science Regulator Act makes provision for the investigation of Forensic Science Providers, and the issuing of a Compliance Notice (see Section 6(2)). Since such notices may be the subject of an Appeal to the First Tier Tribunal – on the grounds that the decision was wrong in law (Section 8(2)(b)) – it is not unreasonable to predict a direct challenge to the definition of ‘forensic science activities’, and of the applicability of the term to a large number of forensic techniques. Should the Bill pass in its current form, that becomes a possibility.

Reference List

Books

Anheier, H.K. (2004) *Civil Society: Measurement, Evaluation, Policy* (London: Civicus)

Appadurai, A. (Ed.) (1986) *The Social Life of Things*, (Cambridge University Press: Cambridge)

Axinn, W. (2006) *Mixed Method Data Collection Strategies* (Cambridge: Cambridge University Press)

Bennet, W.L., & Feldman, M.S. (1981) *Reconstructing Reality in the Courtroom* (New Brunswick: Rutgers University Press);

Bloor, D (1976) *Knowledge and Social Imagery* (University of Chicago Press: Chicago)

Bourdieu, P. (1977) *Outline of a Theory of Practice* (Cambridge: Cambridge University Press)

Bourdieu, P. & Passeron, J-C. (1977) *Reproduction in Education, Society and Culture* (London: Sage)

Bourdieu, P. (1984) *Distinction: A Social Critique of the Judgement of Taste* (London: Routledge)

Bourdieu, P. (1984) *Homo Academicus*, (Paris, Éditions de Minuit)

Bourdieu, P. (1990) *The Logic of Practice* (Chicago: University of Chicago Press)

Bourdieu, P. & Wacquant, L. (1991) *An Invitation to Reflexive Sociology* (Chicago: University of Chicago Press)

- Bourdieu, P. (1998) *The State Nobility: Elite Schools in the Field of Power* (New York: Stanford University Press)
- Brown, J.R. (2001) *Who Rules in Science? An Opinionated Guide to the Wars* (Harvard: Harvard University Press)
- Burchell, G, Gordon, C. & Miller, P. (1991) *The Foucault Effect - Studies in Governmentality* (University of Chicago Press: Chicago)
- Cohen, L.J. (1977) *The Probable and the Provable* (Oxford: Oxford University Press)
- Cole, S.A. (2001) *Suspect Identities: A History of Fingerprinting and Criminal Identification* (Cambridge, MA: Harvard University Press).
- Collins, H. & Evans, R. 2007, *Rethinking Expertise* (University of Chicago Press: Chicago)
- Cotterrell, R. (1984) *The Sociology of Law: An Introduction* (London: Butterworths)
- Darlington, Y (2002) *Qualitative Research in Practice* (Australia: Allen & Unwin)
- Davidson, N., McCafferty, P. & Miller, D. *Neo-liberal Scotland: Class and Society in a Stateless Nation*, (Cambridge Scholars Publishing, Newcastle, 2010)
- Dwyer, D., *The Judicial Assessment of Expert Evidence*, (2008), Cambridge: Cambridge University Press
- Eggleston, R. (1978) *Evidence, Proof and Probability* (Weidenfeld and Nicolson)
- Faigman, D., (1999) *Legal Alchemy: The Use and Misuse of Science in the Law* California: W.H.Freeman
- Foucault, M. & Deleuze, G. (1977) 'Intellectuals and Power' in *Language, Counter-memory, Practice: Selected Essays & Interviews*, Bouchard, DF (Ed.).(Ithaca: Cornell University Press)
- Foucault, M. (1979) *Discipline and Punish: the birth of the prison*. (New York: Vintage)
- Foucault, M. (1980) *The History of Sexuality Vol. 1* (New York: Vintage)

- Foucault, M. (1994) *The Birth of the Clinic: An Archaeology of Medical Perception* Translated by Sheridan A. New York: Vintage Books
- Foucault, M. (2006b) *Psychiatric power: Lectures at the Collège de France 1973–1974*, ed. J. Lagrange, trans G. Burchell. New York: Vintage Books
- Fraser, J. & Lawless, C. Eds. (2009) *Handbook of Forensic Science* (Willan Publishing: Devon)
- Garland, D. *The Culture of Control* (OUP: Oxford, 2002)
- Gillham, B (2005) *Research Interviewing: The Range of Techniques* (Milton Keynes: Open University Press)
- Grenfell, M. & James, D. (1998) *Bourdieu and Education: Art of Practical Theory* (London: Psychology Press)
- Hacking, I. (1999) *The Social Construction of What?* (Cambridge, MA: Harvard University Press)
- Harding, S. (Ed.) (1987) *Feminism and Methodology* (Indiana: Indiana University Press)
- Harvey, D. *A Brief History of Neoliberalism* (OUP: Oxford, 2005)
- Hayek, F. (1988) *The Fatal Conceit: The errors of socialism*. (Chicago: University of Chicago Press)
- Hindmarsh, R. & Prainsack, B. (Eds.) *Genetic Suspects: Global Governance of Forensic DNA Profiling and Databasing* (Oxford: OUP, 2010)
- Jackson, B.S. (1988) *Law, Fact and Narrative Coherence* (Deborah Charles Publications: Liverpool)
- Jasanoff, S. (1995) *Science at the Bar: Law, Science & Technology in America* (Cambridge, MA: Harvard University Press)
- Jenkins, R. (1992) *Pierre Bourdieu* (London: Routledge)

- Kapardis, A. (2003) *Psychology and Law: A Critical Introduction* (Cambridge: Cambridge University Press)
- King, G. (1994) *Designing Social Inquiry : Scientific Inference in Qualitative Research* (New Jersey: Princeton University Press)
- Kruse, C. (2016) *The Social Life of Forensic Evidence* (University of California Press: Oakland, California)
- Kuhn, T. (1962) *The Structure of Scientific Revolutions* (Chicago: University of Chicago Press)
- Latour, B. & Woolgar, S. (1986) *Laboratory Life: The Construction of Scientific Facts* 2nd Ed. (Princeton: Princeton University Press)
- Latour, B (2002) *The Making of Law: An ethnography of the Conseil D.Etat* (Polity: Cambridge)
- Lawless, C (2016) *Forensic Science: A Sociological introduction* (Routledge: New York)
- Levy, H. (1996) *And The Blood Cried Out: a Prosecutors Spellbinding Account of the Power of DNA*, (New York: Basic Books)
- Lewis, C. & Buchan, A. (Eds.) (2012) *Clinical Negligence: A Practical Guide* (London: Bloomsbury Professional)
- Luhmann, N. (1985) *A Sociological Theory of Law* (1985)
- Luhmann, N. (1995) *Social Systems*, J. Bednarz Jr., D. Baecker, trans. (Stanford, California: Stanford University Press)
- Lynch, M., Cole, S.A., McNally, R. & Jordan, K. (2008) *Truth Machine: The Contentious history of DNA Fingerprinting* (Chicago: University of Chicago Press)
- Mack, N. (2005) *Qualitative Research Methods: A Data Collector's Field Guide* (North Carolina: FHI)

- Mackenzie, D.A. (1990) *Inventing Accuracy: A Historical Sociology of Nuclear Missile Guidance* (Cambridge, MA: MIT Press)
- Malatesti, L. and McMillan, J. Eds. (2010) *Responsibility and Psychopathy: interfacing law, psychiatry and philosophy*. (Oxford: OUP)
- Merton, R.K. (1973) [1942], 'The Normative Structure of Science', in Merton, Robert K., *The Sociology of Science: Theoretical and Empirical Investigations*, Chicago: University of Chicago Press
- Miles, M.B. & Huberman, A.M. (1994) *Qualitative Data Analysis: An expanded sourcebook* (Thousand Oaks: Sage)
- Mills, C. Wright (1959) *The Sociological Imagination* (Oxford: OUP)
- Mingers, J.(1995) *Self-Producing Systems: Implications and Applications of Autopoiesis* (London: Plenum)
- Patton, M. Q. (2002) *Qualitative Research and Evaluation Methods* (London: Sage)
- Peterson, K. Ed. (1997) *Intersections: Women on Law, Medicine and Technology* (Hants: Dartmouth Publishing Company Limited)
- Porter, T.M. (1995) *Trust in Numbers. The pursuit of Objectivity in Science and Public Life*, (Princeton, NJ: Princeton University Press)
- Ragin, C. (1987) *The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies* (Berkeley: University of California Press)
- Redmayne, M. *Expert Evidence and Criminal Justice* (2001), Oxford: Oxford University Press
- Rorty, R. (1979) *Philosophy and the Mirror of Nature* (New Jersey: Princeton University Press)
- Seidman, I. (2006) *Interviewing as Qualitative Research: A Guide for Researchers in Education and the Social Sciences* (New York: Teacher's College – Columbia University)

- Shapin, S. (1994) *The Social History of Truth* (Chicago: Chicago University Press)
- Shapin, S. & Schaffer, S. (1985) *Leviathan and the Air Pump* (Princeton, NJ: Princeton University Press)
- Shapiro, B. J. '*Beyond Reasonable Doubt*' and '*probable Cause*': *Historical Perspectives on the Anglo-American Law of Evidence*, (University of California Press, California, 1991)
- Smart, C. (1989) *Feminism and the Power of Law* (London: Routledge)
- Stake, R.E. (1995) *The Art of Case Study Research* (London: Sage)
- Stump, D. ed., (1996) *The Disunity of Science: Boundaries, Contexts, and Power* (Stanford: Stanford University Press)
- Strom, K. J. & Hickman, M. J. *Forensic Science and the Administration of Justice: Critical Issues and Directions* (Sage: Los Angeles, 2014)
- Teubner, G. ed. (1988) *Autopoietic Law: A New Approach to Law and Society* (Berlin, New York: Walter de Gruyter)
- Teubner, G., (1993) *Law as an Autopoietic System*, Oxford: Basil Blackwell
- Timmermans, S. (2006) *Postmortem: How medical examiners explain suspicious deaths*. (Chicago: University of Chicago Press)
- Twining, W. (2006), *Rethinking Evidence*, (Cambridge: Cambridge University Press)
- Valverde, M. (2003) *Law's Dream of a Common Knowledge* (New Jersey: Princeton University Press)
- Wagenaar, W.A., Van Koppen, P.J. & Crombag, H. F.M. (1993) *Anchored Narratives: The psychology of criminal evidence* (London: St. Martin's Press)
- Walliman, S. (2006) *Social Research Methods* (London: Sage)
- Weber, Max: *Essays in Sociology* (New York: Oxford University Press)
- Weber, Max ([1927]1961), *General Economic History*, trans. Frank H. Knight (New York: Collier Books).

Weber, Max (1958), *The Protestant Ethic and the Spirit of Capitalism*, trans. Talcott Parsons (New York: Charles Scribner's Sons).

Weber, Max (1968), *Economy and Society: An Outline of Interpretive Sociology*, Guenther Roth and Claus Wittich (eds.) (Berkeley: University of California Press).

Weiner, I.B. and Goldstein, A.M. (Eds.) (2003) *Handbook of Psychology, Vol. II, Forensic Psychology* (New Jersey: John Wiley & Sons)

White, J.B. (1973) *The Legal Imagination* (Boston).

Willig, C. (2008) *Introducing Qualitative Research in Psychology: Adventures in Theory and Method* London: OU Press

Wright, P. & Treacher, A. (1941) *The Problem of Medical Knowledge: Examining the Social Construction of Medicine* (Edinburgh: Edinburgh University Press)

Yin, R.K. (2003) *Applications of Case Study Research* (2nd Ed.) Thousand Oaks: Sage

Young, J. (2011) *The Criminological Imagination* (Cambridge: Polity Press)

Articles

Annas, G.J., *Privacy rules for DNA databanks: protecting coded future diaries*, J. Am. Med. Assoc. 270 (1993) 2346–2350.

Ashley, L. & Empson, L. *Differentiation and Discrimination: Understanding Social Class and Social Exclusion in Leading Law Firms* Human Relations 66(2) 2013, pp. 219-244

Ayala, F.J. & Black, B., *Science and the Courts*, Am. Scientific 81 (1993) 230–239.

Balding, D.J. *Errors and misunderstandings in the second NRC report*, Jurimetrics 37 (1997) 469–476.

Barnett, C. *The Consolations of 'Neoliberalism'* Geoforum 36 (2005) 7-12

Baxter, J. & Jack, S. *Qualitative Case Study Methodology: Study design and implementation for novice researchers* The Qualitative Report Vol.3 No.4 (2008) pp.544-559

Bjerregaard, T. *Institutional Change at the Forntlines: A Comparative Ethnography of Divergent Responses to Institutional Demands* (2011) Qualitative Research in Organization and Management Vol/6 No.1 26

Black, S & Daeid, NN 2015, 'Time to think differently: catalysing a paradigm shift in forensic science' *Philosophical Transactions of the Royal Society B - Biological Sciences*, vol 370, no. 1674.

Bloor, D. *Anti-Latour* (1999) *Studies in the History and Philosophy of Science* Vol. 30, No. 1, pp. 81–112

Boas, T.C. & Gans-Morse, J., *Neoliberalism: From New Liberal Philosophy to Anti-Liberal Slogan*, (2009) *Studies in Comparative International Development* 44 (2), 137-161

Bourdieu, P. *The Force of Law: Towards a Sociology of the Juridical Field* 38 *Hastings Law Journal* 814 1986-7 814-853

Bracken, P & Thomas, P. *From Szasz to Foucault: On the Role of Critical Psychiatry* *Philosophy, Psychiatry, & Psychology*, Vol. 17, No. 3, (2010) 219

Brenner, N., Peck, J. & Theodore, N. *After Neoliberalization* *Globalizations*, September 2010, Vol.7, No.3, pp. 327-345

Briody, M., *The effects of DNA evidence on sexual offence cases in court*, *Curr. Issues Crim. Justice* 14 (2002) 159–181.

Cambrosio, A., Keating, P., Schlich, T. & Weisz, G. *Regulatory Objectivity and the Generation and Management of Evidence in Medicine*. *Social Science and Medicine* 63 (2006), pp. 189-199

Carrier, N. *The Autonomy & Permeability of Law* 22 *Can. J.L. & Soc.* 123 2007

Castree, N. *From Neoliberalism to Neoliberalisation: Consolations, confusions and necessary illusions* Environment and Planning 2006, volume 38, pp.1-6

Chambers, G.K. *et al Forensic DNA profiling: the importance of giving accurate answers to the right questions*, Crim. Law Forum 8 (1997) 445–459.

Cohen, J.L., *Can Human Irrationality be Experimentally Demonstrated?*, (1981) 4 Behavioural and Brain Sciences, 317, 329-330

Cole, S.A., *Witnessing Identification: Latent Fingerprint Evidence and Expert Knowledge*, (1998) Social Studies of Science 28(5/6): 687-712

Cole, S.A. *The Myth of Fingerprints: A Forensic Science Stands Trial*, (2000) Lingua Franca (November): 54-62.

Cole, S.A. *Fingerprinting: The First Junk Science?*, (2003) Oklahoma City University Law Review 28(1): pp. 73-92

Cole, S.A., *Grandfathering Evidence: Fingerprint Admissibility Ruling from Jennings to Llera Plaza and Back Again* (2004), American Criminal Law Review 41(3)

Cole, S.A. *Twins, Twain, Galton & Gilman: Fingerprinting, individualization, brotherhood and race in Pudd'nhead Wilson*. Configurations (2007) 15, 227-265

Cole, S., *Forensics Without Uniqueness, Conclusions Without Individualization: the new epistemology of forensic identification*. (2009), Law, Probability and Risk 8, 233-255

Cole, S.A., *Forensic Culture as Epistemic Culture: The sociology of forensic science*, Studies in History and Philosophy of Biological and Biomedical Sciences (2013) 44 36-46

Collins, H.M. & Robert Evans (2002) 'The Third Wave of Science Studies: Studies of

Expertise and Experience', *Social Studies of Science* 32(2): 235–296

Cook, R., Evett, I.W., Jackson, G, Jones, P.J. & Lambert, J.A. *A Model for Case Assessment and Interpretation* *Science & Justice* (1998) 38 151-156

Cook, R., Jackson, G, Jones, P.J. & Lambert, J.A. *A Hierarchy of Propositions: Deciding which level to address in casework* *Science & Justice* (1998) 38 231 – 239

Corns, C., *DNA is watching*, *Arena* 92 (1990) 24–28.

Corns, C., *The science of justice and the justice in science*, *Law Context* 10 (1992) 7–28.

Christodoulidis, EA. *A Case for reflexive politics: challenging Luhmann's account of the Political system* *Economy and Society*, 20:4, 380-401

Curran, J.M. *et al. Genetic matches and the logic of the law*, *Genetica* 105 (1999) 211–213.

Daemmrich, A. *The Evidence Does Not Speak For Itself: Expert witnesses and the organization of DNA-typing companies*. *Social Studies of Science* (1998), 28, 741-772

Daston, L. *Objectivity and the Escape from Perspective* (1992), *Social Studies of Science*, 22, 597-618

Daston, L. *The Moral Economy of Science* (1995), *Osiris*, 10, pp.2-24

Derksen, L. *Towards a Sociology of Measurement: The meaning of Measurement Error in the case of DNA Profiling* *Social Studies of Science*, 2000 30: 803

Donnelly, P. & Friedman, R.D., *DNA Database Searches and the Legal Consumption of Scientific Evidence* 97 *Michigan Law Review* 931 1998-99

Enserink, M., *Opponents criticize Iceland's database*, *Science* 282 (1998) 859.

Evans, T. *International Human Rights Law as Power/Knowledge*. Human Rights Quarterly 27 (2005) 1046-1068

Evett, I.W. & Buckleton, J.S.. *Some aspects of the Bayesian approach to evidence interpretation*, J. Forensic Sci. Soc. 29 (1989) 317–324.

Evett, I.W & Weir, B.S., *Flawed reasoning in court*, Chance: New Directions Stat. Computing 4 (1991) 19–21.

Evett, I.W. *Expert Evidence and Forensic Misconceptions of the Nature of Exact Science*, (1996) 36 Science and Justice 118

Evett, I.W., Jackson, G. & Lambert, J.A., *More on the Hierarchy of Propositions: exploring the distinction between explanations and propositions*, Science & Justice (2000); 40 (1): 3-10

Frank, L., *Estonia prepares for national DNA database*, Science 290 (2000) 31.

Finkelstein, M.O. & Fairley, W. *A Bayesian Approach to Identification Evidence* 83 Harvard Law Review 489 (1970)

Flyvberg, B. *Five Misunderstandings About Case Study Research* Qualitative Inquiry Vol.12 No.2 (2006) 219-245

Freckelton, & Selby, H. , *The use and abuse of experts*, Law Inst. J. 63 (1989) 30–35.

Freckelton, I., *DNA profiling: forensic science under the microscope*, Crim. Law J. 14 (1990) 23–41.

Freymond, N. & Platel, C. *The Uses of Pierre Bourdieu's Sociology in Political Analysis of Law and Institutions* Paper presented at the 3rd ECPR Conference. Budapest, September 8-

10, 2005. Section 24: New Developments in Political Sociology. Panel 8: The Political Sociology of Pierre Bourdieu I

Foucault, M. (2006b) *Psychiatric power: Lectures at the Collège de France 1973–1974*, ed. J. Lagrange, trans G. Burchell. New York: Palgrave Macmillan.

Fowler, B. *The Recognition/Redistribution Debater and Bourdieu's Theory of Practice: Problems of Interpretation* Theory Culture Society 2009 26: 144

Golding, S.L. *Mental Health Professionals and the Courts: The Ethics of Expertise* International journal of Law and Psychiatry Vol.13, 1990, pp.281-307

Giannelli, P.C., *The abuse of scientific evidence in criminal cases: the need for independent crime laboratories*, V. J. Soc. Policy Law 4 (1997) 439.

Gibbon, P & Henrikson, L.F. *A Standard Fit for Neoliberalism* Comparative Studies in Society and History 2012; 54(2), pp. 275-307

Glanville-Williams, *The Mathematics of Proof I* (1979) Criminal Law Review, 297

Gnjidic, Z. & Fatovic-Ferencic, S. *Medical Expertise as a Historical Phenomenon and Academic Discipline* Acta Clin Vol.49 No.1 2010

Haack, S. *Irreconcilable Differences? The Troubled Marriage of Science and Law* (2009) 72 Law and Contemporary Problems 1.

Halfon, S. (1998) *Collecting, Testing and Convincing: Forensic DNA Experts in the Courts* Social Studies of Science 1998 28; 801

Halliday, S. and Burns, N. and Hutton, N. and McNeill, F. and Tata, C. *Shadow writing and participant observation: a study of criminal justice social work around sentencing*. (2008) Journal of Law and Society, 35 (2). pp. 189-213.

Hansen, M., *The great detective*, ABA J. 4 (2001) 37.

Heames, J.Thomas & Heames, J.Timothy *Forensic Science Staffing: Creating a Working Formula* Forensic Science Policy and Management, 2: 5–10, 2010

Heinemann, T. , Lemke, T. & Prainsack, B. (2012) *Editorial: Risky profiles: societal dimensions of forensic uses of DNA profiling technologies*. New Genetics and Society Vol. 31, No. 3, September 2012, 249–258 at 255

Hocking, B.A. *et al DNA, human rights and the criminal justice system*, Aust. J. Hum. Rights 3 (1997) 208–237.

Houck, M.M. 2009. *Is forensic science a gateway for women in science?* Forensic Science Policy & Management 1(1):65–69.

Houck, M.M., Riley, R.A. Speaker, P.J. and Witt, T.S. 2009. *FORESIGHT: A business approach to improving forensic science services*. Forensic Science Policy and Management 1(2):85–95.

Houck, M.M., P.J. Speaker, A.S. Fleming, and R. Riley. *The Balanced Scorecard: Sustainable performance assessment for forensic laboratories*. Science and Justice 52 (2012) 209–216

Jasanoff, S. *Procedural Choices in Regulatory Science* Technology in Society. Vol. 17 No.3 (1995) pp.279 -293

Jasanoff, S. (2003) *'Breaking the Waves in Science Studies: Comment on H.M. Collins and Robert Evans, 'The Third Wave of Science'*: Social Studies of Science 33/3(June 2003) pp. 389–400

Jordan, K. & Lynch, M. *The Dissemination, Standardisation and Routinisation of a Molecular Biological Technique* Social Studies of Science (1998) 28: 773

Kahn, J. *Race, Genes and Justice: A call to reform the presentation of forensic DNA evidence in criminal trials*. Brooklyn Law Review (2008) 74, 325-375

Kellie, D.L., *Justice in the age of technology: DNA and the criminal trial*, Altern. Law J.

26 (2001) 173–176.

Keywood, K. *Rethinking the anorexic body: How English law and psychiatry 'think'*. *International Journal of Law and Psychiatry* 26 (2003) 599 – 616

King, M. and F. Kaganas, *The Risks and Dangers of Experts in Court* (1998) *Current Legal Issues* 221–42;

King, M. *An Autopoietic Approach to the Problems Presented by Parental Alienation Syndrome* (2002) *Journal of Forensic Psychiatry* 609–35.

King, M. *The 'Truth' About Autopoiesis* *Journal of Law & Society* 218 1993

King, M. *The Construction and Demolition of the Luhmann Heresy* *Law and Critique* 12: 1–32, 2001.

Kobus, H., Houck, M.H., P. Speaker, P.J., Riley, R. & Witt, T. 2011. *Managing Performance in the Forensic Sciences: Expectations in light of limited budgets*. *Forensic Science Policy & Management* 2(1): 36–43.

Kruse, C. (2012) *Legal storytelling in pre-trial investigations: arguing for a wider perspective on forensic evidence*. *New Genetics and Society*, 31:3, 299-309

Kruse, C. (2013) *The Bayesian approach to forensic evidence: Evaluating, communicating and distributing responsibility*. *Social Studies of Science* 2013 43: 887

Lander, E.S. & Budowle, B. *DNA Fingerprinting Dispute Laid to Rest*, (1994) *Nature* 371, pp. 735 - 738 (27 October 1994)

Lawless, C.J. & Williams, R. *Helping With Inquiries or Helping With Profits? The trials and tribulations of a technology of forensic reasoning*. *Social Studies of Science* (2010), 40, 731-755

Lawless, C. (2010). *A Curious Reconstruction? The Shaping of 'Marketized' Forensic Science*. CARR Discussion Paper 63⁴⁵⁷

⁴⁵⁷ <http://eprints.lse.ac.uk/36544/1/Disspaper63.pdf>

- Lawless, C. *Policing Markets; the Contested Shaping of Neo-Liberal Forensic Science*. British Journal of Criminology (2011) 51, 671-689
- Leslie, M. *Quality Assured Science: Managerialism in Forensic Biology Science Technology Human Values* (2010) 35 , 283
- Lee, S. & Woodward, R. (2002) *Delivering Public Services—Mechanisms and Consequences: Implementing the Third Way: The Delivery of Public Services under the Blair Government*, Public Money & Management, 22:4, 49-56
- Leslie, M. *Quality Assured Science: Managerialism in Forensic Biology Science Technology Human Values* (2010) 35 , 283
- Lessard, C., Contandriopoulos, A-P. & Beaulieu, M-D. *The role (or not) of Economic evaluation at the micro-level: Can Bourdieu's theory provide a way forward for clinical decision-making?* Social Science and Medicine 70 (2010) 1948-1956
- Liebman, J.S., Fagan, J., West, V. & Lloyd, J., *Capital attrition: error rates in capital cases, 1973-1995*, Tex. Law Rev. 78 (2000) 1839–1865.
- Lindsey,S., Hertwig,R., & Gigerenzer,G. (2003). *Communicating Statistical DNA Evidence*. Jurimetrics. 43,147-163
- Lucas, D.M., *The ethical responsibilities of the forensic scientist: exploring the limits*, J. Forensic Sci. 34 (1989) 719–729.
- Lynch, M. & Cole, S.A. *Science and Technology Studies on Trial: Dilemmas of expertise* Social Studies of Science (2005) Vol.35, No.2 pp.269-311
- Lynch, M. *Science, Truth, and Forensic Cultures: the exceptional legal status of DNA evidence*, Studies in History and Philosophy of Biological and Biomedical Sciences (2013) 44 60-70
- Luhmann, N. *Operational Closure and Structural Coupling* (1992) Cardozo Law Review

13/5 (1992), 1434.

Luisi, LP. *Autopoiesis: a review and a reappraisal* *Naturwissenschaften* (2003) 90:49–59

Lynch, M. *The Discursive Production of Uncertainty: The OJ Simpson 'dream team' and the sociology of knowledge machine.*(1998) *Social Studies of Science*, 28, 829-868

Lynch, M. & Cole, S. *Science and Technology Studies on Trial: Dilemmas of expertise,* (2005) *Social Studies of Science*, Vol.35 No.2, pp. 269-311

M'Charek, A. *Technologies of population: Forensic DNA Testing practices and the making of differences and similarities* *Configurations* (2006), 8, 121-158

M'Charek, A. *Silent witness, articulate collective: DNA evidence and the inference of visible traits.* *Bioethics* (2008), 22, 519-528

M'Charek, A., Hagendijk, R. & de Vries, W. *Equal before the law: On the Machinery of Sameness in Forensic DNA Practice* *Science, Technology, Human Values* 2013, 38: 542

McAndrew, W.P. *How Public are Local Public Goods? Empirical Evidence Using Data from the Forensic Science Industry* *Forensic Science Policy & Management: An International Journal*

McAndrew, W. P. (2012) *Are Forensic Science Services Club Goods? An Analysis of the Optimal Forensic Science Service Delivery Model* *Forensic Science Policy & Management: An International Journal*, 3:4, 151-158

McAndrew, W. P. (2012): *Is Privatization Inevitable for Forensic Science Laboratories?*, *Forensic Science Policy & Management*: 3:1, 42-52

McCarthy, J. & Prudham, S. *Neoliberal Nature and the Nature of Neoliberalism* *Geoforum* 35 (2004) pp. 275 - 283

Madsen, M.R., *Legal 'Field' or Legal 'Network'? A Bourdieusian Critique of Manuel Castells' Network Society* *Retfaerd*, 25(4), 2004 4–18

Madsen, M.R., *Pierre Boudieu: from law to legal field* Retfaerd Argang 29 2006 Number 3/114 1-6

Madsen, M.R. *Transnational Fields: Elements of a Reflexive Sociology of the Internationalisation of Law* Retfaerd Argang 29 2006 Number 3/114 23-41

Madsen, M. R. (2013), 'Unpacking Legal Network Power: The Structural Construction of Transnational Legal Expert Networks', In Fenwick, Mar, Van Uytsel, Steven & Wrba, Stefan (eds.) *Networked Governance, Transnational Business and the Law*. Springer, Berlin

Maguire, C., Max M. Houck, Robin Williams and Paul J. Speaker *Efficiency and the Cost-Effective Delivery of Forensic Science Services: Insourcing, Outsourcing, and Privatization* Forensic Science Policy & Management, 3: 62–69, 2012

Mahendra, B., *Science in the miscarriage of justice*, New Law J. 151 (2001) 1686–1687.

Martire, J. *Habermas Contra Foucault: Law, Power and the Forgotten Subject* Law and Critique (2012) 23:123–139

MacCormack, C. *Ethnological Studies of Medical Sciences* Social Science and Medicine Vol. 39, No.9 1994 pp. 1229-1255

McEwen, J.E., *Forensic DNA databanking by State crime laboratories*, Am. J. Hum. Genet. 56 (1995) 1487–1492.

Meagher, D. *The quiet revolution—a brief history and analysis of the growth of forensic police powers in Victoria*, Crim. Law J. 24 (2000) 76–88.

Mirowski, P. & van Horn, R. *The Contract Research Organisation and the Commercialisation of Scientific Research* Social Studies of Science, Vol.35, No. 4 (2005) pp.503-548

Mnookin, J.L. *Fingerprint Evidence in an Age of DNA Profiling* (2001) Brooklyn Law Review, 67, 13-70

Mnookin, J.L., Cole, S.A., Dror, I.E., Fisher, B., Houck, M.M., Inman, K., Kaye, D.H., Langenburg, G., Risinger, D.M., Rudin, N. & Siegel, J. (2011) *The Need for a Research Culture in the Forensic Sciences* 58 UCLA Law Review pp. 725-779

Moreira, T., May, C. & Bond, J. *Regulatory Objectivity in Action: Mild cognitive impairment and the collective production of uncertainty*. Social Studies of Science (2009) 35/9 pp. 665 - 690

Mossman, M.J. *Feminism and Legal Method: The Difference It Makes* 3 Wisconsin Women's Law Journal 147 (1987)

Mullen, PE. *The psychiatric expert witness in the criminal justice system*. Criminal Behaviour and Mental Health 20: 165–176 (2010)

Myles, L. *Quality Assured Science: Managerialism in Forensic Biology Science, Technology and Human Values* (2010) 35: 283

Newman, J., Dawley, D. & Speaker, P.J. *Strategic Management of Forensic Laboratory Resources: From Project FORESIGHT Metrics to the Development of Action Plans* Forensic Science Policy and Management, 2: 164–174, 2011

Nicolson, D., *Truth, Reason and Justice: Epistemology and Politics in Evidence Discourse* 57 (1994) Modern Law Review 726

Nicolson, D., *Taking Epistemology Seriously* (2013) 17 International Journal of Evidence & Proof 1

O'Brien, É, Daeid, NN & Black, S 2015, 'Science in the court: pitfalls, challenges and solutions' *Philosophical Transactions of the Royal Society B - Biological Sciences*, vol 370, no. 1674.

Parlett, M. & Hamilton, D. (1976) *Evaluation as Illumination: A new approach to the study of innovative programs*. in G. Glass (Ed.) *Evaluation Studies Review Annual* 1, pp. 140-157

- Paterson, J & Teubner, G. *Changing Maps: Empirical Legal Autopoiesis* Social & Legal Studies 1998 Vol. 7(4), 451-486
- Patterson, D. *Postmodernism - Feminism - Law* 77 Cornell L. Rev. 254 1991-1992
- Peck, J. *Geography and Public Policy: constructions of neoliberalism* Progress in Human Geography (2004) 28 pp. 392 - 405
- Peterson, J.L. *et al*, *The feasibility of external blind proficiency testing. I. Background and findings*, J. Forensic Sci. 48 (2003) 21–31.
- Piekkare, R., Plakoyiannaki, E. & Welch, C. *'Good' case research in industrial marketing: Insights from research practice*. Industrial Marketing Management 39 (2010) 109 – 117 at 111
- Poole, L. & Mooney, G. (2006) *Privatizing education in Scotland? New Labour, Modernization and 'Public' Services*, Critical Social Policy Vol. 26(3): 562–586
- Porter, T. M. (1992) *Quantification and the Accounting Ideal in Science*, Social Studies of Science 1992 22; 833
- Porter, T.M. *Objectivity as Standardization: The rhetoric of impersonality in measurement, statistics, and cost-benefit analysis*. (1992), Annals of Scholarship, 9, 19-59
- Prainsack, B & Toom, V. *The Prum Regime: Situated Dis/Empowerment in Transnational DNA Profile Exchange*, British Journal of Criminology (2010) 50, 1117 - 1135
- Rappert, B. (2001) *The Distribution and Resolution of the Ambiguities of Technology*, Social Studies of Science, 2001 31; 557
- Rawolle, S. & Lingard, B. *The Sociology of Pierre Bourdieu and Researching Education Policy* Journal of Education Policy, 23: 6, 2008, 729-741
- Redmayne, M. *Expert evidence and scientific disagreement*, Univ. California Davis Law Rev. 30 (1997) 1027–1080.

Redmayne, M., *The DNA database: civil liberty and evidentiary issues*, *Crim. Law Rev.* (1998) 437–454.

Reilly, P.R., *Efforts to regulate the collection and use of genetic information*, *Arch. Pathol. Lab. Med.* 123 (1999) 1066–1070.

Roberts, P., *What price a free market in forensic science services?* *Br. J. Criminol.* 36 (1996) 37–60.

Rose, N. *Government, Authority and Expertise in Advanced Liberalism* (1993) *Economy and Society*, 22:3, pp. 283-299

Rose, N., O'Malley, P. & Valverde, M. *Governmentality* (2006), *Annual Review of Law and Social Science*, Vol. 2, pp. 83-104

Ross, A. *Controversy corner: the quest for truth*, *Aust. J. Forensic Sci.* 30 (1998) 41–44.

Rothe, DL & Overton, A. *The International Criminal Court and the External Non-Witness Expert(s), Problematic Concerns: An Exploratory Endeavour*. *International Criminal Law Review* 10 (2010) 345-364

Ruiz, J. *Sociological Discourse Analysis: Methods and Logic* *Forum Qualitative Social Research*, 10(2), 2009

Saks, M.J., *Prevalence and impact of ethical problems in forensic science*, *J. Forensic Sci.* 34 (1989) 772–793.

Saks, M.J. *et al.* *Towards a model Act for the prevention and remedy of erroneous convictions*, *N Engl. Law Rev.* 35 (2001) 669–683.

Saks, M.J. & Koehler, J.J. (2005) *The Coming Paradigm Shift in Forensic Identification*

Science, *Science*, 309, 892-895

Salomon, Jean-Jacques (1977): 'Science Policy Studies and the Development of Science Policy', in Spiegel-Rösing, Ina and Derek de Solla Price (eds.): *Science, Technology and Society*, 43-71. (28)

Saul, B., *Genetic policing: Forensic DNA testing in New South Wales*, *Curr. Issues Crim. Justice* 13 (2001) 74–109.

Scutt, J., *Beware of new technologies*, *Legal Serv. Bull.* 15 (1990) 9–12.

Shapiro, B.J. *To a Moral Certainty: Theories of Knowledge and Anglo-American Juries 1600-1850* *Hastings Law Journal* 1986, 38, 153-193

Speaker, P.J. 2009a. Key performance indicators and managerial analysis for forensic laboratories. *Forensic Science Policy & Management* 1(1): 32–42.

Speaker, P.J. 2009b. The decomposition of return on investment for forensic laboratories. *Forensic Science Policy & Management* 1(2): 96–102.

Speaker, P.J. & Fleming, A.S. 2009c. *Monitoring financial performance: An approach for forensic crime labs*. *The CPA Journal* 79(8): 60–65.

Speaker, P.J., *The Decomposition of Return on Investment for Forensic Laboratories* *Forensic Science Policy and Management*, 1: 96–102, 2009

Speaker, P.J. and A. Scott Fleming *Benchmarking and Budgeting Techniques for Improved Forensic Laboratory Management* *Forensic Science Policy and Management*, 1: 199–208, 2010

Speaker, P.J. 2009. *Key performance indicators and managerial analysis for forensic laboratories*. *Forensic Sci. Policy Manage.* 1(1): 32–42.

Starrs, J.E. *Mountebanks among forensic scientists*, in: R. Saferstein (Ed.), *Forensic*

Science Handbook, vol. II, Prentice Hall, Englewood Cliffs, NJ, 1988, pp. 1–37.

Starrs, J.E., *Of scientists who stray*, Scientific Sleuthing Rev. 25 (2001) 1–4.

Stebbins, R. *Fitting in: the researcher as learner and participant* (1987) 21 Quality and Quantity 103

Stephens, N., Atkinson, P., & Glasner, P. *Documenting the Doable and Doing the Documented: Bridging Strategies at the UK Stem Cell Bank* Social Studies of Science, (2011) 41, 791

Taroni, F. & Aitken, C.G.G. *Forensic science at trial*, Jurimetrics 37 (1997) 327–337.

Taroni, F. & Aitken, C. *Probabilistic Reasoning in the law. Part 1: Assessment of Probabilities and Explanation of the Value of DNA Evidence* (1998) Science & Justice. 38, 3, p. 165-77

Tata, C. *A sense of justice: the role of pre-sentence reports in the production (and disruption) of guilt and guilty pleas* (2010) Punishment and Society. 12, 3, pp. 239-261

Tata, C & Field, S. *Connecting legal and social justice in the neo-liberal world?: the construction interpretation and use of pre-sentence reports* (2010) Punishment and Society. 12, 3, pp. 235–238

Teubner, G. *How the Law Thinks: Toward a Constructivist Epistemology of Law as an Autopoietic System* (1990) 23:5 Law & Society

Thomas, LCJ. 2015 *The legal framework for more robust forensic science evidence*. Philosophical Transactions of the Royal Society B 370: 20140258 at page 1.

Thompson, W.C., *A sociological perspective on the science of forensic DNA testing*, Univ. California Davis Law Rev. 30 (1997) 1113–1136.

- Tillers, P. *Trial by Mathematics – Reconsidered* Law, Probability & Risk (2011) 10, 167-173
- Tribe, L. *Trial by Mathematics: Precision and Ritual in the Legal Process* 84 Harvard Law Review 1329 (1971)
- Twining, W., *Debating Probabilities* The Liverpool Law Review, (1980), Vol.2(1), pp.51-64
- Vilaca, GV. *Interdisciplinarity and tax law: The case of legal autopoiesis*. Critical Perspectives on Accounting 23 (2012) 483 – 492
- Villegas, M.G., *On Pierre Bourdieu's Legal Thought* Droit et Societe 56-57, 2004 57-71
- Wacquant, L., *Reading Bourdieu's 'Capital'* International Journal of Contemporary Sociology Vol. 33 No. 2 1996 151-170
- Wacquant, L. *Towards a Reflexive Sociology: A Workshop with Pierre Bourdieu* Sociological Theory, vol. 7 (1989), pp. 26–63
- Walsh, S.J., *Current legal issues of DNA typing: "strange new world—revisited"*, Can. Soc. Forensic Sci. J. 25 (1992) 207– 214.
- Walsh, S.J., *Recent advances in forensic genetics*, Expert Rev. Mol. Diagn. 4 (2004) 31–40.
- Walsh, F.J. *et al* DNA profiling and criminal justice—a contribution to a changing debate, Aust. J. Forensic Sci. 36 (2004) 36–45.
- Webb, E. & Tranter, K. , *Genes R Us—ethics and truth in DNA*, Altern. Law J. 25 (2001) 168–172.
- Weber, M (1919) *Science as a Vocation* from *Gesammelte Aufsätze zur Wissenschaftslehre* (Tubingen,. 1922)

Weir, B.S., *Population genetics in the forensic DNA debate*, Proc. Natl. Acad. Sci. USA 89 (1992) 11654–11659.

Weir, L. *The Concept of Truth Regime* Canadian Journal of Sociology 33(2) 2008 367

Wynne, B. (1989) '*Forensic Pathology, Scientific Expertise, and the Criminal Law*' pp.56-92 in Smith, R. and Wynne, B. (eds.) (1989) *Expert Evidence: Interpreting Science in the Law* (Routledge: London)

Wynne, B. (1989). *Sheepfarming after Chernobyl: A case study in communicating scientific information*. *Environment: Science and Policy for Sustainable Development*, 31(2), 10-39.

Williams, R. (2007a) *Policing and Forensic Science*, in Newburn, T. (ed), *Handbook of Policing*, Cullompton: Willan, pp. 760-793.

Woodside, A.G. & Wilson, E.J. *Case Study Research Methods for Theory Building* Journal of Business and Industrial Marketing 18 6/7 (2003) pp. 493-508

Internet Resources⁴⁵⁸

Royal Statistical Society's Working Group on Statistics and the Law Practitioners Guides:

http://www.rss.org.uk/RSS/Influencing_Change/Statistics_and_the_law/Practitioner_guides/RSS/Influencing_Change/Current_projects_sub/Statistics_and_the_law_sub/Practitioner_guides.aspx?hkey=2cfd562-361e-432e-851b-ef6ff5254145

⁴⁵⁸ All internet resources were last visited on 15th April 2018.

Aitken, C., Roberts, P. & Jackson, G. (2010) *Practitioner Guide 1 - Fundamentals of Probability and Statistical Evidence in Criminal Proceedings*, Royal Statistical Society's Working Group on Statistics and the Law

Puch-Solis, R., Roberts, P., Pope, S. & Aitken, C. (2012) *Practitioner Guide 2 - Assessing the Probative Value of DNA Evidence*, Royal Statistical Society's Working Group on Statistics and the Law

Roberts, P. & Aitken, C. (2014) *Practitioner Guide 3 - The Logic of Forensic Proof: Inferential Reasoning in Criminal Evidence and Forensic Science*, Royal Statistical Society's Working Group on Statistics and the Law

Jackson, G., Aitken, C. & Roberts, P. (2015) *Practitioner Guide 4 - Case Assessment and Interpretation of Expert Evidence*, Royal Statistical Society's Working Group on Statistics and the Law

DNA Backlogs as a 'false metric':

<http://nij.ncjrs.gov/multimedia/video-nijconf2010-gialamas.htm>.

<http://crimeandsciencerradio.com/tag/backlogs/>

<http://www.nij.gov/journals/266/Pages/backlogs.aspx>

University of West Virginia FORESIGHT project:

<http://www.be.wvu.edu/forensic/foresight.htm>

Frontiers in Genetics:

<http://www.frontiersin.org/genetics>

United Kingdom Accreditation Service :

Accreditation: A Tool to Support the Criminal Justice System

[http://www.ukas.com/library/Media-Centre/Promotional-](http://www.ukas.com/library/Media-Centre/Promotional-Materials/Brochures/Forensic%20Jan%2009%20Higher%20Res.pdf)

[Materials/Brochures/Forensic%20Jan%2009%20Higher%20Res.pdf](http://www.ukas.com/library/Media-Centre/Promotional-Materials/Brochures/Forensic%20Jan%2009%20Higher%20Res.pdf)

Kubanek, J. & Miller, F., *DNA Evidence and a National DNA Databank: Not in Our Name*. Report of the Vancouver Rape and Relief Womens Shelter, Vancouver. Available from: <http://www.rapereliefshelter.bc.ca/learn/resources/dna-evidence-and-national-dna-databank-not-our-name> (last accessed 28th March 2018).

Reports

Using DNA to Solve Cold Cases. Report of the National Institute of Justice, US Department of Justice, Washington, DC, 2002.

The Forensic Science Regulator, *Response to Professor Brian Caddy's Review of the Science of Low Template DNA Analysis*, 7th May 2008

A Review of the Science of Low Template DNA Analysis: Executive Summary

Gill, P, Guinness, J. & Iveson, S. *The Interpretation of DNA Evidence*, Home Office Review commissioned by the Forensic Science Regulator, July 2012

House of Commons Science and Technology Committee: Forensic science Second Report of Session 2013–14 Volume I

Briefing Paper for the House of Commons Science and Technology Committee; The Home Office's Oversight of Forensic Services, National Audit Office, December 2014

Lambert, J.A., *Second National Research Council Report on the Evaluation of Forensic DNA Evidence*, Report of the UK Forensic Science Service, London, 1997.

House of Commons Science and Technology Committee: Forensic science
Second Report of Session 2013–14 Volume I

Appendix I : Interview Schedule and Questions

<p>Background of Interviewee</p> <p>Primary question: <i>Can you begin by telling me about your professional background?</i>⁴⁵⁹ [Introduction]</p>
<p>Pre-Privatisation DNA Profiling Within the FSS</p> <p>Primary Question: <i>Can you tell me about the nature of your work with the Forensic Science Service?</i> [RQ1 / RQ4]</p>
<p>Governance structure of employing institution</p> <p>Primary question: <i>Do your work processes differ from those you experienced within the Forensic Science Service?</i> [RQ1 / RQ4 / RQ5]</p>
<p>Marketisation Within the Forensic Science Sector</p> <p>Primary question: <i>Can you tell me about your experiences of commercialisation within the forensic field, if any?</i>[RQ1 / RQ4 / RQ5]</p>
<p>The Nature of Forensic Expertise</p> <p>Primary question: <i>How would you define your professional role?</i> [RQ3 / RQ5]</p>
<p>Standardisation and Efficiency</p> <p>Primary question: <i>Have you experience of standardisation processes within your field, or of processes designed to promote greater efficiency?</i> [RQ2 / RQ3 / RQ4]</p>

⁴⁵⁹ All of the questions listed were intended to elucidate and answer the primary research question. However, the questions were also framed to open discussion on, and address, the secondary research questions. Links to these secondary questions are provided by after each question.

<p>‘Triage’ of DNA Samples</p> <p>Primary question: <i>Have you experience of processes designed to ‘triage’, or stream, forensic evaluation and reporting?</i> [RQ1 / RQ2 / RQ3 / RQ4]</p>
<p>Streamlined Forensic Reporting</p> <p>Primary question: <i>Have you encountered Streamlined Forensic Reporting?</i> [RQ3 / RQ4]</p>
<p>Case Assessment and Interpretation (CAI) Methods</p> <p>Primary question: <i>Have you encountered the Case Assessment and Interpretation method?</i> [RQ1 / RQ3 / RQ4]</p>
<p>Case Fragmentation and ‘Quoting’</p> <p>Primary question: <i>Are you aware of the phenomenon of ‘case fragmentation’?</i> [RQ1 / RQ3 / RQ4]</p>
<p>Interpretation of ‘Mixed’ DNA Samples</p> <p>Primary question: <i>Do you have any experience of interpreting and evaluating mixed DNA samples?</i> [RQ2 / RQ3 / RQ4]</p>
<p>Accreditation of Forensic Science Providers</p> <p>Primary question: <i>Can you tell me about accreditation processes within your field?</i> [RQ3 / RQ5]</p>
<p>Regulation of Forensic DNA Profiling</p> <p>Primary question: <i>Can you tell me about regulatory processes within your field?</i> [RQ3 / RQ5]</p>
<p>Scientific Method</p> <p>Primary question: <i>Can you tell me what the term ‘scientific method’ means to you?</i></p>

[RQ3 / RQ5]

Appendix II: Example Codified Forensic Product

SERVICE TITLE	DNA EXAMINATION AND RECOVERY	
SERVICE CODE	20BF	
VERSION NUMBER	20BF_NFF-v1.1	
1.0	GENERAL REQUIREMENT	20BF
1.1	Examine exhibits submitted by the Participating Authority for DNA rich material, with the exception of semen.	
1.2	Examine exhibits by means of a limited non-targeted, limited or targeted search in line with the submission strategy in preparation for DNA profiling through specification 22BF.	
2.0	QUALITY AND ACCREDITATION STANDARDS	20BF
2.1	Possess BS EN ISO/IEC 17025:2005 accreditation issued by UKAS, or an equivalent body. The scope of accreditation should cover the work required to deliver this service code as detailed in the General Requirements Section 1.	
2.2	Maintain the standards set out in the Codes of Conduct and Practice published by the Forensic Science Regulator. This includes any standards set out in annexes (or documents adopted or endorsed in place of or in addition to the annexes) to the Codes specified (by the Forensic Science Regulator) as being applicable to this area of work.	
3.0	DESCRIPTION OF SERVICE REQUIREMENTS	20BF
3.1	Receipt of item at laboratory and continuity record initiated and maintained.	
3.2	Assess and document the forensic strategy where appropriate. This may involve discussion with the Participating Authority.	
3.3	Record details of all discussions and decisions made with the Participating Authority, forensic strategy decisions, continuity, examination processes and the location and description of any findings.	
3.4	Examine item for DNA rich material. This product includes the presumptive testing for blood. Presumptive tests for all other body fluids are not covered within the remit of this specification, but are available through specification 21BF Body Fluid Search, Recovery and Interpretation.	
3.5	Record details of the appearance, identifying marks, features, condition of the item(s) and all visible staining, using photographic records and/or notes and diagrams as appropriate, prior to and during any subsequent examination.	
3.6	Perform examination of items for potential DNA rich material of any type, with the exception of semen. These items may include, but are not limited to:	
3.6.1	<ul style="list-style-type: none"> • <u>Limited non targeted search</u> - blood swabs, hair, cigarette ends, chewing gum, envelopes, drinking vessels (or swabs taken there from), small blood stained items, non-intimate swabs. 	
3.6.2	<ul style="list-style-type: none"> • <u>Limited search</u> - simple clothing/items e.g. gloves, hats, balaclavas. 	
3.6.3	<ul style="list-style-type: none"> • <u>Targeted search</u> - left cuff of shirt, front right pocket of trousers. 	

3.7	A limited or targeted search of items includes the searching of a whole item where it is relatively small and/or simple to search, or part of an item where a specific area can be targeted for searching.
3.8	Consider, preserve but not specifically recover, any other potential evidence types in accordance with the strategy agreed with the Participating Authority. These evidence types may include, but are not limited to: fibres, hairs, paint, and fingerprints. If other evidence is found, consult with the Participating Authority regarding further submissions strategy.
3.9	Where samples require specialist work that the Supplier cannot perform the exhibits/items/samples/notes shall be released to a designated alternative supplier.
3.10	When one or more stain(s) is identified that may be relevant or beneficial to the investigation, and this does not fall in line with the forensic strategy, consult with the Participating Authority to ensure that authorisation for an agreed modified strategy is obtained.
3.11	Select and recover the most relevant stain(s) in line with the forensic strategy for DNA analysis.
3.12	Where appropriate, and in line with the agreed forensic strategy, combine swabs or minitapes for the purpose of analysis. Tubes must be no more than 2/3 full with loosely packed material e.g.:
3.12.1	<ul style="list-style-type: none"> Up to 2 round-head swabs or 4 mini-pointed swabs can be combined in 1 tube (1.5ml) and treated as 1 sample.
3.12.2	<ul style="list-style-type: none"> A tube (1.5ml) can hold 1 minitape and is treated as 1 sample.
3.13	Up to 6 tubes, if appropriate, can be combined and a cell harvesting process undertaken to create 1 sample (this may incur an additional cost). NOTE: this specification shall be used for source level analysis and simple activity interpretation based on that source level analysis e.g. wearer DNA.
4.0	SERVICE TURNAROUND TIMES 20BF
4.1	Standard Service: 95% within 3 calendar days.
4.2	When used in conjunction with any other BF specification a combined standard service turnaround time may apply to the submission. Where appropriate consult the BF TRT Matrix for further information.
4.3	Urgent Service: 24 hours (or less than 24 hours on a negotiated case by case basis)
5.0	REPORT OUTCOMES 20BF
5.1	Case/exhibit/item/sample reference to be quoted when the results of examination are reported.

5.4	Abbreviated or Streamlined Forensic Report, when requested.
5.5	Full Evaluative Statement, only when requested in conjunction with specification 20FS (Full Evaluative Statement).
5.6	When requested, case information to include, but not be limited to, case notes, photographs, results, interpretation, conclusions including any potential lines of further enquiry, index of unused material and any scientific data, all to be provided when requested at no additional cost. In certain crime types the Participating Authority will require electronic data feeds containing, but not limited to, other case information.
5.7	If the processing of an item or sample involves this and another body fluid (BF) specification e.g. 22BF DNA Profiling, the reporting outcome will be combined.
6.0	DOCUMENTATION 20BF
6.1	Submission documentation (e.g. MG21, MG21A, GF111, MGFSP or equivalent)
6.2	List of exhibits
6.3	Signed exhibit label
7.0	STORAGE, RETENTION & DISPOSAL 20BF
7.1	See current version of the Exhibit Retention Guidance for details of storage, retention and disposal requirements.

