

UK parliamentary inquiry reports in forensic science – Plus ça change?

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ABSTRACT

Forensic Science provision in England and Wales underpins scientific evidence in many criminal cases. The quality of scientific investigation by scientists and the presentation of science insights has been under scrutiny and it is increasingly established that multiple significant, deep-rooted and persistent issues exist in the Forensic Science ecosystem.

A thematic analysis of seven UK parliamentary inquiry reports that addressed Forensic Science and published since 2000, identified key themes and contextual factors. A matrix model that illustrates the connectivity between these themes and factors was produced. The primary issue identified was the challenge of the traditionally narrow focus of inquiries on specific elements of the Forensic Science ecosystem, rather than considering that ecosystem holistically.

Through the analysis of these seven inquiry reports, it was possible to develop a matrix which provides a structured framework to critically consider the interconnections, interdependencies and connectivity between the key elements of the Forensic Science ecosystem. The matrix serves to highlight the need for an integrated approach that brings together an understanding of each component of the system and their intersections and connections to address the Forensic Science ecosystem more holistically and address the root causes of key Forensic Science challenges within the criminal justice system. It is hoped that the insights identified in this study offer a starting point for broader discussions and strategic activities across the Forensic Science community to find pathways forward to address persistent deep-seated challenges that have been identified in Forensic Science and find solutions.

1. Introduction

Forensic Science, as a valuable component of the Criminal Justice System (CJS), operates at the intersection of science, law, and policing. Since 2000, seven parliamentary inquiries have been undertaken and the reports subsequently published have served as repositories of evidence and insights, reflecting the position of Forensic Science in England and Wales. The findings of the most recent parliamentary inquiry in the UK [1], highlighted the pivotal nature of Forensic Science in the CJS, emphasising its vital role in ensuring the effectiveness, reliability, and accessibility of forensic services. The report emphasised the necessity for Forensic Science to adhere to high standards of reliability to maintain the trust of the courts and advocated for equal accessibility for both the prosecution and defence. It also addressed the observations heard in written and oral evidence that the closure of the UK Government's

Forensic Science Service in 2012 represented a significant shift in Forensic Science service provision, particularly in fields such as fingerprint analysis and digital forensics which became increasingly conducted in-house by police forces. This shift in service provider dynamics raised critical concerns about the sustainability of the market as well as the reliability and accessibility of Forensic Science within the criminal justice framework [1,2]. Yet, it was also acknowledged that even though these issues remained timely, and a critical part of the 'urgent reforms' called for by the committee, the majority of these insights had been highlighted in previous parliamentary inquiries. This study examined seven UK parliamentary reports (Table 1) [1,3–8] from inquiries held since 2000, to consider the existing, current and future role of Forensic Science and its impact and value on the CJS.

Each of these inquiries was conducted through the independent cross political party process of parliamentary committees. Each inquiry

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Table 1
The inquiry reports considered in this study.

Publication Year	Name	Parliamentary Committee	Objectives/Questions asked
2005	Forensic Science on Trial [3]	House of Commons Science and Technology Committee	<ul style="list-style-type: none"> To examine the consequences on the Forensic Science marketplace and the functioning of the FSS from the government's plan to change the status of the FSS to a public-private partnership. To assess the education and training provisions available for Forensic Science practitioners and also for the development of an effective Forensic Science workforce To investigate the funding mechanism for the Research & Development of Forensic Science To understand the use of Forensic Science in assisting the criminal investigations and the court proceedings.
2011	The Forensic Science Service [4]	House of Commons Science and Technology Committee	<ul style="list-style-type: none"> How will the closure of the Forensic Science Service impact both Forensic Science and the future development of this field in the UK? What implications will the closure have on the quality and impartiality of forensic evidence utilized within the criminal justice system? What is the current financial status of the Forensic Science Service? What is the current state of the forensics market in the UK, particularly in terms of whether the private sector can take over the tasks currently handled by the Forensic Science Service? Additionally, what is the volume and nature of the forensic work carried out by police forces? What alternatives are being considered instead of winding down the Forensic Science Service? Do the arrangements for closing down the Forensic Science Service, making staff redundant, and selling its assets appear to be adequate?
2013	Forensic science [5]	House of Commons Science and Technology Committee	<ul style="list-style-type: none"> Does the Government possess an effective strategy for Forensic Science in the UK, and is it adequate to support research and development as well as the criminal justice system? Did the transition and closure of the Forensic Science Service (FSS) proceed seamlessly and within the allocated budget? What are the impacts of the FSS's closure on: <ul style="list-style-type: none"> The criminal justice system Research and development, and training in Forensic Science. Specifically, has there been rigorous maintenance of appropriate quality standards and accreditation? Please provide evidence/examples. What role should the Forensic Science Regulator play? What is the current size and stability of the forensics market? How do police forces procure Forensic Science services, and are there opportunities for improvement in the procurement processes? Has the discontinuation of the FSS led to a depletion of intellectual resources, with scientists departing the Forensic Science profession or the UK? Please provide evidence/examples. Are the existing arrangements for the FSS's archives satisfactory, and how could the management of case files and forensic materials in the UK be enhanced?
2016	Forensic Science Strategy [6]	House of Commons Science and Technology Committee	<p>The inquiry aimed to address a range of concerns, building on the delayed Forensic Science Strategy and issues highlighted by previous Committees. These include:</p> <ul style="list-style-type: none"> Shrinking and Changing Forensics Market Financial Constraints in Policing Funding and Incentives for Forensic Science Research Utilisation of Forensic Evidence in Court
2018	Biometrics strategy and forensic services [7]	House of Commons Science and Technology Committee	<p>This inquiry mainly focussed on:</p> <ul style="list-style-type: none"> Gathering evidence from the Forensic Science Regulator on the Randox case and on developments subsequent to the publication of the Forensics Strategy in 2016. Seeking Testimonies on the outstanding publication of a Biometrics Strategy and the ongoing management strategies for facial images within the given context.
2019	Forensic science and the criminal justice system: a blueprint for change [1]	House of Lords Science and Technology Select Committee	<ul style="list-style-type: none"> The role of Forensic Science in delivering justice in the UK, analysing its strengths and weaknesses. Examination of the understanding and utilisation of forensic evidence in the criminal justice system. This included an assessment of the level of comprehension within the system and exploration of avenues to enhance understanding among the judiciary, legal teams, and juries, ensuring effective and robust utilisation of forensic evidence, including digital evidence, throughout the entire process. Evaluation of standards and regulation, encompassing the performance of the forensic services market in the UK and the role played by the Forensic Science Regulator. Analysis of the Forensic Science research landscape, including funding considerations, the necessity for new research programs, and the potential focus areas for those programs. Investigation into digital forensics, covering the detection, recovery, integrity, storage, and interpretation of evidence from digital devices and networks in the context of crime investigation and prosecution.
2019	The work of the Biometrics Commissioner and the Forensic Science Regulator [8]	House of Commons Science and Technology Committee	<p>A follow up from the 2018 inquiry, focusing on:</p> <ul style="list-style-type: none"> Examination of the progress made in implementing the recommendations outlined in the Committee's Report. The Government's 'Biometrics Strategy.' Review of the developments and implications associated with the Forensic Science Regulator Bill.

comprised extensive consultation with a diverse range of qualified and relevant stakeholders from across the Forensic Science ecosystem culminating in a report of key findings and recommendations. Therefore, each of these reports offer a rich source of insight, mapping issues and concerns raised in the last two decades. In particular, this period covered the privatisation of the UK Forensic Science market. This study analysed each of these seven reports to identify common themes, chart any changes in perceived challenges, and identify characteristics of the current Forensic Science ecosystem, and potentially trace the antecedent conditions of those characteristics.

To date there has not been a systematic examination and evaluation of the content of these reports and the operational outcomes resulting from their recommendations. By utilising Reflexive Thematic Analysis as the primary qualitative research method, this study sought to identify key themes and interconnected elements of the Forensic Science ecosystem within these parliamentary reports. In doing so, it was possible to develop an understanding of the key themes, establish their prevalence, and then consider their significance and implications for the Forensic Science industry and the Criminal Justice System (CJS) in England and Wales.

By categorising the key themes based on their frequency and significance, the study sought to illuminate persistent concerns, transformative shifts, and unresolved challenges within Forensic Science. It is hoped that the findings from this study may pave the way for a broad cross disciplinary and cross sector discussion on the opportunities going forward to address the challenges faced in Forensic Science practice and for Forensic Science as a discipline.

2. Material and methods

This study addressed seven parliamentary reports from inquiries into Forensic Science published since 2000 (Table 1). These reports encompass a range of inquiry topics, including focused reviews targeting specific issues facing Forensic Science and broader examinations of the entire Forensic Science system in England and Wales. For each inquiry, a committee selects a topic, and then makes an open call for evidence. This written evidence is collated with evidence given orally by invited witnesses. The committee then scrutinises the evidence before producing a report to document the findings alongside recommendations. The report is then published and the relevant government department provide a written response [9–15] to the findings and recommendations within two months of publication, where possible [16]. The inquiry report is then debated in the relevant parliamentary chamber with the government minister invited to respond.

Reflexive Thematic Analysis (RTA) was chosen as the primary research method as it offers a transparent and rigorous approach for qualitative analysis [17–20]. The emphasis of RTA on reflexivity allowed for a critical examination of the researcher's perspectives and biases, which was crucial for navigating the multifaceted issues discussed in the parliamentary inquiries into Forensic Science.

Key themes were identified through the analysis of the chosen reports and the frequency with which each theme was mentioned or discussed in each report was established (see Table 2). Duplicate instances of themes were omitted from the count. For instance, themes mentioned in the contents page, title, or header/footer of a report were excluded. Additionally, themes referenced in recommendations or written/oral evidence transcripts were not counted to prevent double counting (as recommendations are generally presented once within the document and again in the conclusion). Themes mentioned solely in these supplementary sections were also excluded from the count, as they were not part of the main body of the report.

3. Results

In using Reflexive Thematic Analysis to analyse the seven chosen reports, eight key themes were identified. Table 2 presents the

overarching themes that emerged from the analysis and the number of times each theme was mentioned in the body of the reports.

The key themes identified were: Research & Development, Quality & Public Trust, Marketplace, Forensic Science Strategy, Leadership & Governance, Workforce Management, Funding, and the Forensic Science Service (see Fig. 1). These themes are influenced by cross-cutting elements such as Knowledge Production, Communication and Dissemination and the Identity of Forensic Science.

Quality & Public Trust, the Forensic Science Marketplace, and the Forensic Science Service were all featured in all seven House of Commons and House of Lords reports. Additionally, Research & Development, funding for Forensic Science, Leadership & Governance, and Strategy for Forensic Science were discussed in six reports, while Workforce Management appeared in four reports.

Six out of seven reports discussed Research and Development. It was not mentioned in the 2018 Biometrics Strategy and Forensic Services report [7], and in the 2019 Biometrics Commissioner and Forensic Science Regulator report [8] it was mentioned only once. These two reports were focussed on a specific issue and did not include a review of the wider Forensic Science service context.

Quality & Public Trust and Marketplace were consistent topics of discussion across all the reports, more so in the 2011 [4] and 2013 reports [5]. This was because these reports focussed on the closure of the Forensic Science Service (FSS), the biggest service provider of the time, and its impact on the performance of the marketplace and the quality of the Forensic Science evidence since its closure. The presence of both these themes in the reports over the years indicates the importance of quality of Forensic Science evidence for the CJS and how it has been affected by the changes in the marketplace. It is noteworthy that funding was cited (amongst other factors) for the increase in marketplace instability that was identified and resulting quality issues.

Leadership & Governance (of Forensic Science) was highlighted in all but one report, 2011 [4], which concentrated on the FSS closure and its aftermath for the Forensic Science industry. The leadership and governance discussion in the 2005 report [3] was focussed around the FSS and the DNA database. However, post FSS closure, the focus of the inquiries shifted towards the governance and oversight of Forensic Science as an industry, and national level leadership. Since the closure of the FSS, delivery of Forensic Science evidence is provided either by private laboratories or by various law enforcement agencies' laboratories across the country, the landscape has been more diverse and fragmented [1,6]. National leadership and governance was frequently referred to during the transition phase. Although leadership was not discussed directly in 2011 report [4], the inquiry did discuss a need for a national strategic vision for Forensic Science.

Workforce Management appeared in four of the seven reports, but only discussed in depth in the 2005 report [3]. This inquiry [3] considered this theme with a focus on the education and training of experts, i.e. Forensic Scientists, investigators and legal professionals. The report from the inquiry also emphasised the importance of fluid communication channels coupled with cross-pollination of knowledge between the Forensic Science service provision and the legal domain. Workforce Management also featured in the 2011 [4] and 2013 reports [5] where it was considered in the context of the risk of losing a pool of well-trained experts from the industry due to the closure of the FSS. It was then only next discussed in the 2019 House of Lords report [1].

The theme of the Forensic Science Service (FSS) has featured in all the inquiry reports, although the context of the discussion changed over the years. The 2005 report [3] considered the FSS in terms of the changing trading status of the FSS and the consequences of that change on the Forensic Science marketplace. The 2011 report [4], which was commissioned in response to the decision by the Home Office to close the FSS, had the main aim of understanding the impact this decision could have on the marketplace and more importantly on the CJS more widely. However, since then, all the following reports reviewed the impact of closing down the FSS and the subsequent instability of the

marketplace [1,5]. References to the FSS fell after the 2013 report [5] as more time passed since its closure and the focus of committees turned to the current landscape and challenges faced in Forensic Science.

Forensic Science Strategy was discussed in all the reports except the 2005 report [3]. The 2011 [4] and 2013 reports [5] focussed on the lack of a strategy for Forensic Science and its value in stabilising the industry with a concentration on key areas such as research and development. Notably, the 2016 review [6] was commissioned to appraise the Forensic Science Strategy along with other issues already raised in previous inquiries. This theme was in detail in the 2018 inquiry [7] and referred to briefly in 2019 [1,8].

Funding was a recurring theme that appeared in six out of the seven inquiry reports. Although funding was never discussed as a theme on its own, funding (or a lack of it) was often attributed as a strong contributing factor behind many issues and challenges addressed in the inquiry in question.

Upon further analysis of the data from these inquiry reports, a matrix of themes and connected key factors emerged (Fig. 2). This matrix presents five overarching themes and their intersections with three contextual factors and incorporates two underlying and cross cutting elements that are intrinsic to each of the five themes and contextual factors.

- 5 overarching themes: Research & Development, Quality & Public Trust, Marketplace, Leadership & Governance, and Workforce Management,
- 3 contextual factors: Transitions in service provision, Strategy for Forensic Science, and Funding (which addresses the three broad genres of funding, government funding, research funding (from research councils, industry and government departments) and legal aid funding),
- 2 cross-cutting elements: how knowledge is generated, communicated and shared ‘knowledge production, communication and dissemination’ and the impact of the perceived identity of Forensic Science.

This matrix (Fig. 2) represents the interactions and intersections between the themes and contextual influences discussed in the parliamentary reports addressed in this study. The cross-cutting elements are key factors that influence and shape the themes and contextual influences in a broad range of explicit and tacit ways [21,22]. For example, how knowledge is generated and shared within the forensic service provision sector is necessarily different to how this is done in the research and development space (which itself is differentiated in terms of the context in which the R&D is taking place (for example within a university or within industry). As a result, the strategy driving R&D

activities, the audiences for which the outcomes are framed, and the priorities for R&D will reflect the different drivers that are manifested in different contexts.

The terms ‘high’, ‘medium’ and ‘low’ indicate the degree of the potential impact between the themes and contextual factors. The strength of connection between these factors reflecting the degree of impact between each theme and contextual influence was derived from the analysis of the reports [1,3–8] investigated in this study. The frequency with which each theme and contextual factor was mentioned in each report and the context within which they were mentioned was used as a proxy to indicate the perceived degree of impact between the factors. For example, the designation of ‘high’ at the intersection of ‘Research and Development’ and the ‘Transitions in service provision’ is mentioned on more than ten occasions whereas ‘Research and Development’ and ‘Funding for Access to Forensic Science services’ were mentioned one time or less, hence a ‘low’ designation.

The cross-cutting elements ‘Knowledge production, communication and dissemination’ and ‘Identity of Forensic Science’ were observed in this study to consistently intersect with and influence each of the themes and contextual factors. How knowledge is produced, the ways that it is communicated and shared varies between stakeholders. This cross-cutting element includes the sharing of knowledge and best practices both between and within stakeholder groups. When there is a lack of communication and engagement it can lead to a lack of awareness and a lack of appreciation of different contributions, which can hamper collaboration. What Forensic Science is and what it is for is not universally agreed (22). Different perceptions and understandings of the identity of Forensic Science in different contexts across different stakeholders within the Forensic Science ecosystem (including police, forensic scientists, lawyers and judges), can lead to different priorities, strategies and practices. As such both how knowledge is produced and shared, and what Forensic Science is considered to be and to be for, are critical factors intrinsically interwoven into the overarching themes and contextual factors within the matrix.

It is pertinent to note that there was only one report of the seven considered in this study that covered and discussed all the themes identified in the matrix [1], indicating that this most recent inquiry in 2019 took the most comprehensive ‘whole system’ approach to their review.

4. Discussion

The matrix (Fig. 2) derived from the analysis of the parliamentary reports highlights key dynamic intersections between different aspects of the Forensic Science ecosystem. The prominence of the five overarching themes identified from the analysis reflexive thematic analysis

Table 2

A table presenting the eight themes identified in this paper and their frequency of discussion within the seven reports used as the base for this research. The ‘-’ indicates that the theme was not discussed in that particular report.

Themes	2005 Forensic Science on Trial	2011 The Forensic Science Service	2013 Forensic Science	2016 Forensic Science Strategy	2018 Biometrics Strategy & Forensic Services	2019 House of Lords’ Blueprint for Change	2019 Biometrics Commissioner & FSR
Research & Development	100	136	124	86	-	98	1
Quality & Public trust	24	102	105	46	34	57	25
Marketplace	57	152	94	24	23	53	21
Leadership & Governance	12	-	4	24	31	30	19
Workforce Management	177	10	11	-	-	27	-
Forensic Science Service	276	420	237	32	7	14	2
Strategy for Forensic Science	-	2	22	90	41	6	3
Funding	42	38	51	22	-	35	5

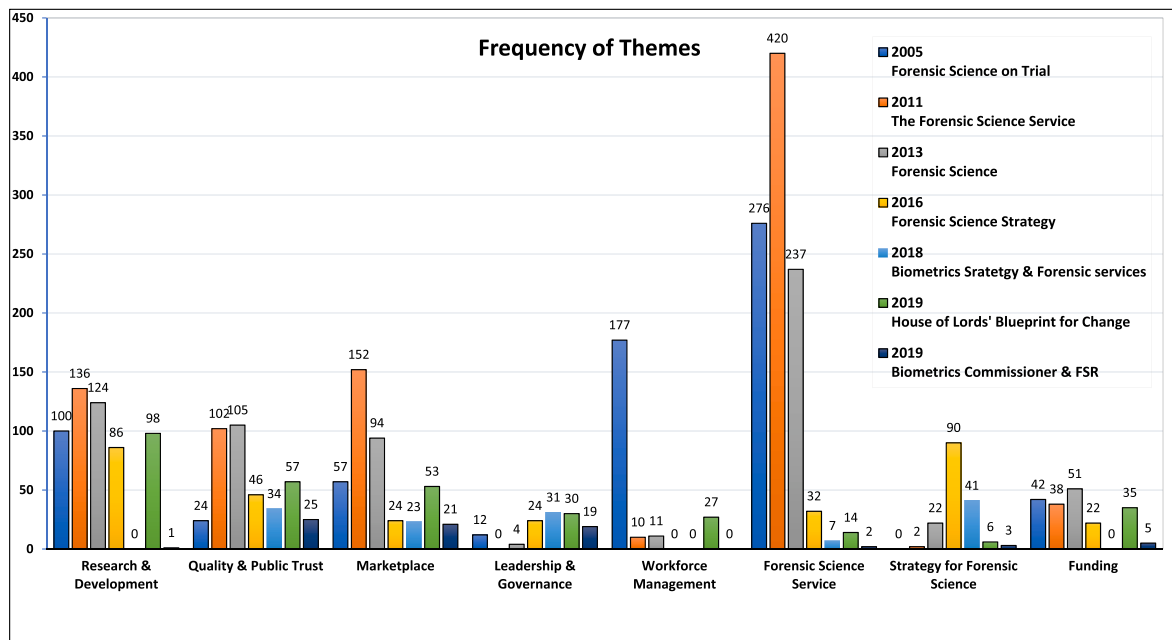


Fig. 1. The frequency of the eight themes identified from the analysis of the seven parliamentary inquiry reports [1,3–8].

(Research & Development, Quality & Public Trust, Marketplace, Leadership & Governance and Workforce Management) can be considered to be key issues given their prevalence within the series of inquiries. As such it appears to be important that these themes are incorporated into any consideration of the future development of the Forensic Science ecosystem. In the analysis, it was identified that all of these themes have critical intersections with three contextual factors (the transitions in service provision, the implementation of the Strategy for Forensic Science, and the funding landscape). It is possible to trace the influence of each of these factors within the Forensic Science ecosystem as precipitators of key changes within Forensic Science documented in and/or addressed by the inquiries and their subsequent recommendations. Two cross-cutting elements are also represented within the matrix (Fig. 2) due to the intrinsic impact of different practices of knowledge production, communication and dissemination that are incorporated across the Forensic Science ecosystem, and also the impact of what Forensic Science is considered to be, and what it is considered to be for, on each theme and contextual factor and the intersections between them.

As explained in Section 3, the ‘high’, ‘medium’, and ‘low’ impact indications within the matrix convey the different degrees of impact and interdependence between the themes and contextual factors. For example, the ‘transitions of service provision’ are considered from the discussions captured within the inquiry reports to have a ‘high’ impact

on ‘Quality & Public Trust’ (more than 10 mentions). The ‘Strategy for Forensic Science’ was considered to have a ‘medium’ impact with the Marketplace (2–9 mentions), suggesting that while strategic initiatives are crucial for setting a broad agenda, other factors are considered to also play significant roles in shaping the commercial aspects of Forensic Science.

This matrix serves as a tool to explore and open up conversations about recurrent themes identified in the inquiry reports that create important intersections between different sectors, stakeholders and activities within the Forensic Science ecosystem. The matrix also offers a framework for assisting future policy-making and research endeavours by highlighting the connections and intersections between key parts of the ecosystem and opening up opportunities to consider challenges with a holistic ‘whole system’ approach.

In this section, each of the five main themes is addressed, taking into account contextual factors that led to their discussion and relative prominence in the inquiry reports, and the future recommendations presented in those reports.

4.1. Transitions in service provision

The evolution of Forensic Science services in England and Wales illustrates a transition from a localised or regional approach to a

Overarching Themes		Contextual Factors				
		Research & Development	Quality & Public Trust	Marketplace	Leadership & Governance	Workforce Management
Transitions in service provision		High	High	High	Medium	High
Strategy for Forensic Science		High	High	High	High	High
Funding	Government	High	High	High	High	High
	Research	High	Medium	Medium	High	Low
	Access to Forensic Science services	Low	Medium	Medium	Medium	Low

← Knowledge production, communication and dissemination →

← Identity of Forensic Science →

Fig. 2. The matrix of 5 overarching themes, 3 contextual influences and 2 cross cutting elements and the degree of impact between the themes and the factors (more than 10 mentions = high; 2–9 mentions = medium; 1 or less mentions = low).

centralised national service, followed by a return to a decentralised model led by individual police forces or regional collaborations [3,4, 23–25]. This evolution is marked by an increased level of marketisation as outlined in Table 3.

The Forensic Science Service (FSS) established as an executive agency in 1991, served as a pivotal national institution, offering comprehensive services to all police forces [1,3–5]. However, over time, the FSS underwent various structural adjustments, eventually culminating in its closure in March 2012. Throughout the existence of the FSS, the industry observed a progressive shift from national to localised service delivery, accompanied by a gradual shift towards marketisation [3,4,23].

In 2010, the Home Office announced the planned closure of the FSS, responsible for approximately 60 % of forensic services in England and Wales at the time. Despite its substantial market share, it was considered that the FSS had challenges in adapting to the evolving Forensic Science landscape [4], resulting in a gradual decline in its market influence. The financial difficulties were rooted in a combination of factors, including the diminishing Forensic Science market caused by increased police in-sourcing of forensic services and a competitive procurement framework that led to reduced prices [3,4]. These financial constraints served as one of the key reasons prompting the government to initiate the closure of the FSS, raising questions about the long-term sustainability and viability of the Forensic Science marketplace [4]. Prior efforts to reform the FSS, including a change in its status to a Government-owned, Contractor-operated (GovCo) entity in 2005 and the initiation of a transformation programme in 2008, were deemed ineffective. Consequently, the government determined that the uncertainties and costs associated with restructuring and maintaining the business were unwarranted [4]. The FSS ceased accepting new submissions in October 2011 and officially concluded operations in March 2012.

The work outputs, running and subsequent closure of the FSS have been discussed in each of the reports analysed in this study [1,3–8]. While the 2005 and 2011 [3,4] reports discussed the work of the FSS, subsequent reports have reviewed its impact and legacy following its closure. The issues and legacy of the FSS have been a consistent lens through which inquiry committees [1,3–8] have discussed all the themes identified in this study (Table 2).

4.1.1. Research & Development

Research & Development was a persistent theme discussed in the inquiry reports. Issues that were consistently highlighted included inadequate funding [1,3–6,23,26], limited funding sources [1,4–6,26, 27], a lack of national coordination and governance [1,4,6,26], a lack of strategic vision [1,4,6,22,26,27] and the repercussions of FSS closure leading to marketplace instability [1,4–6].

The 2011 report [4] primarily addressed the consequences of the FSS closure on the Forensic Science industry and its research landscape, given that up to that time it could be argued that the FSS was the primary research environment in the field with dedicated teams of scientists and funding. Other private Forensic Service Providers (FSPs) also contributed, with research approaches generally more focused on business development and industry requirements and generating value for shareholders [4]. In comparison the FSS was able to concentrate on what could be considered in the short term, less-profitable foundational areas to support the development of forensic investigation practices. However, it was noted by the 2011 [4] and 2013 [5] inquiry committees that due to commercial sensitivities and marketplace competition, there had been a distinct shift in practice with the FSS not sharing its research with the private laboratories that lacked similar research funding from the government [4,5] and vice versa.

There were diverse perspectives on the impact of the FSS closure on Forensic Science research that were considered in the 2013 inquiry [5]. For example, Professor Bernard Silverman, then Chief Scientific Adviser, challenged the level of impact the FSS closure would have and the idea that it would create a research vacuum for Forensic Science. He argued

that such activities are dispersed across private providers and academia. In contrast, Sir Alec Jeffreys voiced profound concern, characterizing the closure as “potentially disastrous” [5; 42] and highlighting the FSS as the “natural national focus for forensic R&D” [5; 42]. Professor Peter Gill emphasised the international standing of the FSS, citing its global ranking as 5th in scientific citations [5; 42]. Forensic Science Northern Ireland echoed this sentiment, emphasising the global leadership in research of the FSS [5; 42]. It was also asserted in the inquiries that took place after the closure that the UK’s reliance on outdated DNA technology after the FSS closure had led to unsolved crimes, resulting in a shift from “pole position to banana republic” in DNA profiling [5; 42].

Irrespective of the perceived impact of the FSS on research, the inquiries highlighted that the FSS invested regularly in Forensic Science research. For example, between 2008 and 2011, the FSS invested 2 % of its turnover, amounting to £3–4 million for research and development purposes [4] (Table 4).

Since the closure of the FSS, research funding has been described as limited, sporadic, ad-hoc [1,6,23,26], and lacking a dedicated and clearly defined funding stream for research bodies [1,4–6,26,27]. It has been suggested that this has been a particular challenge in the wake of the research and development capability of the FSS not being replaced. It has become increasingly voiced that removing Forensic Science as a strategic priority at the national funding level since 2012 [1] has been a significant factor in the challenges of ensuring a pipeline of research that can support Forensic Science in the present as well as in the future [22, 27].

4.1.2. Quality

The significance of quality in Forensic Science has been consistently highlighted across the different inquiry reports, with recurring themes such as granting statutory powers to the Forensic Science Regulator (FSR), the closure of the Forensic Science Service (FSS), police in-sourcing, and the prevalent issue of an uneven playing field [1,5–7,23] and their impact on quality. The House of Lords review went so far as to declare that “The quality and delivery of Forensic Science in England and Wales is inadequate.” [1].

At the time of the FSS closure, it processed 60% of the Forensic Science casework nationwide, with the remaining workload divided between police forces’ laboratories and private FSPs [4]. In the 2011 inquiry [4], the committee recognised the risk of FSS work going to unaccredited laboratories after its closure. While private FSPs were accredited for most common Forensic Science processes, they did not encompass the extensive range offered by the FSS. Additionally, police laboratories had a minimal level of accreditation [4]. The subsequent 2013 inquiry committee was satisfied that the FSS work was transferred to accredited FSP laboratories under the oversight of the Forensic Science Regulator (FSR). However, the same could not be said about the police laboratories, which also raised questions about the creation of an ‘uneven playing field’ [1,5–7,23] and police impartiality [4–6].

4.1.3. Marketplace

The 2005 inquiry committee heard from witnesses that since the arrival of private companies in the UK marketplace, the market share of FSS had reduced noticeably [3]. Although benefits were identified for policing in terms of planning, budgets and efficiency, due to the change from having a monopoly on services with the FSS to a competitive market [3; 14], this privatisation worked as a catalyst in the closure of the FSS [3,4]. Since the closure of the FSS (the biggest forensic service provider at the time), funding for Forensic Science services has been reduced significantly and police forces have increased the level of in-sourcing, causing the private marketplace to shrink [1,5,7,29]. The reduced funds available increased competition, which drove prices and turnaround times down to what was considered unsustainable levels more recently. In this context, more instability and uncertainty was observed in the marketplace, along with a lack of resilience to shocks in the market [1,5,7,29].

Table 3
History of Forensic Science service transition in the UK.

Year	Significant event	Service Status
1935	The first police Forensic Science laboratory was established – Metropolitan Police Laboratory [23–25].	Local/Regional
1935–1956	Seven regional Forensic Science laboratories were established under the Home Office Forensic Science Service – Nottingham (1935), Bristol (1935), Cardiff (1938), Birmingham (1937/38), Preston (1938), Wakefield (1941) and Newcastle (1956) [25].	
1991	The Forensic Science Service (FSS) became an Executive Agency of the Home Office [5] with five regional laboratories (previously operational under the Home Office Forensic Science Service) – Birmingham, Chepstow, Chorley, Huntingdon and Wetherby [4,24].	Regional
1996	The Metropolitan Police Forensic Science Laboratory integrated with the FSS to form one national service for all the 43 police forces in England and Wales [3,23].	National, inception of a private marketplace
1999	Private companies started to penetrate the Forensic Science marketplace [3].	
1999	The FSS gained Trading Fund status [3,23].	Development of private marketplace
2002	Police forces were required to look for the best value for the services received (Local Government Act 1999) [3].	
2002	FSS stopped being the “preferred supplier” of forensic services for the Association of Chief Police Officers [3,4].	
2003	The procurement practices of the Metropolitan Police Service were reviewed, resulting in the division of its Forensic Science services’ procurement between the FSS and two other providers [3].	
2003	Other forces followed suite, while some outsourced all their Forensic Science services out of the FSS to private companies [3].	
2003	The McFarland Review of the FSS recommended the FSS to become a Public-Private Partnership via the Government-owned, contractor-operated (GovCo) model [3,4,23].	
2003	The review underlined the impact of FSS’ perceived monopoly on the market competition and its operational limitations under the trading fund status [3].	
2005	FSS’ trading status changed from a Trading Fund to a GovCo company [3,4,23].	
2008	The FSS initiated a £50 million cost-cutting transformation programme with the aim to conclude it by 2011, leading to a closure of three of its laboratories [4].	
2010	On 14 December, the Government announced closure of the FSS [3,4].	
2012	The FSS was closed and Forensic Science provision transitioned to local and regional police forces laboratories and the private marketplace [4].	Decentralised local/regional service with a heightened degree of marketisation

The FSS closure coincided with the cessation of the National Policing Improvement Agency (NPIA), which played a role in overseeing forensic procurement. Both of these changes instigated a transition process, encompassing various components of the Forensic Science marketplace, including the re-tendering of Forensic Science casework by police forces, the transfer of staff and assets to alternative providers and adjustments to the governance structure of the archives of the FSS [4,5].

Since the FSS closure, subsequent inquiries have grappled with issues such as the precariousness of an unstable and uncertain marketplace [1, 5–7], the escalating trend of police insourcing [1,4–6,8], intricate police outsourcing frameworks exerting downward pressure on pricing to unsustainable levels [1,4–6], a substantial reduction in Forensic Science funding resulting in the fragmentation of casework [1,4–6], and an uneven playing field between prosecution and defence [1,6–8].

4.1.4. Leadership & Governance

Leadership and governance within the Forensic Science ecosystem was a recurring theme in all inquiry reports, except for the 2011 inquiry [4]. Notably, the 2019 inquiry report [1] explored this theme extensively. The 2005 inquiry report [3] specifically focused on leadership and governance concerning the change in FSS trading status. Subsequent inquiry reports consistently emphasised the critical need for governmental and ministerial oversight in the Forensic Science industry, underscoring the importance of a strategic vision to effectively manage the fragmented landscape [1,23,26] within the industry. The connection between leadership in the context of transitions in service provision in England and Wales has been clear over the years spanned by these inquiries [1,3,6–8], most notably with a two-way influence with the issue of leadership and governance and the transitions of service provision being deeply interconnected.

The transitions in service provision have resulted in a shift towards localised leadership and governance in Forensic Science since 2012 (Table 3), departing from the previous centralised model. This shift has led to variability in Forensic Science practices [1,5] and arguably a lack of strategic vision for the industry [1,5]. Consequently, it is possible to observe the impact of fragmented leadership structures that have emerged, with a challenging impact on research and development, marketplace dynamics, quality assurance, workforce management and

funding. This lack of strategic direction outlined in the evidence heard by the inquiry in 2019 has further compromised the identity and perceived value of Forensic Science across the broad Forensic Science ecosystem within England and Wales [1].

Based on the evidence received addressing leadership and governance during the 2019 inquiry [1], the committee made the following recommendations, emphasising the need for enhanced leadership in Forensic Science in England and Wales:

“It is clear that there is a need to deliver strategic and accountable leadership that reflects all the main stakeholders to set the vision, strategy, and agenda for Forensic Science.

The Home Office and the Ministry of Justice are not working closely enough to address the absence of high-level leadership in Forensic Science. Furthermore, it is necessary to ensure that the operational independence of the police and the independence of the courts and of forensic scientific evidence are safeguarded. Therefore, we recommend the creation of a Forensic Science Board as an arm’s length body to be responsible for the coordination, strategy and direction of Forensic Science in England and Wales.” [1].

The transitions in service provision have been influenced by national level leadership and governance. During the period when the Forensic Science service capability was centralised under the FSS, its trading status was changed three times [3]. These changes led to the adoption of more localised models with escalating levels of marketisation [3,4] paving the way for Forensic Science service provision in England and Wales to fully transition to a local service 2012 [3,4]. It is interesting to note that despite the strong connection between leadership and governance and Forensic Science service provision at the national level, the theme of leadership and governance was conspicuously under-discussed in the inquiry reports, with only 120 mentions [1,3,5–8] compared to the 988 mentions of the FSS [1,3–8]. It is possible to suggest that a lack of emphasis on the importance of leadership and governance may have hindered a comprehensive consideration of achieving effective, efficient, high quality service provision [1].

4.1.5. The Forensic Science Regulator

The Forensic Science Regulator (FSR) is a public appointed Home

Office sponsored role that seeks to ensure Forensic Science services within the CJS adhere to scientifically rigorous standards. While supported by the Home Office, the regulator functions autonomously, representing the entire CJS to maintain impartiality [30].

The role of the FSR was recommended in the report from the 2005 inquiry [3], and then established in 2007. Since then, it is notable that every parliamentary inquiry into Forensic Science has advocated for granting statutory powers to the FSR [1,4–8] especially with the transitions of the service provision [1,4–8,31]. The FSR published Codes of Practice & Conduct for all Forensic Science laboratories, aligning with ISO Quality Standards (17020 & 17025). However, it was noted in the inquiries [1,4–8] that the absence of statutory powers limited the ability of the FSR to regulate and enforce compliance with these standards effectively despite setting deadlines for accreditation against standards for a range of key Forensic Science services.

Since the creation of the FSR role, the inquiry reports have recommended the government legislate to grant statutory powers to the Regulator [1,4–8] and enabling legislation was passed in 2021, effective from October 2023 [30]. The slow governmental uptake drew criticism and disapproval from committees, sentiments notably expressed by Baroness Walmsley during the 2017-19 House of Lords committee debate –

The Government did not agree with these recommendations, but I believe that a regulator needs teeth, otherwise how can he or she do the job? It is nearly 10 years since the Government promised that the regulator would have such statutory powers, a time lapse which the committee described as embarrassing. Can the Minister assure us that the Government will take appropriate action so that it is no longer embarrassed? [1].

4.1.6. Workforce

The 2005 inquiry committee [3] placed a significant focus on the educational aspect of the Forensic Science industry, addressing standards such as the accreditation of university courses and raising general awareness about the nature of the practice within policing and law colleagues. However, in the subsequent inquiry reports in 2011 [4] and 2013 [5], the attention shifted towards examining the repercussions of the closure of the Forensic Science Service (FSS) on the skilled workforce in the country and the anticipated skills gap. In more recent inquiries, the emphasis has been on addressing gaps in the understanding of Forensic Science of judges and lawyers. The inquiry reports highlight the reliance on individual motivation for self-development to keep pace with industry developments and the potential impact on their work [1].

During the 2005 inquiry [3], the FSS asserted its position as the sole entity responsible for training Forensic Science practitioners in England and Wales, citing an expenditure of approximately £100,000 for the training of each expert [3]. However, following the closure of the FSS, the industry lost this comprehensive training programme. Moreover, a number of trained, skilled and experienced forensic scientists either faced redundancy or were transferred (under TUPE¹) to other Forensic Science service providers. The 2013 inquiry committee [5] were informed by the Home Office that 548 scientists were neither transferred nor recruited by other providers, forcing a majority of them to exit the industry entirely contributing to a substantial skills deficit within the industry in England and Wales [5].

By 2019, the House of Lords inquiry [1] reported that there was not a set entry route for Forensic Science nor a consistent training plan

¹ Footnote - When a business or a service changes its owner or provider, the employees who work for it may be affected by a UK law called Transfer of Undertakings (Protection of Employment) Regulations 2006 or TUPE for short. This law aims to safeguard the employees' rights by making sure that they keep their same jobs, contracts, and service history with the new employer [Source: Business transfers, takeovers and TUPE: Overview - GOV.UK (www.gov.uk)].

between different service providers and police forces. Neither was there a career progression plan for practitioners. A national joined up approach was recommended around training instead of the piecemeal, scattered and siloed system that existed [1].

The urgency of addressing the Forensic Science industry in England and Wales was summarised by the 2019 House of Lords committee:

“A free society is dependent on the rule of law which in turn relies on equality of access to justice. The evidence we received points to failings in the use of Forensic Science in the criminal justice system and these can be attributed to an absence of high-level leadership, a lack of funding and an insufficient level of research and development. Throughout this inquiry we heard about the decline in Forensic Science in England and Wales, especially since the abolition of the Forensic Science Service.” [1].

4.2. Strategy for Forensic Science

As outlined in Section 4.1 the 2011 [4] and 2013 [5] inquiries identified a lack of a longer-term strategy in Forensic Science, attributing it to the instability in the marketplace and the decline in research [4,5,23] activities. The inquiry reports included recommendations for increased ministerial attention to Forensic Science to ensure its long-term health and effectiveness in the CJS, advocating for the need for a comprehensive and wider strategy for Forensic Science [4,5,29].

The 2013 inquiry committee [5] linked the strategy and the leadership of Forensic Science in one of their recommendations from the inquiry:

“Forensic science provides evidence to the CJS and therefore any Government has a duty to protect its health in the short and long term. In our view, this requires a strategy and knowledgeable Ministerial oversight.” [5].

Consequently, the Home Office published a Forensic Science strategy in 2016 [32]. The 2016 inquiry [6], was exclusively commissioned to examine the strategy upon its release and evaluated its effectiveness and implementation plan. Subsequent inquiries in 2018 [7] and 2019 [1,8] delved into the limitations of the strategy, emphasising the need for a new one with a more explicit and comprehensive vision, along with a well-defined implementation roadmap.

The primary objective of the strategy was to establish a uniform national approach, with a focus on seven key areas as the means of delivery:

1. Quality and the Forensic Science Regulator's statutory role
2. Governance for Forensic Science
3. Establishment of a Joint Forensic and Biometrics Service (JFBS) to drive consistencies and financial efficiencies.
4. Cultivation of a healthy and stable marketplace
5. Opportunities for Forensic Science research and innovation
6. Strengthening the Forensic Science workforce
7. Enhancing education and awareness of Forensic Science across the board

These areas closely aligned with the overarching themes identified in this study, and thus, it is possible to argue that the Forensic Science strategy had a significant impact on the themes identified.

The Forensic Science research landscape has been characterised as uncoordinated [1,5,26] and fragmented [1,23,26], primarily relying on disparate funding streams [1,4,6]. This lack of a cohesive strategy has hindered efforts to make research more effective and aligned with practical needs, leading to gaps in the research landscape [1,6,22,23,26,27]. The inquiry committees [1,4,5] heard evidence that the absence of central governance and a strategic direction [23] resulted in missed opportunities for potential research and forced research efforts to be ad-hoc [1,6,23,26] and disconnected [1,5,6]. It was also considered that

the decentralised nature of research activities among various stakeholders, including academia, private industry, Policing, and the CJS, had further contributed to the lack of coordination and cohesion [1,22,27]. The 2016 strategy, labelled a ‘short-term’ approach by the then FSR, primarily targeted immediate Policing issues, lacking a long-term vision for industry innovation and development [6].

The lack of a strategic vision for the Forensic Science industry has been reflected in the leadership and governance of it too. The 2019 House of Lords committee summarised,

“A consistent theme that arose in our inquiry was the piecemeal nature of oversight of and responsibility for Forensic Science in England and Wales. We repeatedly heard that the system was not operating as it should and was in a state of crisis, presenting a threat of undermining trust in the criminal justice system.” [1]

The 2005 inquiry [3] found the number of university Forensic Science courses in the UK to be disproportionate with the job market in the industry, considered to be a result of a lack of national strategy around workforce management. In 2004-05 there were 401 undergraduate Forensic courses provided by 57 universities which increased to 634 undergraduate courses by 99 providers and 173 postgraduate Forensic courses by 64 providers in the academic year 2023-24 [33] (see Table 5).

Forensic Science is comprised of the more mainstream fields of expertise (including fingerprints, DNA, digital) alongside more niche fields of expertise (including trace, anthropology etc). As such it is a very diverse ecosystem but one with limited job opportunities. The prolific media and television portrayals of crime reconstruction, crime investigation and Forensic Science are one factor that has contributed to a broad interest in the field, which in turn has arguably contributed to a significant gap between the number of job opportunities and the number of graduates [1,3,4,34]. The 2005 [3] and 2019 [1] inquiry committees highlighted concerns regarding the quality of the Forensic Science courses provided by some universities [1,3,35]. Many of these courses did not align with industry practices, leaving graduates inadequately prepared for the job market [3,4]. Professor Jim Fraser, in his evidence to the 2011 inquiry, offered his views on the quality of education and influx of Forensic Science courses:

“The situation is inflated, anyway. There is a fashion for Forensic Science at the moment that is, frankly, unhealthy. Most of the educational programmes are driven by the business needs of universities and not by the needs of employers. It was inevitable that this boom would bust. [...] When it is quite plain that the employment opportunities are much more limited, the market will then settle down to something more realistic and people coming into Forensic Science will go into it with some realism about what it is and what kind of education they need.” [4].

This situation has also impacted the perceived value of Forensic Science as a distinct discipline as opposed to an application domain for ‘parent’ science and social science disciplines [27]. As a result, it was heard in the inquiries that employers were often more inclined towards hiring graduates with degrees in pure science subjects rather than Forensic Science [3,35].

The 2016 inquiry committee [6] described the strategy as an “Incomplete” strategy, citing its vagueness, lack of detail, and absence of a ‘coherent vision for Forensic Science’ and a corresponding implementation plan. The government faced criticism for not communicating and consulting with crucial stakeholders in the Forensic Science domain, including the FSR, private laboratories, defence, Crown Prosecution Service (CPS), MoJ and Policing. This lack of consultation was found to be unacceptable by the 2016 inquiry committee [6], as these stakeholders were considered to play a crucial role in delivering and implementing the strategy. Moreover, the predominant focus of the strategy on Policing, without a consideration of the whole ecosystem, was highlighted as a limitation in effectively delivering Forensic Science to the CJS. The reviews further noted the failure of the strategy to instil

certainty or stability in the marketplace, prompting calls for the government to review and establish a sustainable vision [6–8].

The inquiry committees [1,6,8] articulated the expectation that the government would regard the published strategy as a blueprint for reviewing, re-evaluating, and rewriting the strategy, emphasising the need for broader consultation. This approach aimed to formulate a strategic vision for the Forensic Science industry and establish a robust plan for its implementation [1,6,8]. This also became part of the concluding recommendation of the 2018 inquiry [7] on the Biometrics and Forensic Science strategies:

“The main result of our inquiry is that there is a need not just for the long-delayed Biometrics Strategy, but also a reassessment and revision of the 2016 Forensics Strategy. Our brief inquiry has identified an urgent and significant need for action on the governance and oversight of both forensics and biometrics. This is vitally important because these disciplines, and the way their techniques and data are used, are at the heart of our courts system and underpin essential confidence in the administration of justice.” [7].

4.3. Funding

Funding consistently emerged as a recurring theme throughout the inquiries addressed in this study [1,3–8]. It was not explored independently in any of the inquiries, but it was addressed in connection with other overarching themes, focusing on its role as a contributing factor to a range of issues discussed in the inquiry reports. Three distinct aspects of funding emerged from the analysis of the inquiry reports: government funding allocation to Forensic Science (via Policing), funding opportunities for Forensic Science research and development, and the availability of funding for legal aid.

4.3.1. Government funding

The inquiries heard that the introduction and advancement of a competitive market for Forensic Science coincided with a reduction in budgets and resources across all key stakeholder domains. It has been suggested that this has significantly affected the provision of forensic services, in terms of quality, commissioning processes, research initiatives and marketplace stability [1]. The then Forensic Science Regulator, Dr Gillian Tully, emphasised on the funding issue in her 2017-18 annual report:

“The strains from many years of funding restrictions continue to impact severely on forensic scientists in policing and the commercial sector. [...] It is my view that profound changes to funding and governance are required to ensure that forensic science survives and begins to flourish rather than lurching from crisis to crisis. I hope that those with a mandate for funding and governance will tackle the problems once and for all, for the protection of justice rather than the protection of historic or current policies.” [36].

At the same time as tackling the challenges resulting from a lack of centralised leadership, governance and a strategic vision [1] for the Forensic Science industry (as discussed in Section 4.2), funding for Forensic Science has been affected. In terms of Forensic Science services, the inquiry committees heard that over the years, police funding has been reduced and the budget for Forensic Science services has followed the same trajectory [1,6]. In 2008, Policing’s external Forensic Science spend was in the region of £175 million, which had reduced to around £50–55 million in 2018-19, compared to an insourcing spend of approximately £245–250 million in the same year. This made the total spend for 2018-19 to be £300 million, representing just 2.4 % of the total Policing budget of £12.3 billion [1,4,5]. However, at the same time, the spending by the police on Forensic Science services from FSPs (through outsourcing) has reduced to a degree that is out of proportion with the overall funding reduction for police, as insourcing has increased. The inquiry committees heard evidence that this had contributed to the

Table 4
FSS central research facility funding just before closing [4].

Financial Year	Amount (£)
2008–09	4.01m
2009–10	4.11m
2010–11	3.30m ^a

^a The funding in 2010–11 was affected after the closure announcement in December 2012 [28].

Table 5
Number of Forensic courses available in the UK - Source - UCAS [33].

	2004–05	2022–23	2023–24	2024–25
Undergraduate Providers	401 57	598 95	634 99	622 101
Postgraduate Providers		173 65	173 64	184 69

instability observed in the marketplace [1,6], and that the lack of funding for Forensic Science services was also related to lack of a clearly articulated strategy for Forensic Science [1,6].

4.3.2. Research funding

The inquiry committees heard evidence that in the domain of research funding, funding opportunities existed for limited short-term research focussed on technology developments [1,5,6]. However, the inquiries also identified that challenges in securing funding for longer-term projects focusing on foundational research and future innovations remained. This challenge of focusing on the short term technological needs for investigation and detection at the expense of ensuring a pipeline of early stage and foundational research to underpin the broader Forensic Science discipline and its applications, was deemed to be a contributing factor to the lack of growth and development of Forensic Science research in England and Wales [37].

The funding allocated to Forensic Science for research activities, has also suffered due to a lack of strategic understanding [4,5,23] of the purpose of Forensic Science, and its identity as a discipline at the strategic level (as elaborated in section 4.5) affecting the perceived significance of research in Forensic Science for forensic service provision, and ensuring the discipline of Forensic Science and its applications in practice have scientific foundations [38–40]. It was of note that the 2019 inquiry [1] committee considered that the allocated funding for Forensic Science research did not align proportionately with its value to the CJS [1], as outlined in their recommendation:

“Current levels of investment in forensic science research are inadequate and do not appear to reflect value to the criminal justice system. We believe that the Home Office has abdicated its responsibility for research in forensic science. We recommend that UK Research and Innovation urgently and substantially increase the amount of dedicated funding allocated to forensic science for both technological advances and foundational research, with a particular focus on digital forensic science evidence and the opportunities to develop further capabilities in artificial intelligence and machine learning.” [1].

4.3.3. Access to forensic science services

Across the inquiry reports, legal aid was discussed in three of the inquiries [1,3,5]. In each instance the scarcity of funding and resources available to defence lawyers when compared to CPS resources, especially for Forensic Science services was considered. More recent inquiries [1] placed a specific emphasis on the quality of Forensic Science evidence and the adherence to quality standards by both sides of the adversarial system with the challenges within the legal aid system being highlighted, emphasising cost-focused decisions over quality, leading to

unequal access to forensic expertise for defendants. Similar concerns were raised in the 2005 report [3], which recommended automatic authorisation of defence funding.

The consideration of disparity in access to Forensic Science resources, especially funding to achieve that access, between the prosecution (police-commissioned) and the defence was made in the earliest inquiry in 2005 [3] and the most recent in 2019 [1] highlighting the pervasive persistence of this challenge. The Forensic Science budget, controlled by police forces, lacks a mechanism to consider defence requirements. To secure legal aid, a defence team must provide three quotes and strong justifications, with controlled hourly rates that are often far below current market rates [1]. The primary selection criterion is usually to select the cheapest quote, irrespective of the quality or suitability, contributing to an inequality of arms in terms of gaining access in the first place, and then securing the best test for the issue at hand [1,3,5]. Access to Forensic Science analysis or independent Forensic Science expertise is also a challenge for those that are not reliant on legal aid for allied reasons.

Therefore, access to Forensic Science services is an important issue that has been acknowledged in the inquiries held since 2005, but remains under considered. It is nevertheless a factor that emerged from the analysis of the inquiry reports that clearly has significant impact on the Forensic Science ecosystem in explicit and tacit ways ranging from the importance of ensuring a fair trial, to larger scale societal trust in the justice system.

4.4. Knowledge production, communication and dissemination

The ways that knowledge is produced, communicated and shared by stakeholders within the Forensic Science ecosystem (forensic scientists, police forces, legal actors, government policy makers and academia) has been acknowledged as a contributing factor to different issues within the system [1,3,5,6]. Yet there has been a notable absence of in-depth discussion on this cross cutting element within the broader ecosystem. Interestingly, even the Forensic Science strategy lacked specific discussions or plans regarding knowledge communication and dissemination, highlighting a lack of strategic emphasis on establishing common language, clear channels of communication within the ecosystem and the means for sharing insight across the ecosystem.

A key theme that emerged from the analysis of the inquiry reports was that the landscape of Forensic Science research appeared fragmented [1,23,26], posing challenges to effective collaboration and innovation. One of the primary concerns emphasised in different reviews [1,26] was the necessity for enhanced communication and presentation of new insights and capabilities, particularly in ensuring their effectiveness in legal proceedings. Bridging the gap between the scientific community, responsible for developing methods and robust science, and investigators who utilise science insights as intelligence, and legal practitioners, who interpret science insights in the context of presenting evidence in court, has been identified as a critical area for improvement [1,23,26].

Considering that the final output of any Forensic Science laboratory influences investigative and legal decisions, the knowledge and awareness of the legal system within the Forensic Science stakeholders was considered inadequate [1]. It was observed that as a result of open channels of communication, common language, and opportunity for cross sector dialogue between different professionals within the Forensic Science ecosystem there were significant challenges arising from the fragmentation in understanding and appreciation of different contributions [1,3,5,6].

The 2019 House of Lords [1] inquiry committee observed gaps in the understanding of Forensic Science by those in the legal professions. The committee heard about different activities designed to mitigate this, with one example being the Royal Society and the Royal Society of Edinburgh ‘Primers for Court,’ addressing specific forensic practices [1]. Whilst six primers had been published, efforts to keep pace with forensic

developments was identified as a challenge [1,41]. Additional initiatives by the Inns of Court, College of Advocacy, and the Royal Statistical Society aim to address the knowledge gaps, but the 2019 House of Lords committee [1] highlighted optional participation and uncertain adoption rates as key challenges. The inquiry committee stressed the necessity of integrating Forensic Science into foundational legal training and ongoing professional development, potentially through the Judicial College, to ensure ongoing engagement with legal practitioners [1].

There have been many recommendations in different inquiry reports [1,3,26], to create a unified platform representative of all stakeholders in the Forensic Science ecosystem, to provide oversight and strategic leadership, to enable ongoing dialogue to share knowledge, expertise and experiences. At the time of writing no such entity has been formed. It is clear from the inquiry reports that this can be considered to be a significant obstacle to achieving a more connected ecosystem that can ensure an informed, cohesive, and efficient utilisation of science within the CJS.

Indeed, the importance of communication beyond the Forensic Science ecosystem is also profoundly important. The 2019 inquiry committee [1] heard evidence that underscored the impact of popular media representations of Forensic Science on juries, with the risk that certain forms of science evidence can be overvalued or overshadow other components of the case being presented.

Therefore, the importance of establishing better understanding of how knowledge is produced in different domains within the Forensic Science ecosystem, and how we communicate that knowledge and imbue that knowledge with meaning in the context of an investigation or within the justice system more broadly is a cross cutting element that needs to be incorporated into any consideration of the main themes or contextual factors that emerged from this analysis (Fig. 2) [1,5,6,26].

4.5. Identity of Forensic Science

The second cross cutting element identified in this study was the contested nature of the identity of Forensic Science, with Forensic Science often perceived as a field where different ‘parent’ sciences are applied to Forensic Science challenges rather than a multidisciplinary discipline in its own right [22]. This contested identity manifests itself across the main themes and contextual factors (Fig. 2). For example, when considering research funding, there has been a tendency to fund Forensic Science indirectly. Grants are awarded to research addressing a particular chemistry or biology challenge, and then attributed to Forensic Science because the results of the research may have potential application to Forensic Science. This identity struggle impacts funding opportunities, with a historical trend of low research funding due to its multidisciplinary nature. For example, national level funding for specific Forensic Science research questions was identified as £17.2m between 2009 and 2018, with £15m of that going on the development of analytical capabilities and only £2.2m addressing foundational research to underpin the evaluative interpretation of science evidence [27]. The 2019 House of Lords report [1] noted a lack of strategic long-term research due to scarce funding, with the UK Research and Innovation (UKRI) allocating only 0.1 % of annual funding for Forensic Science. Despite the inquiry report making recommendations and calling for reform and prioritisation of research funding, to date Forensic Science still lacks dedicated funding streams or research in the UK, perpetuating a challenging landscape [1,5,6,26].

It was found to be difficult to measure the true impact of Forensic Science on the CJS, especially with the absence of available data to assess the true value it adds to the system [6]. Whilst in some cases forensic evidence had a direct impact on the investigation by providing evidential support, in other cases it also had an indirect impact by providing/offering intelligence which would have been useful for investigations. In addition, the fragmentation of Forensic Science across different stakeholders augments the challenge of attempting to establish value, when one part of the system may benefit from the investment

from another part of the system. For example, Forensic Science has a significant impact on the trial process, necessitating a “more coordinated approach by the Home Office and the Ministry of Justice” [1]. However, the absence of metrics to measure the impact of Forensic Science on the CJS poses a challenge. Without effective metrics, evaluating the true value of Forensic Science and understanding its influence on funding and resource allocation within the industry becomes difficult, making Forensic Science an ‘easy target’ for cutting costs [1,6,42]. Finding ways to understand the value of science evidence in the broader Forensic Science ecosystem has remained elusive, but there is growing recognition of the need to consider value more holistically across different sectors within Forensic Science, and also across the short, medium and longer terms [1,6]. Indeed, based on recommendations from the 2016 [6] and 2019 [1] inquiries, the Home Office initiated an assessment of the impact of Forensic Science on the CJS, resulting in the commissioning of the Impact of Forensic Science project. The first phase report of this project was released in August 2022, presenting a model for impact measurement along with a series of studies to validate the model [43].

5. Conclusion

In conclusion, this study has identified five overarching themes, three contextual factors and two cross cutting elements from a reflexive thematic analysis of seven parliamentary inquiries. A matrix of factors (Fig. 2) has been developed to represent these components of the Forensic Science ecosystem, illustrate their connectivity, the key intersections, and the elements that are intrinsically (if not explicitly) embedded in each theme. The matrix illustrates the importance of considering context, connectivity and the dynamics of these different factors. It is hoped that the matrix offers a useful representation of the complexity of the Forensic Science ecosystem, and also a valuable tool for productive dialogue between stakeholders across the whole ecosystem that can set us on a path to address the challenges that have been repeatedly highlighted in the Forensic Science ecosystem.

The matrix highlights the importance of considering the Forensic Science ecosystem as a whole, engaging with the intersections between key components of the system, and retaining flexibility and nuance as challenges are tackled in response to the dynamic and ever evolving entity that Forensic Science represents. The findings from this study also highlight the importance of language and finding common ground. Many of the challenges that emerged from the inquiries remained persistent due to previous attempts to tackle those challenges remaining embedded in a single perspective. For example, the consideration of Research and Development has traditionally been considered within a service provision and industry (FSP) lens, rather than considering the research landscape within the whole Forensic Science ecosystem. More broadly it includes technical detection capability research, foundational research to underpin evaluation and interpretation, historical research to underpin an understanding of context and evolution, as well as incorporating high and low technology readiness level research and development, and short, medium and long-term needs.

The findings from this study highlight many of the persistent and multifaceted challenges facing Forensic Science provision in England and Wales. Despite extensive scrutiny and recommendations from parliamentary inquiries spanning over two decades, many of these issues remain unresolved. The findings from this research demonstrate how integrated these challenges are within the Forensic Science ecosystem and illustrates the necessity of holistic approaches that tackle the root causes of these challenges.

It is salutary that many of the recommendations have not been manifested in practice. It is possible to suggest that serial inaction could be considered to be an additional factor contributing to the need for ‘urgent reform’ suggested in 2019 [1].

Looking forward it is hoped that the matrix offers a stimulus to recommitting to tackling the deep rooted issues that exist and contribute

to the challenges addressed in many of the inquiries. Ongoing open dialogue that crosses traditional boundaries within the Forensic Science ecosystem is necessary. To achieve this, the matrix illustrates the importance of developing a clearer consensus on what Forensic Science is and what it is for, along with a common language and narrative of Forensic Science that enables cross-pollinating conversations and sharing of insights between different professions and practices.

In conclusion, addressing the deep-rooted issues within Forensic Science provision must recognise the complexity, interconnectedness and persistent fragmentation of the Forensic Science ecosystem. From the analysis undertaken in this study, it is possible to suggest that a coordinated, whole-systems approach will be critical to making progress and addressing deep seated challenges. It is clear that this presents a significant challenge, and one that does not have straightforward solutions. However, developing a cohesive strategy that integrates all relevant stakeholders, disciplines, sectors, and an understanding of society and culture at the local, regional and global scales appears to be the only way forward if real progress is sought. Open-ended, wide reaching dialogue across traditional siloes fuelled by a commitment for change and progress to ensure that science evidence can support the justice system, must be the place we need to start.

CRedit authorship contribution statement

Shrey Jhalani: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – original draft. **Ruth M. Morgan:** Conceptualization, Formal analysis, Methodology, Project administration, Supervision, Visualization, Writing – review & editing. **Amelia Shooter:** Conceptualization, Supervision, Writing – review & editing, Methodology, Visualization. **John Cassella:** Conceptualization, Formal analysis, Supervision, Writing – review & editing, Methodology, Visualization.

Declaration of generative AI and AI-assisted technologies in the writing process

During the writing process of this paper an author used ChatGPT in order to improve the readability and language of the paper. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the published article.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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