WMG, University of Warwick – Written evidence (FRS0093)

Supporting Statement

Professor Mark Williams heads the Digital Scanning and 3D printing research group (CiMAT) at WMG, The University of Warwick. He leads a unique research partnership between West Midlands Police (WMP) and the University applying Digital Manufacturing Technology to support the Criminal Justice System. This project also involves working closely with Home Office Pathologists and the Crown Prosecution Service (CPS). This capability has produced forensic evidence and provided expert witness statements to support more than 86 homicide cases for 13 Police Forces across the UK. The founding project ran for three years and has recently been expanded into the Centre for Digital Scanning and 3D Printing: a national research hub supporting homicide investigations. This collaboration is championed by Detective Chief Superintendent Mark Payne, Head of WMP Force CID and Michelle Painter, Head of WMP Forensic Services. All named parties would be happy to expand on the written evidence provided and answer any further questions if required.

The relevant Call for Evidence Questions are addressed in turn below.

1. Is forensic science contributing to the delivery of justice in the UK?
1. Research at the Centre for imaging, Metrology, and Additive Technology (CiMAT) – WMG, University of Warwick - has developed novel underpinning image processing methods and 3D visualisation techniques which are helping to shape the Criminal Justice System in the UK.

2. Methods have been developed and pivotal evidence provided for 86 homicide investigations across 13 Police Forces in the UK and abroad. Prosecution has not been pursued by the Crown Prosecution Service for over 10% of these cases, which represents cost savings (that are currently being quantified by a PhD student) because cases do not have to go to full trial. The research has produced new Standard Operating Procedures and training delivered as part of Continual Professional Development (CPD). A ground-breaking collaboration with West Midlands Police (WMP) has resulted in Warwick founding a three year funded ‘Centre for Digital Scanning and 3D Printing: a national research hub supporting homicide investigations’. CiMAT has developed a strong working relationship over the last four years with Home Office Pathologists and has delivered presentations at their annual conference. Two of the ground-breaking cases that CiMAT has worked on have been published in international, highly ranked, peer reviewed journals (Forensic Science International and the Journal of Forensic Science).

3. CiMAT is developing a number of Standard Operating Procedures (SOPs) for Forensic Examination which will be adopted within WMP and applied to Police Forces in the UK and Overseas. These include SOPs for Data Storage/Dissemination, MicroCT scanning of Forensic evidence, and Sample Logistics, which will be finalised in 2019. These processes are being developed to overcome any issues of evidence continuity and presenting evidence to a jury for homicide investigations. The 3D scanning technique employed provides image resolutions thousands of times more detailed than a hospital CT scan. Unlike in
traditional post mortems carried out by pathologists, the scanning is non-contact. Therefore, it is a Non-Destructive Technique that produces high-definition 3D scans of bones or organs without the need for an invasive procedure. Our 3D scans can identify injuries that would not be visible in a traditional Post Mortem, such as evidence of strangulation where no bruising exists. This technique has been validated through correlation studies with Histology techniques and results published in high-ranking research journals. The combination of micro computerised tomography scanning, 3D printing and 3D virtual reality makes this analytical process a UK first, as the sequence of events can be reconstructed and virtual models of the crime scene can also be created.

4. The evidence from the University of Warwick used in homicide investigations demonstrates that image processing methods and 3D visualisation techniques/digital processes in forensics play a critical role in establishing the truth. They help prevent miscarriages of justice and enables justice for victims, who are often vulnerable members of society, as well as justice in favour of protection and overall public welfare.

2. What are the current strengths and weaknesses of forensic science in support of justice?

5. Strengths: Improvements in credibility/robust investigations as Police Forces, the Crown Prosecution Service (CPS) and the Home Office are beginning to develop collaborative relationships with external research institutions who have expertise in technology relevant to forensic science.

6. Weaknesses: There is a slow uptake of new technology in forensic science, as the Criminal Justice System relies heavily on precedent and is understandably risk averse. There remains a significant disconnect between the digital world and forensic science and there does not appear to be sufficient resources available to validate the potential of emerging new technologies. There is a clear need to forge strategic partnerships with research institutions with the expertise to build confidence and help overcome these barriers.

3. What is the scientific base for the use of forensic techniques in the investigation and prosecution of crimes? Are there any gaps in that evidence base?

7. The scientific basis is the use of novel image processing techniques and 3D model reconstruction algorithms to produce manageable data sets for 3D visualisation for presentation as evidence. Novel optimisation methods enable reduced scanning time and minimise image artefacts that obscure important detail at higher resolutions, which were initially applied to help characterise material structures. WMG has a 20-year track record in this area. This research then led to the creation of methods and unique algorithms for reconstruction, in parallel with human anatomy studies (anterior cruciate ligament, hip and femoral research), which are used as a baseline (as accurate and reliable) to measure the deviation in other applications including pathology and forensic research, as well as in heritage conservation studies.

8. In order to fill the gaps in the evidence base CiMAT has developed a unique strategic partnership at a regional level (with West Midlands Police) and
nationwide to understand the needs of the criminal justice system and provide technical solutions.

4. How can the Criminal Justice System be equipped with robust, accurate and transparent forensic science? What channels of communication are needed between scientists, lawyers and the judiciary?
9. Guidelines issued by the Forensic Science Regulator requires future expert witness testimony to be backed up by data acquired through hard science. The multi-disciplinary approach that has developed between University of Warwick, West Midlands Police (WMP), Home Office pathologists and the CPS ensures that the Criminal Justice System is underpinned by robust, scientific evidence. As an exemplar, the partnership between WMP and CiMAT demonstrates how new technology is enabling an evidence-led approach to criminal justice. This is because there is an understanding of the practical issues faced during investigations, where CiMAT is able to apply its research and develop solutions to tackle these issues (including the development of Standard Operating Procedures). This unique partnership has been driven by the vision at WMP at a regional level, who are committed to overcoming the challenges faced in forensic science. Ideally, this approach should be rolled out nationally.

5. What is the level of understanding of forensic science within the Criminal Justice System amongst lawyers, judges and juries? How can it be improved?
10. Understanding of forensic science can be limited as lawyers, judges and juries are often non-experts. This can be improved through education via training programmes.

6. Is the current training available for practitioners, lawyers and the judiciary appropriate?
11. Training with digital technology is limited. Therefore, via WMP, CiMAT is working with the CPS to understand the training needs and tools that can be developed.

11. Is the Forensic Science Strategy produced by the Home Office in 2016 suitable?
12. The Forensic Strategy rightly recommends that specialist research institutions such as WMG/University of Warwick partner with all components of the Criminal Justice System. The reality is that this strategy requires significant support to deliver. Therefore, there is a need for the UK Government to invest in capacity, infrastructure and funding to ensure this vision becomes reality.

12. How should further research funding for forensic science be justified? What should be the focus of such research? What is the role of UK Research and Innovation, especially considering the interdisciplinary nature of much forensic science?
13. There is a requirement for sustained funding commitments from public and private funding bodies to ensure that scientific breakthroughs continue in the area of forensic science. Currently, funding is limited as public funding bodies have priorities around the UK Government’s Industrial Strategy and there seems to be no standardisation at the national level of funding approaches with different Police Forces. Currently, CiMAT has a strong relationship with 13 forces,
particularly West Midlands Police. The vision is to roll out this robust and credible approach nationally as a standardised practice, which mitigates the risks associated with using a number of different processes and represents a cost-effective measure to ensure that the use of digital processes is credible in forensic science.

14. UKRI also have a role to play in enabling multi-disciplinary research in this area, as well as capital investment. There should be a joined up approach across the UKRI bodies with regards to forensic science. Targeted calls are likely to stimulate collaborations between centres with varying expertise, which will ultimately build research capacity and innovation in this area.

13. Where are the gaps in research and understanding of forensic science? How and by whom should the research questions be articulated to fill these gaps?
15. The gaps are not fully understood and therefore it is recommended that a road-mapping exercise is undertaken, involving all stakeholders. This exercise should be multi-disciplinary as the research questions are not understood by a single party/group.

14. How can a culture of innovation in forensic science be developed and sustained?
16. There is a requirement for sustained funding commitments from public and private funding bodies to ensure that scientific breakthroughs continue in the area of forensic science to encourage innovation. The development of strong relationships with local Police Forces means that their needs will also be a central consideration to the research being developed, as this will ensure relevance and utilisation. There needs to be a recognition of emerging centres of expertise as a means to recognise innovations and partnerships. If funding continues to be channelled into the same sources, there is a risk that innovation will be stifled.

15. Are there current or anticipated skills gaps? Who should have responsibility for and/or have oversight of training?
17. There are currently skills gaps around the use of image processing methods and 3D visualisation techniques in forensics, particularly Data Dissemination, MicroCT and Sample Logistics (hence the development of SOPs). CiMAT is ideally positioned as a training centre to roll out CPD activities to other centres of analysis and members of the Police Force as part of a joined up approach. Training has already been delivered via the College of Policing and the National Surveillance Technical Professional Development Forum. CiMAT will continue to work with training bodies to address emerging skills gaps and base training around real cases, as well as informal opportunities for placements of CID officers for example, at Warwick.

16. Are there gaps in the current evidence base for digital evidence direction, recovery, integrity, storage and interpretation?
18. CiMAT is continuing to build the evidence base for the use of digital evidence. In the development of the novel underpinning image processing methods and 3D visualisation techniques, gaps have been identified in Data Dissemination, MicroCT and Sample Logistics (hence the development of the SOPs). CiMAT will continue to work with the Criminal Justice System to address emerging evidence gaps.
17. Is enough being done to prepare for the increasing role that digital forensics will have in the future? Does the Criminal Justice System have the capacity to deal with the increased evidence load that digital forensics generates?

19. There can be confusion regarding the definition of ‘Digital Forensics’ between the Criminal Justice System and academic community. For the purpose of responding to this question, Digital Forensics encompasses image processing methods and 3D visualisation techniques (use of digital processes in forensics).

20. It is the duty of any judicial system to meet the continuing challenges presented by the Information Age, as demonstrated by the fact that image processing methods and 3D visualisation techniques are playing a key role in the delivery of justice itself. Technological advances mean that experts have had to develop new ways to present increasingly complex evidence in court which can help make the evidence more relevant and easier to understand. Providing evidence of this nature in a court setting, as an expert witness (18.04.2017, Warwick Crown Court) is a challenge as the IT environment is outdated and does not easily facilitate the use of technology to deliver interactive experiences (for example, 3D virtual reality to demonstrate complex crime scenes or 3D animation models to demonstrate injuries).

21. In-court presentation requires the presentation of forensic findings in a way that is easy to understand for people without a specialist background. The presentation of different sources of information requires tools that align the different coordinate systems of 3D volumes, 2D photographs and reference model geometry into a common coordinate frame by means of registration algorithms. Presentation also benefits from a focus & context visualization paradigm, where specific details of a forensic case can be highlighted while showing them in the context of the remaining data set and the reference model. Animations can be presented in the form of videos or interactive demonstrations in the courtroom.

*submission by Professor Mark Williams*

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