Integrating research into operational practice

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Research and development can be classified into three categories: technology adoption, technology extension, and knowledge and technology creation. In general, technology adoption is embedded in operational forensic science laboratory practice but the latter two categories require partnerships with industry and/or academia both to conduct the research and implement the outcomes. In a 2012 survey, Australian and New Zealand forensic science laboratories identified a number of ‘roadblocks’ to undertaking research and operationalizing research outcomes. These included insufficient time and funding, a lack of in-house research experience and the absence of a tangible research culture. Allied to this is that, increasingly, forensic science research is conducted in a ‘commercial in confidence’ environment and the outcomes are not readily or cost-effectively available to be integrated into operational forensic science laboratories. The paper is predominantly reflective of the current situation in Australia and New Zealand.

1. Definitions

Forensic science: The application of science knowledge and methodology to legal problems and criminal investigations (http://legal-dictionary.thefreedictionary.com/forensic+science (accessed 6 December 2014)).

It is important to note that this definition refers to criminal investigations because the application of the forensic sciences extends beyond the court environment to adding focus to investigations and to the development and provision of intelligence. Therefore, a full discussion on forensic science research and innovation should have a broader focus than the courts.

Research: The systematic investigation into the study of materials and sources in order to establish facts and reach new conclusions (www.google.com.au/#=definition+for+research (accessed 6 December 2014)). Synonyms included in this definition are investigation, experimentation, testing, exploration, analysis, scrutiny and probing.

Innovation: Make changes in something established, especially by introducing new methods, ideas or products (www.google.com.au/#=definition+for+innovation (accessed 6 December 2014)). Synonyms included in this definition are change, revolution, upheaval, transformation and metamorphosis.

Both the last two definitions and particularly the synonyms are relevant to forensic science. Within the synonyms for research are investigation, testing, scrutiny and probing and this regularly occurs at the casework level in forensic science and so research is multi-dimensional. Within the synonyms for innovation are revolution, transformation and metamorphosis, and in forensic disciplines such as DNA, electronic evidence (cybercrime), pathology (CT scanning) and drugs (new psychoactive substances), for example, these words are certainly not out of place. Therefore, it is relevant to use both terms, research and innovation, in this discussion on the forensic sciences.

2. Phases of innovation

Kirkbride [1] defined three phases of innovation:
— technology adoption, which is the introduction and validation of new technology within a forensic science facility;
— technology extension, which is the extension and integration, within the forensic sciences, of technology from other fields of science or from extended research; and
— technology/knowledge creation, which is the discovery of knowledge and the invention of technology.

Traditionally forensic facilities have undertaken technology adoption and, generally, have the resources to do so at least in Australia and New Zealand. Those facilities that are accredited to international standards, for example ISO/IEC 17025, must also undertake the process of validation and/or verification. Therefore, integration of research and innovation at this level into operational practice could be considered routine.

Technology extension and, to a greater extent, technology/knowledge creation are more problematic when it comes to integration of these into operational practice. Both of these phases almost inevitably require engagement with agencies external to the forensic facility unless the facility has a well-developed research capability. However, few operational facilities within the forensic sciences have such a capability. External agencies include academia and for any forensic science facility engaging in meaningful research and innovation, particularly at the levels of technology extension and technology/knowledge creation, partnerships with universities are crucial. External agencies may also include other industries which have discovered and/or are working with technology and knowledge that has application within forensic science.

This is highlighted by a recent article in The Australian newspaper [2] which reported that a research paper from Universities Australia ‘noted that university collaboration with industry in Australia is poor and a greater focus is needed on translating research into products, services and innovations’. The paper ‘recommends the introduction of ‘stronger incentives’ for universities and industry to collaborate’. Such incentives should include research tax rebates for industry when collaborating with a university and recognition of industry/academic collaboration in the awarding of competitive grants.

In a paper titled ‘Research, development and engineering metrics’, Hauser [3] discussed the concept of tiers to describe R&D activities in the engineering field. Within this structure, Hauser described three tiers. The first relates to basic research which is exploratory and not tied necessarily to market outcomes. It has a longer term focus.

Tier two represents the development of ‘core technical competence’ with a focus on meeting the goals of a current strategic plan and setting directions for new planning. The third tier relates to activities that are carried out within the business units of an organization and generally have a market focus.

The three tiers of R&D described by Hauser have clear similarities to the three phases of innovation described by Kirkbride, with tier one aligning with technology/knowledge creation and tier three with technology adoption. The difference is that the tiers described by Hauser have a more commercial focus although such a focus may now be more relevant in an environment of increasing commercialization within forensic science service provision.

3. Roadblocks

The National Institute of Forensic Science (NIFS) in Australia is a Directorate with in the Australia New Zealand Policing Advisory Agency (ANZPAA). In 2012, NIFS surveyed the operational forensic science laboratories in Australia and New Zealand regarding their participation in research and innovation. One particular question related to the identification of ‘roadblocks’ to engaging in research and innovation within these facilities.

The most commonly identified roadblocks were the lack of:
— funding;
— research experience;
— time;
— a research culture; and
— capacity to operationalize research outcomes.

Roux et al. [4] described similar difficulties related to research in the forensic sciences in their paper ‘From forensics to forensic science’, especially with respect to attracting funding and, as discussed later in this paper, the inappropriate use of metrics to measure research success.

(a) Funding

The lack of funding was no surprise and it is a universal issue for forensic science research. Until recently, in Australia at least, forensic science was not seen as a science in its own right and therefore lacked any substantial support from the national funding bodies.

The lack of funding also impacts on a facility’s capacity to integrate research outcomes, particularly if expensive instrumentation is involved. The overwhelming focus of the majority of forensic science laboratories is the ever present caseload and resources are channelled into meeting those demands. Therefore, the resources required for research integration are often not available.

This is changing, with several forensic science laboratories in Australia appointing Chief Scientists who have a research focus. Funding for these positions, inclusive of a research budget, in some cases amounts to 3–4% of the total facility’s budget. However, in other cases, it is less than that. Even with these positions, the discretionary budget for research and/or the integration of research outcomes within operational forensic science laboratories is very limited.

(b) Research expertise

Traditionally, many of the practitioners working in forensic science have undergraduate qualifications and do not have sufficient research experience to engage in research itself or the integration of research outcomes. However, this situation is changing to a point where a critical mass of practitioners have postgraduate qualifications and research experience, and with appropriate resourcing will be in a position to engage in meaningful research. This situation should also lead to a greater capacity to implement research outcomes.

The forensic science programme in some of the universities in Australia has also matured to a point where there are a significant number of PhD students and some post-doctoral positions. This is adding to the collective research expertise within the broader forensic science community.
(c) Time
The time component for research is also linked to casework demands. Meaningful, mid- to long-term research cannot be achieved if it is expected to be undertaken in conjunction with casework. Researchers require blocks of time free of casework to be successful. Several facilities in Australia have appointed Chief Scientists with a research focus and this is a forward step not only in conducting research but in operationalizing research outcomes.

(d) Research culture
The lack of a research culture is essentially the product of the first four identified roadblocks and hopefully a research culture will develop as the other roadblocks start to diminish. One of the consequences of a minimalistic research culture, particularly at a management level, is a reluctance to engage in medium- to long-term research the emphasis, if any, being on short-term outcomes. Such an outlook perpetuates the existing environment.

(e) Capacity to operationalize research outcomes
Again, this issue relates to the other identified roadblocks. However, there are a number of initiatives internationally aimed at improving the rate of uptake, or at least sharing research outcomes with forensic science service providers and practitioners.

The Office of Justice Programs at the National Institute of Justice (NIJ), USA, has recently announced a programme which makes funding available to ‘Bridge research and practice’ [5].

The purpose of the programme is to make funds available to disseminate research outcomes to practitioners. Funding will be made available to previous NIJ research grantees such that they are better able to share their findings. Activities for research outcome sharing and which would attract funding include:

— "publishing in trade journals, newsletters or other practitioner publications;"
— presenting at professional, practitioner-focused conferences or webinars; and
— recording videos or podcasts for practitioner audiences’.

One of the key functions of the NIFS in Australia is to facilitate and fund an annual workshop programme with a number of the workshops each year being dedicated to knowledge and technology transfer. The Institute provides funding for an airfare for attendance by practitioners from each State and Territory to ensure that all jurisdictions receive the benefits of the transfer. However, it is the responsibility of individual organizations as to whether or not they implement the knowledge or technology.

Funding is also provided for attendance of academic staff at these workshops where they have been directly involved in the research. This maximizes the learning outcomes. On a number of occasions, NIFS provision of these workshops has counted as in-kind contributions which are integral to the total pool of resources considered in a research funding proposal. This is a means of guaranteeing knowledge and/or technology transfer at the conclusion of the project. NIFS also convenes ‘critical issues’ workshops where practitioners have the opportunity to identify research needs. Depending on the level of research required for any identified needs, partnerships with academia will be discussed.

Forensic science is not the only industry with concerns regarding the integration of research outcomes and lessons may be learnt from others.

For example, the Minnesota Department of Transportation [6] identified the end goal of transportation research being ‘to transfer the knowledge generated through research to those who can put it to good use’. Information is disseminated through websites and e-mail lists and, increasingly, the use of social media and blogs.

The report from the Minnesota Department of Transportation also identified that in terms of knowledge and technology transfer, practitioners ‘overwhelmingly prefer one- or two-page technical briefs’ and ‘are mostly interested in information on how to implement findings, as well as cost–benefit analyses of implementation. ‘The bottom line is that research results need to be condensed into useable bits of information and made easily accessible in a variety of formats’.

An emerging roadblock related to forensic science research and its integration into operational laboratories is the increasing tendency towards commercialization in forensic science service provision. Research outcomes which were once readily available throughout the forensic science community are now, to some extent at least, considered commercial-in-confidence. While this is understandable, it cuts across the basic tenet of science which is to share information.

Similarly, increasing levels of competition between universities may well lead to reduced opportunities for multi-agency academic/industry engagement which can be crucial for medium- to long-term research outcomes.

4. Research metrics
In conjunction with the tiers concept, Hauser [3] discussed the use of metrics in measuring research success, and this is a topic that is highly relevant in any discussion related to the implementation of research outcomes by forensic science facilities.

The use of metrics to measure research success has been the subject of debate over a considerable period. For example, Hauser included the topic in his paper on tiered R&D activities in 1997. In 2002, Toutkoushian et al. [7] discussed measures for research output and success and included metrics such as the total number of publications attributed to individuals at a particular institution and measuring research output by dividing the total number of publications produced by an institution by the number of full-time faculty. Research metrics is still the topic on keen debate.

In 2013, The US Research Universities Futures Consortium [8] released a report from the Research Metrics Working Group. The report discussed the importance of long-term exploratory goals for research and the advancement of society, and contrasts that with the increase in public expectations and levels of accountability related to publicly funded research. The report advocates the need for universities to self-measure research success rather than having externally imposed measures. It suggests that current measures are too heavily weighted towards institutional size.

With respect to research metrics, the report argues that to be most effective and to encourage international research collaboration, there should be global commitment and consistency in
an agreed range of metrics. This could lead to useful benchmarking and ‘meaningful ‘apples-to-apples’ comparisons’.

Similarly, the Research Excellence Framework (http://www.ref.ac.uk/ (accessed 7 December 2014)) introduced in the UK in 2014 advocates:

— the use of assessment outcomes by funding bodies ‘to inform the selective allocation of their research funding to higher education institutions (HEIs);
— assessment providing ‘accountability for public investment in research’ and ‘evidence of the benefits of (the) investment’ and
— ‘assessment outcomes providing benchmarking information and the establishment of reputational yardsticks’.

The Research Metrics Working Group report describes academic decisions that rely on metrics ranging from tenure, university ranking and levels of funding for research. The report refers to the UK Snowball research metrics project where ‘research intelligence and performance management frameworks can focus institutional strategies on research quality, raise the profile of an institution’s research, manage talent and build a high-quality research environment’. The report describes such metrics as being useful to funding agencies, governments and students.

There is also considerable discussion regarding the measure of research success in the UK. In April 2014, the Minister of State for Universities and Science launched a review of the role of metrics in research assessment. The Higher Education Funding Council for England is providing project management services for the review.

The review was designed to gain a greater understanding of the thinking around the use of metrics and called for submissions from a wide range of relevant sources [9]. Traditionally, peer review has been the key plank in assessing the quality and diverse impacts of research. Where there are productive relationships between the forensic science community and academia, operational scientists often become involved in the peer review process, and this can be helpful in terms of the integration of the outcomes into practice.

The use of other metrics is developing rapidly. The review discusses a range of bibliometric methods for assessing the value of research along with emerging social media and Web-based assessment alternatives [9]. In general, such metrics are used to ‘inform judgements of research quality that are made inside HEIs for their own management purposes around human resources and research strategy development, and in decisions by funding agencies’.

Responses to the request for submissions varied in terms of a preferred approach. Many were sceptical about the introduction of new metrics and some felt that they may be unfairly discriminatory for disciplines such as arts, humanities and social sciences. It was suggested that ‘a ‘basket’ of metrics which could vary in their use by discipline and subject area’ should be developed. It is worth noting that, in the Australian and New Zealand forensic science community at least, there is increasing engagement in social science research. This is particularly so in projects related to the efficiency and effectiveness of forensic science. An example of this is a paper by Kelty et al. [10] which explores the inter-relationships between medicine, science, law and law enforcement with respect to the investigation of complex forensic science cases.

A fifth of respondents to the survey supported an increase in the use of metrics in assessing the value of research. However, ‘a common theme that emerged was that peer review should be retained as the primary mechanism for evaluating research quality’. Concern was expressed about the reliability of journal impact metrics and also that ‘the use of metrics would discourage risk-taking in research’ where the inevitable ‘blind alleys’ of research would be less well tolerated.

Metrics suggested as having merit included ‘the number of citations, the number of research outputs, staff and postgraduate research student numbers and the amount of grant income or number of funding awards’. These are similar to those suggested by the Research Metrics Working Group in the USA [8].

5. Research uptake

Interestingly, in all the discussion about metrics to measure the value of research outcomes, there is little or no focus on measures related to the level of uptake of research outcomes by industry. Yet from an applied science perspective, and forensic science is an applied science, uptake by industry would appear to be a very important measure of research value. Granted, this should not necessarily be the case for the first tier of research as described by Hauser [3] as this relates to basic research. Similarly, the level of uptake should not be a contributory factor in discouraging risk-taking in research, which is an important factor in knowledge and technology creation. However, in research aimed at technology adoption and technology extension, uptake by industry should surely feature in any assessment of the value of the research.

The critical issue here is the relationship between forensic science and academia.

6. Partnerships

This point is made in papers from the health industry and environmental science with their engagement in bridging the gap between research and its successful implementation. In a paper titled ‘Bridging the implementation gap between knowledge and action for health’, Haines et al. [11] state that ‘There is a need to strengthen institutions and mechanisms that can more systematically promote interactions between researchers, policy makers and other stakeholders who can influence the uptake of research findings.

Similarly, in a paper titled ‘Bridging the gap between ‘planning’ and ‘doing’ for biodiversity conservation in freshwaters’, Barmuta et al. [12] advocated genuine collaborative involvement between stakeholders and managers in the planning process. They also strongly encouraged maintenance of that collaboration throughout the project if sustained change is to be realized.

Academia has the expertise, the time and the culture required for successful research, especially long-term research involving researchers at PhD and post-doctoral level. Forensic science will have knowledge of where research is required in order to enhance the outcomes of forensic science service provision. The partnership between forensic science and academia needs to be such that the forensic science community can at least inform the research agenda if not drive it. However, there needs to be an understanding within the forensic science community that basic, ‘blue sky’ research will not always return useable outcomes. The partnership should be such
that there are opportunities to leverage any available funding and engagement should be ongoing through the entire course of the research as suggested by Barmuta et al. [12].

Switzerland has a very successful model for partnership research where PhD students from the University of Lausanne work part-time within policing. This is a symbiotic arrangement described by Margot [13] where policing can influence the research agenda, students have access to important data sources and there is a direct transfer of research outcomes into practice.

As a note of caution, for forensic science, academia and research provide support for practice improvement. For academia, forensic science can be viewed as a convenient domain for the application of fundamental science and a rich source of data. In this respect, the emphasis of the research may be on publications rather than value-add to forensic science. The different approaches need to be modified if the partnerships are to produce maximum effect.

7. ‘New’ fields of research

As mentioned previously, the application of forensic science is broader than the court room environment and extends into intelligence and investigation. With intelligence, forensic science can play a role in crime disruption and crime prevention which it has not traditionally played. With respect to investigation, forensic science can influence the focus of investigations through early elimination of suspects, for example. It is vital that future research is not only in forensic science but also on forensic science [14].

The roadblock to these latter activities is timeliness. The production and presentation of intelligence and investigative information has a critical time element. This information should be available to investigators in hours and days rather than weeks and months, the latter of which is often the case as a result of ever present caseloads and backlogs.

Forensic intelligence is a relatively new initiative for forensic science and, similar to research, there is not a well-developed intelligence culture. As discussed by Crispino et al. [15], this will need to be developed through education and training in this field. Research is also required in, for example, the areas of validation and verification or peer review in the forensic sciences. This was highlighted in the NAS report [16] and more recently in a paper by Edmond et al. [17] titled ‘How to cross-examine forensic scientists: a guide for lawyers’. Along with the previously mentioned social science research related to effectiveness and efficiency, these areas represent a new dimension in research, away from the traditional methodology- and technology-based focus. While the continuation of traditional research is essential, so too is research within these other areas.

Unfortunately, the broader scope of research will most likely need to be undertaken within the existing funding base available for forensic science research, and in fact the more practical areas of research such as validation and verification are unlikely to attract interest from the more traditional funding bodies. This is obviously problematic given the importance of the research.

What is certain is that whatever the scope of forensic science research, there will still be a requirement for strong partnerships between academia and the forensic science industry and an ongoing requirement for the integration of outcomes.

8. Summary

Forensic science is rapidly changing and evolving. This is both as a result of research outcomes and a driver for additional research; it will ever be thus.

It is essential for forensic science to become and remain contemporary in the interest of public safety and sound justice outcomes. To do this, it must engage in a broad scope of research and research at different levels of complexity. In much of this, the forensic science community must engage in the development of strong productive partnerships with academia. This is not just to conduct the research but to ensure that the outcomes of research are integrated into operational practice. The metrics used to gauge research success should include the level of uptake of research outcomes by the relevant industry, and this will be assisted by peer review where there are productive industry/academic relationships.

Finally, every facility, every jurisdiction and every country are facing the same issues in forensic science and, by default, are seeking the same solutions. The need for international cooperation in forensic science research and innovation is obvious and should be vigorously pursued.

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