Forensic Technology
CENTER OF EXCELLENCE
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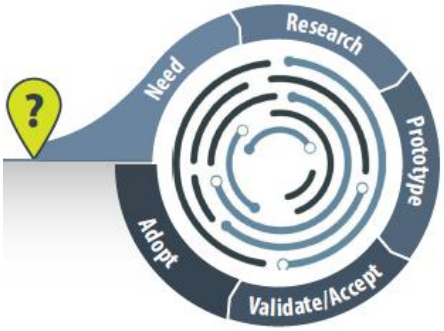
IN-BRIEF
The Researcher's Role in Technology Transition



"We need strong science to support the fair and impartial administration of justice. Researchers can positively impact the operations in the field."

—Lucas Zarwell
Director, Office of Investigative and Forensic Sciences, National Institute of Justice

Introduction

Research and development (R&D) plays a key role in improving the practice of forensic science. The knowledge, tools, and methods developed by researchers can help improve the objective collection, analysis, and interpretation of evidence. Adoption into practice is the end goal and true value of all R&D, and **technology transition** is critically important for the forensic community.

Technology transition starts with understanding the **needs** of forensic practitioners and generating a research question. Researchers then develop solutions to address these needs through their **research** and iterate upon solutions by creating and **testing prototypes** with end users. Eventually, researchers introduce technologies into casework to scientifically and legally **validate** solutions and drive **acceptance**. **Dissemination** to the community promotes **adoption** into casework. The transition process is continuous and cyclical as solutions demand continuous improvement and enable solutions not previously envisioned.

Typically, researchers are champions of their technologies and feel responsible for developing, refining, and promoting their work so that it may be adopted by an end user. However, successful technology transition often requires researchers to interact with users and connect to the forensic community far earlier than they might have anticipated. Forensic stakeholders can help researchers better understand a need, consider the realities of use in the field, or highlight realities specific to use in the criminal justice context. This in-brief provides an overview of the researcher's role in driving technology transition and summarizes both the characteristics of successfully transitioned technologies and the roles of forensic stakeholders in moving research to practice.

Objectives

- Outline the steps required for technology transition and the role of the researcher in driving research to practice
- Highlight the researcher's goals of desirability, feasibility, and viability in developing quality forensic solutions
- Outline the roles of the researcher and other stakeholders in the forensic community in successful technology transition

Grantees, the fate of your research lies in **your hands**. How might you set up your research for successful transition?

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Successful Technologies Create Value by Addressing End User Needs

Solutions that successfully move from research to practice share three important characteristics that add value to the innovation: The technology must (1) address a need expressed by end users, (2) be technically feasible— the technology, and implementation of technology, is attainable; and (3) be viable in a laboratory, court, or field setting—the technology works in practice. These characteristics are diagrammed in **Figure 1**.[1]

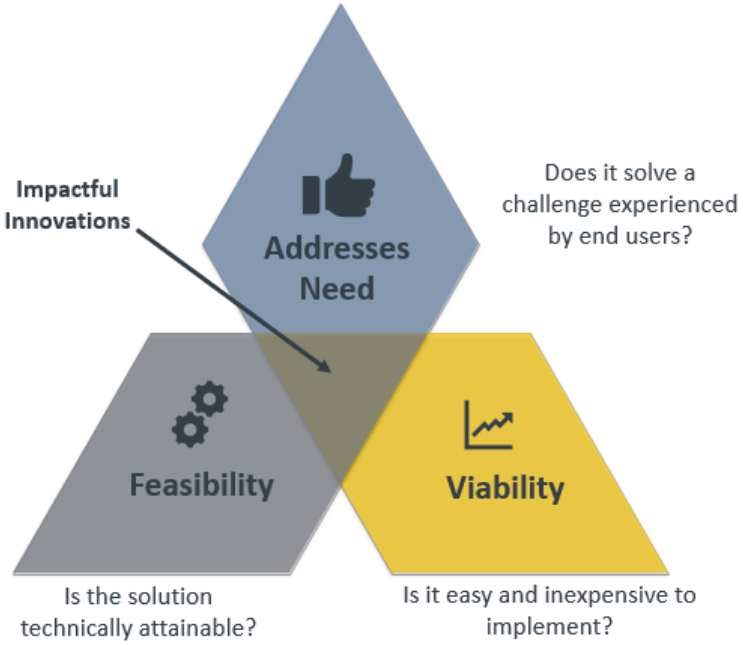

Figure 1: Value is created when an idea or technology addresses forensic needs and is feasible and viable.

Addressing Forensic Needs

New forensic solutions must address the needs of forensic practitioners. A new tool, process, or technique can resolve a challenge that practitioners regularly experience when carrying out their jobs. **Desirable** innovations have a strong **value proposition**, which is a statement that describes how it creates value for end users (e.g., improves accuracy, enhances capabilities, is less expensive, is faster or more efficient). Researchers must take into consideration competing solutions and convey both how their solution is better and what it costs in terms of investment and implementation to ensure end user adoption.

Value propositions capture how your solution provides value to the end user. Resources like Strategyzer provide frameworks to brainstorm, develop, and test value propositions with end users.

Technical Feasibility

A **feasible** innovation must be technically attainable. That is, it must be technically possible for the product, technique, or process to offer the intended benefits. Although this is often the focus of research, development partners, such as manufacturers or forensic collaborators, can help ensure feasibility by providing feedback, testing, and evaluation.

Viability

Solutions that are feasible and desirable to the end user must be sustainable in order to be adopted and implemented in the forensic community. **Viable** innovations are affordable to agencies and laboratories and are easily integrated into the workflows of forensic practitioners.

Feasibility, Desirability, and Viability in Action
The National Institute of Justice's (NIJ) Forensic Technology Center of Excellence (FTCoE) provides resources and support to forensic researchers to help them "close the loop" between research and adoption. For example, the FTCoE considered desirability, feasibility, and viability in its efforts to support technology transition for Dr. Bruce McCord at Florida International University (FIU). Dr. McCord, a NIJ-supported researcher, developed a paper-based microfluidic system for explosives and illegal drug testing (2012-DN-BX-K048). The FTCoE assisted with transitioning this technology, as described below:

Addressing Needs: Addressing a need to quickly identify unknown substances in a field setting, these paper-based devices are presumptive tests for chemicals and body fluids and are intended to replace methods that often require large laboratory-based equipment and caustic reagents. This need was validated by discussions enabled by a FTCoE-produced, researcher-led webinar that introduced the technology and its capabilities to the forensic community [2].

Feasibility: Dr. McCord's technology provides presumptive multiplex testing that is sensitive to the microgram level, and the team is working on enhancing that sensitivity. Dr. McCord is currently working with the FTCoE to identify and pursue appropriate partners, including potential co-development partners. A FTCoE-produced success story summarizes the value propositions of this technology to potential partners and end users [3].

Viability: This paper-based technology is inexpensive and easy for trained law enforcement officers to use. Dr. McCord has validated his technology with the Miami-Dade Bomb Squad, who provided useful feedback on improving the usability and design. He is currently seeking external partners to continue field-based validation.

The FTCoE supported Dr. McCord with enhancing the desirability, feasibility, and viability of his innovation and effectively communicating the value of the technology to end users. The FTCoE is currently working with FIU's Office of Technology Management to develop marketing collateral and identify development partners.

Researchers Drive the Transition Journey

With the support of other stakeholders, researchers cross the gap from research to practice through a process that challenges them to iterate, validate, and ultimately drive adoption of their solutions in the forensic community. As outlined in **Figure 2**, researchers play a key role in the transition journey.

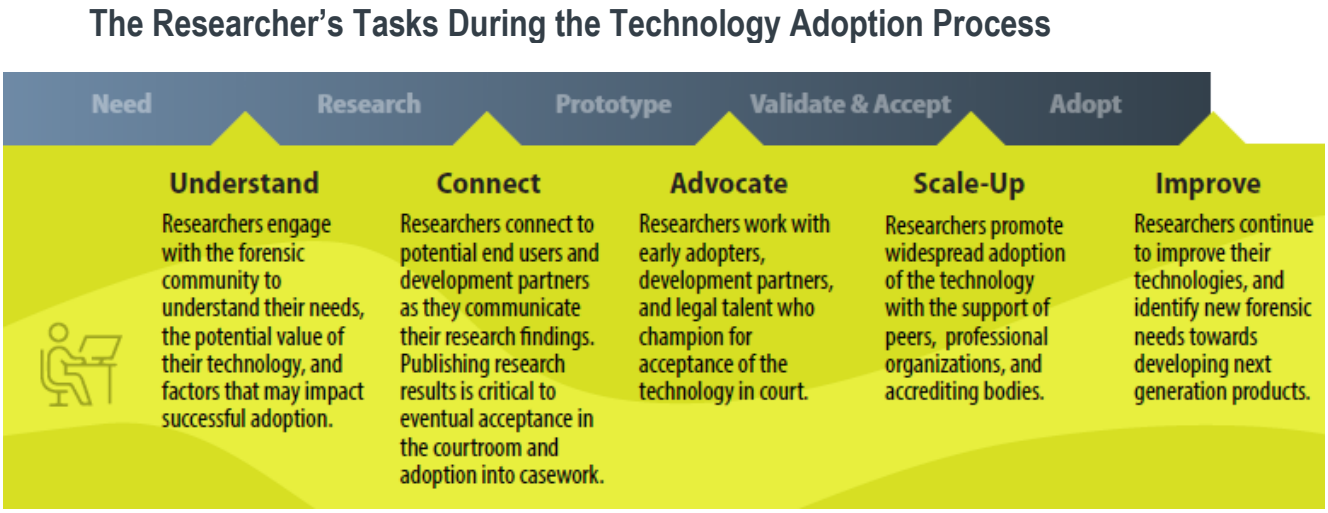

Figure 2: Researchers work from need through prototype to use and then to improvement.

Understanding the Need

Successful technology transition starts even before research begins. Researchers gain insight by interacting with end users to understand and pinpoint key community challenges. This input allows researchers to focus their research questions and develop technologies and methods to address relevant gaps in the community.

Understanding Needs of the Practitioner Community

NIJ helps identify key needs in the forensic community. For example, NIJ supports the Forensic Science Research and Development TWG, which identifies and discusses operational requirements across forensic disciplines. NIJ also supports the Forensic Laboratory Needs TWG (FLN-TWG), which discusses ways to improve efficiencies through the implementation of innovations in forensic laboratories. Both TWGs are comprised of experienced forensic science practitioners who provide valuable input as end users of forensic technologies.

The National Institute of Standards and Technology help to understand and communicate needs through the 25 discipline specific Organization of Scientific Area Committees (OSAC) Subcommittees.

Connecting with Stakeholders to Test their Innovations

During prototyping and validation, researchers continually make changes to better align solutions and improve the end user experience. Researchers must connect with forensic laboratories, law enforcement agencies, and development partners to test their solutions in realistic environments. Successful paths to adoption may include engagement such as

- Testing to understand user experiences of the innovation and iterate towards a value-adding innovation;
- Piloting the technology in a real or realistic environment
- Validating that the technology offers an improvement over existing solutions
- Helping move the technology towards legal validation, when the legal community petitions for acceptance of evidence related to the use of a technology in a court system, using a Frye or Daubert standard

Advocating for Adoption and Improvement

Researchers promote adoption of their solutions by disseminating information in the form of publications, presentations, trainings, and other resources. Professional organizations and accrediting bodies support implementation by developing standards and best practices that improve potential users' consistent and accurate use. Even after a solution has been widely implemented in casework, there is room for further development, as researchers continue to improve the outcomes, efficiency, cost, or usability. Researchers build upon past work and start the transition cycle again.

Each transition pathway is unique. In the FTCoE's Transition to Impact Webinar, three researchers share their experience bringing their research to practice [4].

- Dr. Cassandra Calloway of the Children's Hospital Oakland Research Institute discusses the process of transitioning a new methodology of analyzing DNA samples that are sparse or degraded.
- Dr. Catherine Grgicak from Rutgers University shares insights from developing Cesspit and PROVEDIt, software programs for autosomal short tandem repeat (STR) DNA analysis.
- Dr. Randall Clark from Auburn University offers perspective from his experience transitioning knowledge related to resolving isomeric forms of synthetic drugs.

Navigating Unique Paths

The pathway to adoption is unique for each solution developed. Some succeed through a traditional commercialization pathway, where an innovation is productized, intellectual property is protected, and the technology is monetized. For example, a researcher developing a novel, rapid, paper-based presumptive drug test could significantly benefit from a partnership with a scientific equipment manufacturer able to support validation and eventually become a distribution partner. Although a traditional commercialization pathway may add value to products or services purchased by end users, some methodologies and databases may be best disseminated through knowledge transfer activities, such as webinars and workshops. Given the range of pathways, researchers may benefit from engaging with their technology transfer office, development partners, or end users in the nascent stages to help identify a potential business model and transition path for their innovation.

Stakeholder Engagement is Critical for Technology Adoption

Successful solutions to challenges are rarely developed by researchers working alone. When researchers connect with stakeholders in the forensic community, there is more likelihood of achieving real impact. These stakeholders ultimately enable adoption, leading to long-term impact on forensic practice. Indeed, the entire forensic community plays a role in technology transition, as shown in **Figure 3**.

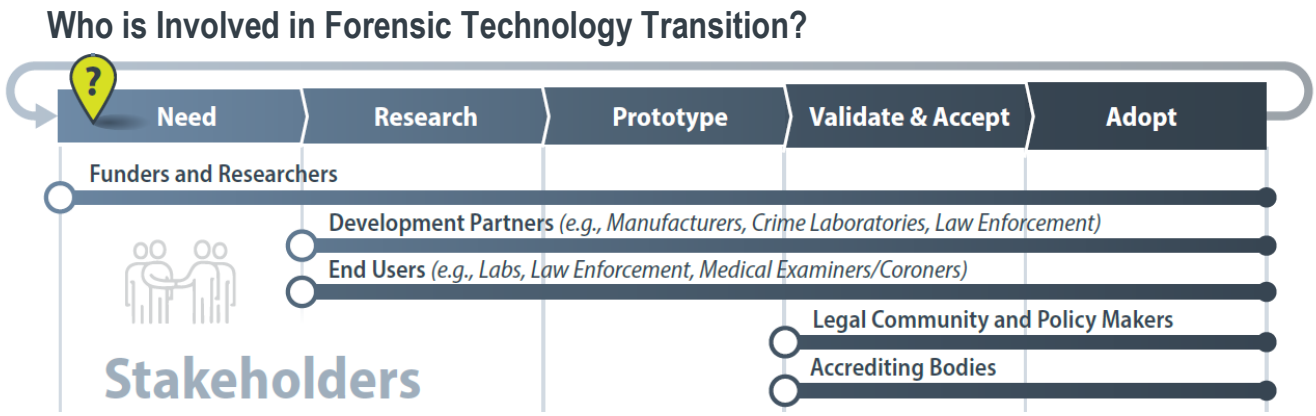

Figure 3: Every member of the forensic community is needed to create meaningful solutions to problems.

Funding Sources

Agencies, foundations, companies, and venture capital firms constitute key contributors to successful innovation. They put resources toward understanding needs and support the development of solutions from basic research to validation and acceptance into practice. These stakeholders seek to engage and financially support researchers to recognize needs, provide solutions, and facilitate adoption practices.

The FTCoE published a landscape report on forensic R&D funding (2016), which provides a detailed overview of sources of federal and foundation funding for forensic science research [5].

Development Partners

Development partners help researchers mature their technology into functional prototypes and products. These partners can include (1) forensic laboratories and law enforcement agencies who are willing to validate a new technology and evaluate its value in a real-life environment; and (2) manufacturers who can assist with prototyping or helping researchers achieve a technically feasible innovation.

Development partners are often not aware of emerging research that is ready for commercialization. Researchers' participation in forensic conferences and professional organizations can foster awareness and lead to meaningful collaborations with other stakeholders.

Programs that Connect Researchers to Development Partners

- The Laboratories and Educators Alliance Program is a partnership of the American Society of Crime Lab Directors (ASCLD) and Council of Forensic Science Educators (CFSE). This program enables universities to partner with forensic laboratories interested in hosting a student for an internship opportunity or collaborating on a research project.
- The Industry-University Cooperative Research Centers Program (IUCRC) is a National Science Foundation program with support from NIJ that partners university with industry to transition research to the field. The Center for Advanced Research in Forensic Science (CARFS) is an IUCRC with locations at FIU, Northeastern University, Texas A&M, and the University of South Alabama. CARFS aims to connect researchers with industry partners and foster pre-competitive research.

End Users

The experience and needs of end users, such as forensic science practitioners, the legal community, and law enforcement, lie at the heart of the technology transition process. These groups serve as the customers of the processes, tools, and products stemming from research. Thus, end users must be open to testing these innovations during the development process. As future users/customers of the technology, their input is crucial to the development of desirable solutions. The needs of users are the innovation driver and are often expressed via needs assessments or working groups.

Accrediting Bodies and Professional Organizations

Accrediting bodies and other professional organizations promote the adoption of forensic innovations by developing standards and best practice guidelines. State forensic science commissions help coordinate resources and foster communication among laboratories and stakeholders. These entities communicate with end users to understand their experiences using the technology, create user-friendly guidelines that enable the innovation to be used consistently and appropriately, and drive broader adoption.

Professional Organizations Promote Technology Adoption

Examples of accrediting and certification bodies include the following:

- American National Standards Institute (ANSI)'s National Accreditation Board (ANAB)
- American Board of Criminalistics (ABC)
- International Association for Identification (IAI)
- Forensic Specialties Accreditation Board (FSAB).

The FTCoE has published a report describing the roles of and lessons learned by state forensic science commissions in the United States [6].

Legal and Policy-Making Professionals

Legal and policy-making stakeholders can help support the use of evidence related to the use of new technologies in the court system. They work closely with researchers, end users, and development partners to understand and communicate the value of the innovation in supporting justice.

The FTCoE Can Help You

The FTCoE drives innovation and technology transition by providing stakeholders in the forensic community with evidence-based resources. For researchers, these resources include information about, testing of, and training on forensic technologies; working group efforts; and active support to assist researchers through the technology transition process. The FTCoE aims to help researchers develop solutions that are desirable, feasible, and viable by:

- **Identifying and understanding community needs**. The FTCoE identifies challenges and limitations emerging from working groups, workshops, and symposia and creates content that highlights and supports these needs. These resources and engagement opportunities help researchers define research questions and develop solutions with a greater likelihood of adoption and impact.
- **Enabling products and processes**. The FTCoE can perform in-field evaluation and validation studies. Furthermore, the FTCoE can also help connect researchers to development partners and provide licensing and other commercialization support.
- **Engaging and informing stakeholders**. The FTCoE communicates products and techniques ready for adoption via avenues such as success stories and landscape reports and provides knowledge transfer opportunities for researchers to present their work to the forensic community. The center also participates in stakeholder meetings to better understand and engage the innovation process.

The FTCoE understands the value of connecting individuals working in the forensic community to promote collaboration. Their no-cost resources serve a variety of forensic disciplines and stakeholders in the community.

Conclusion

Forensic R&D creates significant impact when its outputs are adopted by the forensic community. Researchers are responsible for driving this transition process and can improve their chances of success by developing innovations that are desirable, feasible, and viable. Engagement with the right forensic community stakeholders is necessary for developing solutions with these important characteristics and, ultimately, for improving the practice of forensic science.

Resources

[1] Brown, T. (2009). *Change by design: How design thinking transforms organizations and inspires innovation.* New York, NY: HarperCollins.

[2] Forensic Technology Center of Excellence. (2018). *Paper Microfluidic Devices for Fieldable Forensic Testing.* National Institute of Justice, Forensic Technology Center of Excellence https://forensiccoe.org/webinar/paper-microfluidic-fieldable-testing/

[3] Forensic Technology Center of Excellence. (2019). *Success Story: Enabling Forensic Field Testing with Paper Microfluidic Devices.* National Institute of Justice, Forensic Technology Center of Excellence https://forensiccoe.org/success-story-mccord-field-testing-paper-microfluidic-devices/

[4] Forensic Technology Center of Excellence. (2019). *Webinar: Transition to Impact—Bringing Research to Practice.* National Institute of Justice, Forensic Technology Center of Excellence https://forensiccoe.org/webinar/webinar-transition-to-impact-bringing-research-to-practice-live/

[5] Forensic Technology Center of Excellence. (2016). A Landscape Study of Federal Investment in Forensic Science R&D National Institute of Justice, Forensic Technology Center of Excellence https://forensiccoe.org/report-federal-investment-in-forensic-science-rd/

[6] Forensic Technology Center of Excellence. (2016). State Forensic Science Commissions. National Institute of Justice, Forensic Technology Center of Excellence https://forensiccoe.org/report-state-forensic-science-commissions/

Additional Resources

The FTCoE supports researchers throughout the technology transition process. The in-brief titled Innovation in Forensics: A Community Effort, provides an overview of how the FTCoE can help researchers at every step of the technology transition process. This in-brief and other resources can be found at www.forensiccoe.org.

The NIJ R&D Portfolio Management and Technology Transition Support report can be found at www.forensiccoe.org.

About NIJ's Office of Investigative and Forensic Sciences

Image Credits

Page 1, 3, 5—RTI International

Page 2—Adapted from Brown, T. (2009). *Change by design: How design thinking transforms organizations and inspires innovation.* New York, NY: HarperCollins.

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