

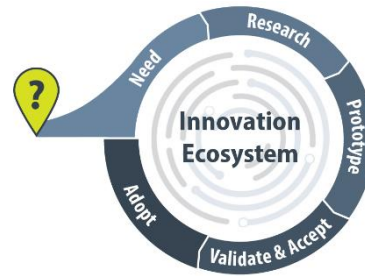


IN-BRIEF

Innovation in Forensics: A Community Effort

“Innovation requires connections... among key stakeholders ... These connections are increasingly taking place in ‘innovation ecosystems’...”[1]

—Fiona Murray and Phil Buddem, MIT Sloan School



Innovation is a cycle empowered by people moving from needs to solutions to use.

Introduction

Innovation in forensic science advances new technologies and techniques to improve the scientific foundation of the field as well as the objective collection, analysis, and interpretation of evidence. These advancements can have a significant impact on the forensic community; however, incorporating technologies and knowledge into practice is challenging and requires strategic and committed community engagement.

Innovation is often described using the biological ecosystem concept including resources, relationships, competition, and collaboration. The forensic innovation ecosystem comprises a network of multiple stakeholders including researchers, funding agencies, development partners, suppliers, legal and policy professionals, accrediting bodies, and criminal justice end users working together to develop, validate, and implement forensic technology transition solutions. Stakeholders in this ecosystem play a key role in enabling technology adoption and transitioning knowledge into practice.

This in-brief introduces the forensic innovation ecosystem concept and further identifies and considers the roles of various stakeholders and activities required for success in the forensic innovation ecosystem. Toward this aim, the National Institute of Justice’s (NIJ) Forensic Technology Center of Excellence (FTCoE) supports the forensic innovation ecosystem by connecting stakeholder groups and supporting researchers through technology transition to practice.

Consider where you fit in the ecosystem, the role you can play, and the impact you can have in enhancing justice outcomes by improving forensic innovation.

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Objectives

- ▶ Introduce the forensic innovation ecosystem concept as a framework for understanding and improving transition of research and technology into forensic practice.
- ▶ Highlight key stakeholders in the forensic innovation ecosystem.
- ▶ Outline how the NIJ FTCoE actively supports innovation for the forensic community at large, including technology transition for researchers.

Successful innovation requires **multi-stakeholders within the forensic community** to participate in:

- sharing needs and ideas;
- researching and building new solutions; and
- using and improving products, methods, and arguments.



The Forensic Innovation Ecosystem

What is an innovation ecosystem, and what is unique to forensics?

The concept of an ecosystem serves as a common framework in today’s innovation management discussions. Ecosystems are a complex set of relationships associated with survival and growth within a shared equilibrium. In most cases, an innovation ecosystem has economic tensions that are parallel to traditional energy dynamics in biology or energy transfer in chemistry dynamics[2]. Technology development and utilization are the shared equilibrium in innovation ecosystems. In this context, the actors include resources and people, which are both focused on research, and the user community which is typically the marketplace. Economies are linked in market-driven ecosystems (e.g., pharmaceuticals, aviation, information technology, defense) because the commercial sector drives the research agenda. The economics of law enforcement are resource constrained, especially towards technology over manpower. In profit-based economies, the financial upside helps drive interest, engagement, and action. However, in the case of the forensics innovation ecosystem, the financial element of market pull is reduced, limiting technology adoption. Implementing forensic technology requires not only alignment with stakeholder needs, but with factors such as legislative mandates, court systems, and accreditation requirements. The complexity of the ecosystem leads to a nonuniform marketplace, as some jurisdictions may experience an easier environment to adopt new innovations compared to others. The path to successful forensic innovation implementation often includes a “large energy barrier”, which consists of unique forensic considerations such as Daubert factors and widespread community acceptance. In this ecosystem, the balance between research and adoption is more tenuous and—in some cases—this balance may require other players, such as the government, to “add energy” (e.g., funding, policy).

The reality of technology innovation and transfer for the US government is highlighted in the recent publication [Return on Investment Initiative for Unleashing American Innovation](#). The government is working to (1) advance Lab-to-Market impacts, including cross-agency benefits, and (2) maximize the transfer of federal investments in science and technology into value for America [3]. For forensics, this translates to greater impact from research and development towards justice.

What are the stages of the innovation ecosystem, and who are the stakeholders in forensics?

Innovation either begins with a need or is empowered by a new, enabling idea or technology. Innovation involves continuous improvements and iterations. It is complex, with many people working independently or together. It includes people with disparate and inter-related needs. It involves people working on novel ideas and improving existing solutions. Innovation is not simple, and it is not a linear process. However, depicting the path in a linear fashion can be helpful to understand the innovation pathway. **Figure 1** illustrates how innovation forms a path from need to solution, to practice.

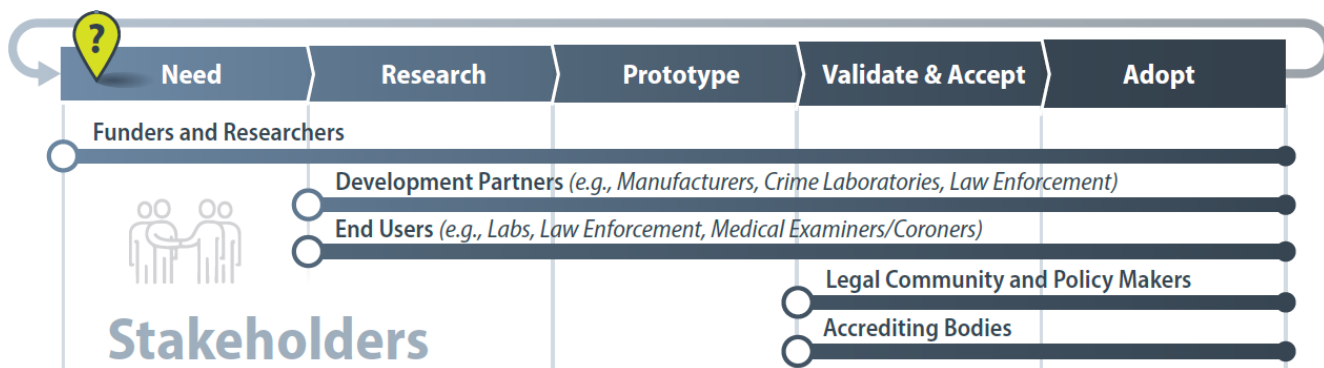


Figure 1: Innovation arises from valued use, which is driven by people with needs and solutions that compel use.



People are the true drivers of innovation. Within the forensic community, “people” includes police and prosecutors seeking justice, the victims and survivors of the crime, and even individuals accused of crimes and the attorneys who represent them. All parties are served by forensic practitioners—at crime scenes and in the laboratory—who need more efficient and more cost-effective ways of collecting, managing, analyzing, and interpreting evidence. Forensic practitioners benefit from the products and methods that researchers and developers design and produce; standards and accrediting bodies often guide the adoption of these products and methods. It takes the combined perspectives and actions of these stakeholders to understand and solve challenges with new products, methods, and services in order to support the fair administration of justice.

How do you fit into the forensic innovation ecosystem?

How can the NIJ FTCoE work with you?

Innovating is hard, and researchers need help connecting their work to create real impact.



Understanding Technology Transition Needs

NIJ identifies, discusses, and prioritizes operational needs and requirements by engaging the forensic science practitioner community through the [NIJ Forensic Science Research and Development Technology Working Groups](#). [4] These needs and requirements help inform NIJ's planned and ongoing research and development activities, and ensure that future research and development investments meet practitioner-driven needs.

The FTCoE supports the forensic community by:

- Developing resources and activities that address forensic community technology transition and operational needs;
- Seeking to understand stakeholders' evolving needs and deliver relevant, valuable support and content. The FTCoE identifies challenges and limitations brought up in working groups, workshops, and symposia;
- Creating content that highlights, defines, and supports these needs. End-user feedback is employed heavily in resources like landscape reports, which provide overviews of a product (or technology) environment to support purchase and implementation.

Community Needs Drive FTCoE Efforts and Investments: During the 2018 portfolio review, the FTCoE identified multiple NIJ-funded grants with microbe-based technologies for postmortem interval (PMI) determination. Diving deeper, the FTCoE considered needs of researchers, technology developers, and end users in this space. As a result, the FTCoE developed webinars to improve awareness of technologies that use microbial data for PMI; these webinars also helped to accelerate understanding, development, and transition. Next, the FTCoE helped organize a [working group meeting](#) at the 2019 American Academy of Forensic Sciences annual meeting, which brought together researchers, medical examiners, pathologists, and legal experts to address gaps in research and to collectively consider an improved path to technology adoption. The FTCoE continues to support these grantees and is currently considering next steps such as an ongoing list of needs for microbe-based PMI methods stemming from working group discussions.

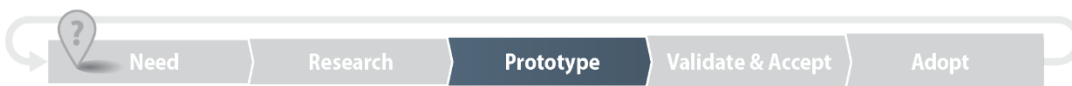


Linking Research to Impact

Reviewing the research portfolio is an important measure that helps the NIJ understand where forensic needs and solutions align. Periodically the FTCoE engages in a “trriage” process, where the team and external industry experts evaluate each R&D grant for anticipated impact, transition barriers, and potential results from transition support. The FTCoE follows up with PIs of high priority cases to further assess the technology and develop a plan to move through the innovation pathway.

Engagement between researchers and the FTCoE enables grantees to work towards certain transition paths. As a result of the portfolio review process, the FTCoE team connects with select researchers to help them consider transition, initiate dissemination, and pursue commercialization of their research. Every year, the FTCoE program provides NIJ-supported grantees with an opportunity to update their progress, and publications, as well as voice their needs for transition support. To date, over 500 cases have been triaged by the FTCoE, with 122 cases being further assessed and 41 directly supported. In addition, the FTCoE provides opportunities to present research to the forensic community at any stage in the process. Specific knowledge-sharing opportunities include webinars (e.g., [Emerging Forensic Research webinar series](#)), [podcasts](#), [reports](#), and the [NIJ Forensic Science R&D Symposium](#).

Helping Researchers Plan for Impact Early: Having supported various grantees in transition over the years, the FTCoE recognized that encouraging researchers to think about transition before the end of the grant was critical to helping NIJ have a greater return on investment for the forensic community. The FTCoE assembled a group of successful PIs and presented a facilitated panel discussion via [webinar](#) to discuss the steps researchers can take to improve the likelihood of your research impacting practice and highlight key factors that should be considered for future success.



Enabling Testing and Validation of Prototypes

It is critical for researchers to consider, find, and connect to the appropriate development partners—companies, experts, and end users. These partners can help researchers design a product or process from an end user’s view, address an important technical limitation, or help to build an example for testing. Their feedback plays a vital role in the development of an innovation that aligns well with ecosystem needs.

Partners Help Prototype: Researchers often work in academic settings and laboratories without the resources to build prototypes. The FTCoE can help find the right partners. For example, the FTCoE helped an NIJ-supported researcher at Ames Laboratory to develop a prototype statistical analysis method for toolmark identification (award 2004-IJ-R-088). The principal investigator needed a prototype to enable beta testing and refinement of the product. The FTCoE scanned the market landscape to identify potential development partners, designed marketing collateral, and helped to connect the researcher to a company that creates optical topography hardware and software.



Facilitating the Necessary Steps of Validation and Acceptance

In-field evaluation and validation studies help researchers better develop their solutions to meet end user needs. The FTCoE can leverage the robust technical expertise of its staff as well as academic and industry partners to provide actionable and valuable feedback and practitioner toolkits on the capabilities and user experience. These studies help benchmark the technology against existing solutions and build a case for scientific and legal validation.

Validation Begets Quality: The FTCoE leverages its academic and industry partners to execute evaluation and validation studies so that products and processes may be ready for the field. These reports can be found on the [FTCoE website](#).



Promoting Adoption, a Measure of Success

Access to information helps promote technology adoption by informing the community about technologies that are ready for laboratory or field implementation. When appropriate, the FTCoE supports researchers and the technology transfer office of the respective organization in licensing and other commercialization support. [Success stories](#) share results that have positively impacted the forensic community in an effort to accelerate uptake [5]. Ready-to-implement technologies are included in [landscape reports](#) as available options for end users. The FTCoE also [hosts technology transition workshops](#) to help end users implement technologies into their practice.

Facilitating Community Awareness and Use: The FTCoE worked with a researcher at Children’s Hospital Oakland Research Institute (CHORI) to explore transfer of a whole genome mitochondrial assay to a commercial partner (award 2010-DN-BX-K141). The team worked with the technology transfer office at CHORI and recommended prosecution of a provisional patent for the probe capture sequences. More information can be found in this FTCoE [success story](#).

Success of the Forensic Innovation Ecosystem — A Community Effort

In the forensic innovation ecosystem, stakeholders—such as crime laboratory directors and senior managers, researchers, and legal professionals—must work together to move technologies along the innovation continuum, from needs identification to adoption. Communication between stakeholders (1) promotes awareness of needs and research that may address challenges and (2) fosters opportunities to partner and develop valuable solutions. The FTCoE serves as a conduit of resources and engagement opportunities in this innovation ecosystem to promote new technology adoption and ultimately improve the practice of forensic science. Stakeholders can engage with the FTCoE in a variety of ways: **researchers** can explore dissemination options to reach the end user and foster connections for validation and testing. In addition, they can work directly with the FTCoE to transition their research into the community. **End users** can participate in working groups, roundtables, and technology evaluations, where they can communicate challenges and opportunities for improvement in forensic technologies. The **legal community, funders, and accrediting bodies** can participate in presenting and consuming digital deliverables such as webinars, reports, and podcasts to keep the entire community in the loop about important needs and emerging technologies. We encourage you to consider your role as a stakeholder in the forensic innovation ecosystem and to evaluate how you can better connect and drive engagement with other stakeholders towards ensuring technology has a greater impact. Researchers and stakeholders working together creates innovation and promotes awareness to foster justice.



The NIJ FTCoE Works to Foster the Forensic Innovation Ecosystem

The forensic innovation ecosystem thrives when stakeholders connect, learn from each other, and facilitate technology transition, ultimately enabling forensic science research transition into practice. The FTCoE drives innovation and technology transition through the assessment and active support of NIJ supported research for transition, evaluation, technology implementation. The FTCoE also aids the ecosystem through dissemination of evidence-based resources based on NIJ research, as well as support from other federal agency partners. These resources include information, testing, and training about forensic technologies and associated methods, working group support and dissemination related to specific challenges. The NIJ FTCoE bridges the gap between the scientific and justice communities through three main functions:

1. Sharing Knowledge

The FTCoE ensures that key information is manifested in a variety of media—including reports, webinars, and podcasts; all forms of FTCoE media are available for free at [forensiccoe.org](https://www.forensiccoe.org). The FTCoE engages regularly in outreach opportunities to connect with a variety of community stakeholders and has a strong presence at conferences and annual meetings.

2. Addressing Challenges

The FTCoE convenes stakeholders to identify problems and discuss potential solutions in the forensic community. These activities include topic-focused working group meetings, technology transition workshops, and research symposia. For example, the FTCoE supports the NIJ's [Forensic Laboratory Needs Technology Working Group \(FLN-TWG\)](#), which identifies forensic laboratory challenges and drives research that will address these operational and implementation needs. Through these meetings, the FTCoE provides opportunities for stakeholders to learn about emerging technologies and resources, and to connect and collaborate with others.

3. Advancing Technology

The FTCoE helps support researchers through the technology transition process. The FTCoE maintains a database of more than 675 NIJ forensic science R&D grants, with a goal of facilitating end-user adoption of NIJ-funded research and development efforts. Periodically, the FTCoE assesses the portfolio and identifies research that is ready for support to transition into forensic science practice. The team then works directly with the grantees to help them plan and execute a transition strategy.

Considering the simplified path described in this document, the FTCoE supports the ecosystem by transitioning technologies from research to practice through:

- Building resources and supporting activities to transition research toward application. This can include helping facilitate understanding **needs**. For example, by creating opportunities for researchers to gain insight by interacting with end users to pinpoint and understand challenges that impact their ability to do their jobs.
- Connecting grantees to appropriate development partners to encourage **prototyping** and **pilot testing in realistic environments**, such as forensic laboratories, law enforcement agencies, and other R&D partners.
- Communicating successes where solutions are introduced into casework being supported by both scientific and legal **validation** and **acceptance**. Technology **adoption** is supported by further communication as well as the development of standards and best practices that improve consistent and accurate use.
- Highlighting solutions developed under NIJ funding to meet **needs** in the forensic community.

The FTCoE recognizes that the technology transition process is a continuous, cyclical process; even after a technology has been widely implemented in casework, there is room for further development as researchers continue to make improvements.



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Resources

[NIJ R&D Portfolio Management and Technology Transition Support](#)

[About NIJ's Office of Investigative and Forensic Sciences](#)

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