



NATIONAL INSTITUTE OF JUSTICE

NOVEMBER 2024

INTRODUCING THE NIJ FORENSIC INTELLIGENCE FRAMEWORK:

PILLARS AND GUIDING PRINCIPLES FOR SUCCESSFUL IMPLEMENTATION



By Tracey L. Johnson, Basia E. Lopez,
Jonathan McGrath, Caleb D. Hudgins,
Meaghan L. Pimsler, and Veronica White

U.S. Department of Justice
Office of Justice Programs
999 N. Capital St. N.E.
Washington, DC 20531

Nancy La Vigne, Ph.D.

Director, National Institute of Justice

This and other publications and products of the National Institute of Justice can be found at:

National Institute of Justice

Advancing Justice Through Science

NIJ.ojp.gov

Office of Justice Programs

Building Solutions • Supporting Communities • Advancing Justice

OJP.gov

The National Institute of Justice is the research, development, and evaluation agency of the U.S. Department of Justice. NIJ's mission is to foster and disseminate knowledge and tools derived from objective and rigorous scientific research to inform efforts to promote safety and advance justice.

The National Institute of Justice is a program office of the Office of Justice Programs, which also includes the Bureau of Justice Assistance; the Bureau of Justice Statistics; the Office for Victims of Crime; the Office of Juvenile Justice and Delinquency Prevention; and the Office of Sex Offender Sentencing, Monitoring, Apprehending, Registering, and Tracking.

Opinions or conclusions expressed in this paper are those of the authors and do not necessarily reflect the official position or policies of the U.S. Department of Justice.

NOVEMBER 2024

NATIONAL INSTITUTE OF JUSTICE
**RESEARCH
REPORT**

**INTRODUCING THE NIJ FORENSIC
INTELLIGENCE FRAMEWORK:**

**PILLARS AND GUIDING PRINCIPLES FOR
SUCCESSFUL IMPLEMENTATION**

BY TRACEY L. JOHNSON, BASIA E. LOPEZ, JONATHAN MCGRATH,
CALEB D. HUDGINS, MEAGHAN L. PIMSLER, AND VERONICA WHITE

Table of Contents

Learning Objectives	1
Purpose and Background.....	1
NIJ Forensic Intelligence Framework	2
The NIJ Forensic Intelligence Framework Is Flexible and Adaptable.....	4
A Generalized Hierarchy of Scale Supported by the NIJ FOR-INT Framework.....	5
Forensic Intelligence Supports and Enhances Intelligence-Based Policing.....	6
Example of the Application of the Forensic Intelligence Approach.....	7
Forensic Intelligence Can Be Integrated Into Existing Processes	8
Driving Forensic Intelligence Success Through Implementation and Impact Assessment	10
Acknowledgments	12
NIJ Forensic Intelligence Framework Initiative Team Members (Current and Former)	12
External Reviewers	12
Endnotes.....	13

Introducing the NIJ Forensic Intelligence Framework: Pillars and Guiding Principles for Successful Implementation

Learning Objectives

- 1) Introduce NIJ Forensic Intelligence (FOR-INT) Framework concepts and guiding principles for law enforcement, forensic laboratories, and researchers.
- 2) Explain the foundations for implementing and sustaining a forensic intelligence program, including Organization, Process, Technology, Capabilities and Resources, and Information Sharing.
- 3) Provide strategies for practitioners and researchers to evaluate the effectiveness of forensic intelligence programs, including examples of forensic intelligence practices.

Purpose and Background

The purpose of the NIJ Forensic Intelligence (FOR-INT) Framework is to provide guidance to state and local law enforcement agencies and their forensic laboratories in the implementation of an innovative approach to the investigation of crime, including serial and organized crime. Forensic intelligence is defined as the collection, organization, interpretation, and sharing of forensic case data in support of criminal investigations and intelligence procedures.¹ Although current practices utilize forensic data to solve and prosecute individual crimes, collected data often remain archived in state and local labs. The forensic intelligence approach uses these datasets to link and track crime patterns individualized to local jurisdictions and ultimately reduce crime in those areas. The NIJ FOR-INT Framework capitalizes on advancements in forensics, analytics, operations, and technology capabilities, with the goal of developing actionable intelligence for solving, disrupting, and preventing crime, based on available data and information. The Framework also provides opportunities for evaluation to measure the effectiveness of the implementation of forensic intelligence activities.

The FOR-INT Framework is a result of a multiyear, intramural research effort under the NIJ Forensic Intelligence Framework Initiative carried out by NIJ scientists from the Office of Research, Evaluation, Forensics, and Technology, with support from external subject matter expert consultants. This research serves as a roadmap that law enforcement agencies can use to begin implementation, whether in part or in full, based on their own agency priorities.

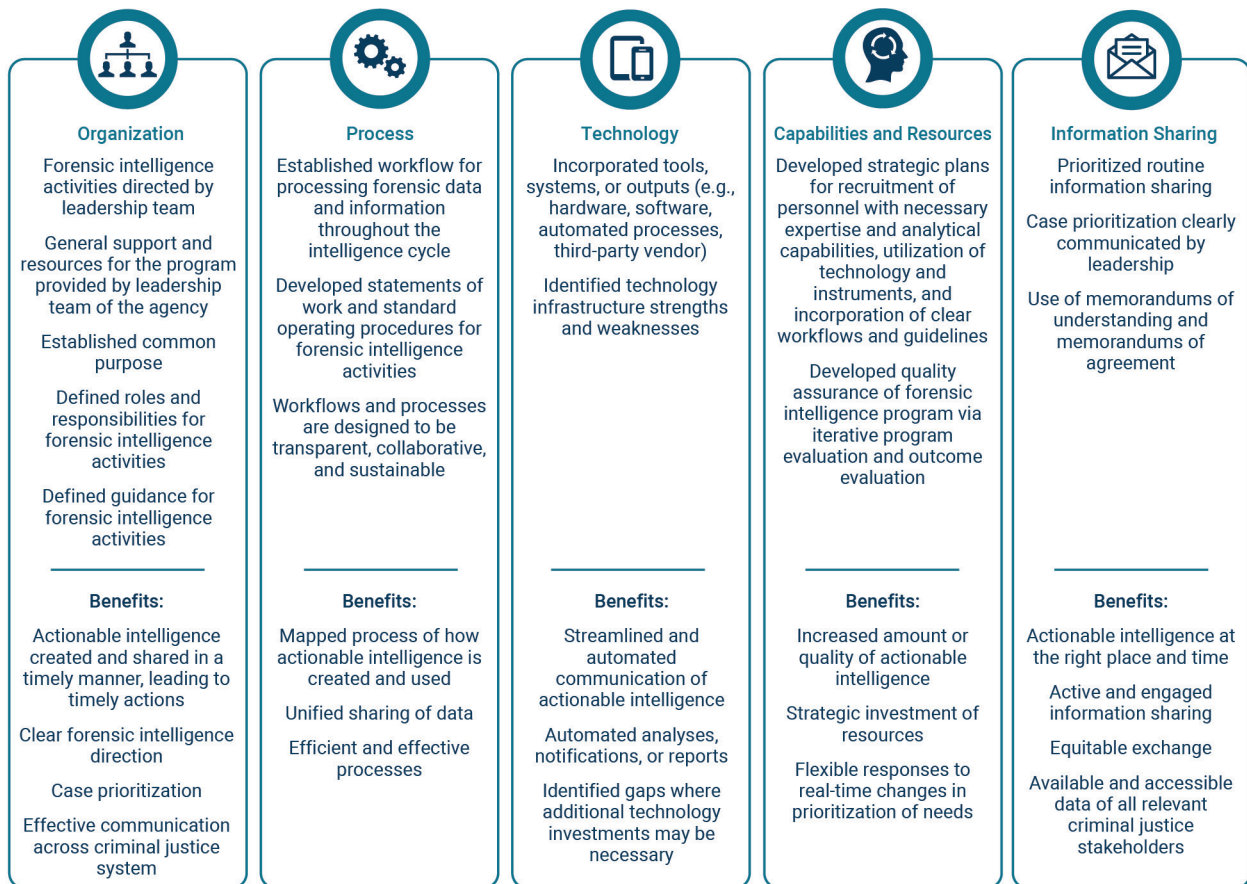
The NIJ FOR-INT Framework is grounded in the findings reported in the 2023 NIJ publication, "[Forensic Intelligence Models: Assessment of Current Practices in the United States and Internationally](#)," and synthesized from an extensive literature review with additional input from various state, local, and federal subject matter experts.² As such, this framework was created by assessing existing national and international examples of forensic intelligence initiatives in collaboration with multiple practitioner and research partners. It provides guidance to state and local law enforcement agencies — especially their investigative and analytical components and forensic laboratories — to maximize investigative resources by gathering and using forensic data early in the crime inquiry cycle and across cases to help detect and disrupt crime or patterns of crime (e.g., gun crimes, prescription drug fraud), including serial and organized crime.

The implementation of forensic intelligence approaches demonstrates how they can help law enforcement agencies to use data objectively and build public trust in police investigations. Some local- or state-level agencies already collaborate with forensic labs and other agencies by leveraging existing intelligence units. For example, the Miami-Dade Police Department has hired a full-time intelligence analyst within the forensic laboratory, which proved to be a successful method in producing actionable forensic intelligence.³ This demonstrates the flexibility of forensic intelligence in various operational environments and agencies.

NIJ Forensic Intelligence Framework

As depicted in exhibit 1, the framework has five pillars: Organization, Process, Technology, Capabilities and Resources, and Information Sharing. Together, these pillars support an effective and sustainable forensic intelligence program. Each of the five pillars describe different aspects of NIJ’s evidence-based vision for state or local forensic intelligence programs and, although there is some overlap among the pillars, all five are essential for development or enhancement of state or local forensic intelligence programs.

Exhibit 1. The NIJ Forensic Intelligence Framework



The NIJ Forensic Intelligence Framework is grounded in the following seven guiding principles:

- **Collaboration** – When designing a forensic intelligence program for a jurisdiction, the different organizational components involved — whether they are within the same organization or across multiple organizations (e.g., different intelligence units, fusion centers, and other intelligence agencies) — should work together to identify relevant data, design and establish policies and practices for implementation and evaluation, and create a feedback loop for understanding priorities and resource allocation.
- **Interoperability** – Data and systems interoperability (i.e., the ability of different systems or products to work together seamlessly, allowing them to exchange information and collaboratively perform tasks) should maximize data-sharing efficiencies and effective data usage by the collaborating components while acknowledging that some types of datasets/information may have different levels of sensitivity or classification that must be considered.
- **Integrity** – Understanding data quality and timely data sharing is critical to its effective use, as is operating in an ethically responsible manner, ensuring actions are informed by evidenced-based best practices, objective and free from bias, and evaluated to identify and correct quality discrepancies.
- **Flexibility** – Implementation, research, and evaluation of forensic intelligence approaches will require that partners be open to new ways to collect, use, and share data to keep pace with demands and iterative workflow improvements.
- **Accountability** – Partner organizations should hold each other accountable to effectively collect, share, and use data through open communication, transparency, and established responsibilities.
- **Justice** – Implementation should consider relevant public safety objectives and priorities to support a fair and just criminal justice system and improve community safety and trust.
- **Sustainability** – All partners and their organization’s leadership should ensure “buy-in” of personnel, resources, and time to effectively establish and maintain forensic intelligence practices while maintaining institutional knowledge.

These principles inform and support the design and implementation of a forensic intelligence program using the five NIJ FOR-INT Framework pillars: Organization, Process, Technology, Capabilities and Resources, and Information Sharing, as shown in exhibit 1. An example of how the guiding principles and pillars support each other would be a jurisdiction that wants a forensic intelligence program to automatically generate intelligence products — such as intelligence reports — and analyses that incorporate information or data in laboratory reports or results from other forensic casework analysis. The information and design of the product should be collaboratively developed across the organization, use the available technologies, and establish accountability mechanisms for those components that contribute to creating intelligence products.

To successfully integrate forensic intelligence practices into current criminal justice practices, an organization’s leadership should commit to the guiding principles of the NIJ FOR-INT Framework pillars, ensuring the desired end state is achieved. Examples include the following:

- **Organization** – A structure that includes a leadership team with defined roles and responsibilities working toward a common purpose and designed to facilitate communication for direction and prioritization. Coordination and outreach with neighboring organizations can strengthen the scope and effectiveness of forensic intelligence.

- **Process** – An established workflow that enables forensic data and information to move through organizations and between stakeholders during the intelligence cycle via processes that are transparent, collaborative, and sustainable.
- **Technology** – Investments in tools, systems, or outputs that are used during the intelligence cycle to collect, submit, transfer, and analyze forensic data, produce linkages, and share information as actionable intelligence.
- **Capabilities and Resources** – Personnel, combined expertise, instruments, analytical capabilities, and workflows that integrate forensic data into the crime and intelligence analysis process.
- **Information Sharing** – Information, intelligence, and finished products that are made available to all relevant criminal justice partners. Routine information sharing enables the use of forensic data and intelligence in combination with other data sources in the production of actionable products to drive operations and policy investigations.

The NIJ Forensic Intelligence Framework Is Flexible and Adaptable

The NIJ Forensic Intelligence Framework is intended to be flexible and allow for different models to be developed and tested. See the sidebar “A Generalized Hierarchy of Scale Supported by the NIJ FOR-INT Framework” for a summary of different scales and applications of forensic intelligence approaches. Programs can be flexible in their real-time priority, changing when responding to crime patterns and local community safety needs, through efficient and economic placement of resources and personnel and informed strategic planning.

Adaptability and flexibility can be enhanced through additional investment in research and evaluation, either in-house or with external partners (e.g., academic researchers). Understanding how the program functions and identifying areas of improvement will result in capabilities keeping pace with demands and iterative improvement in workflows, processes, and analytical approaches.

Specific, measurable goals should be developed by program stakeholders to track implementation and evaluate outcomes of adopting a forensic intelligence program. These goals should align with existing and planned investments in local capabilities and resources for technology and information sharing. Research experts can assist with development of a specific evaluation plan and analysis of outcomes.

A Generalized Hierarchy of Scale Supported by the NIJ FOR-INT Framework

The NIJ FOR-INT Framework was developed to be useful at a range of scales, from supporting individual case needs to identifying and developing proactive, long-term solutions for persistent community safety needs (see exhibit 2). *Tactical intelligence* refers to the use of forensic intelligence approaches to generate leads in individual cases, such as earlier incorporation of forensic data in the investigative cycle. At a larger scale, analysis of patterns across time and geography can generate *operational intelligence* to identify case linkages, particularly with respect to serial crimes or criminal organizations. Both tactical and operational intelligence are reactive but their implementation is likely to impact future events by reducing serial crimes. In contrast, *strategic intelligence* is a proactive use of forensic data analysis to guide agencies and associated policymakers in policy development, personnel deployment, and coordination with non-law enforcement agencies for long-term solutions to community needs.⁴

Exhibit 2. Generalized hierarchy of scale



Note: Modeled after Marclay, 2014.⁵

Forensic Intelligence Supports and Enhances Intelligence-Based Policing

Forensic intelligence involves gathering and using forensic data both early in the criminal inquiry cycle and across cases to generate actionable intelligence.⁶ Timely processing and analysis of evidence makes the difference between generating information and producing intelligence. Expanding investigative approaches across cases to incorporate various forensic data (e.g., firearm, DNA, latent prints, and drug-related evidence) can help identify novel links, patterns, and trends through various analytical methods (e.g., statistical modeling, and social network and spatio-temporal analysis). Integrating these results with other sources of intelligence, such as human source intelligence or HUMINT (e.g., informants), open-source intelligence or OSINT (e.g., social media), and signal intelligence or SIGINT (e.g., cellphone triangulation), license plate information or LPR (e.g., cameras), and general investigative information (e.g., situational, behavioral, and modus operandi information) may generate new insights into the crime and produce valuable intelligence.

Forensic intelligence practices can have many benefits (see exhibit 3), including improvement in processing times, communication, and number or quality of connections between interrelated crimes within a jurisdiction.⁷ Additional benefits of applying forensic intelligence practices may include:

- Early identification and elimination of suspects and recognition of criminal tactics, techniques, and procedures.
- Increased public safety through the detection, disruption, prevention, and deterrence of serial and organized crime.
- Improved policing and security actions through enhanced threat and risk assessments and identification of emerging issues of concern to the community.^{8,9}

Exhibit 3. Selected benefits of applying forensic intelligence practices



Early Identification



Increased Public Safety



Improved Policing & Security



Process Times



Communication

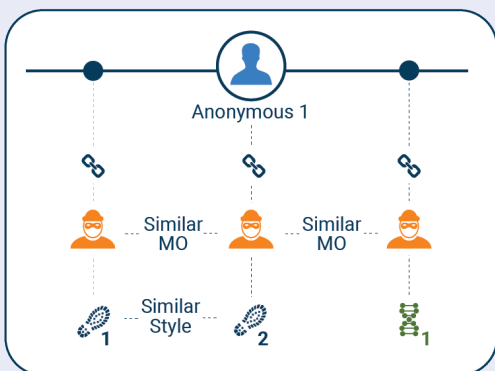


Number or Quality of Connections

Example of the Application of the Forensic Intelligence Approach

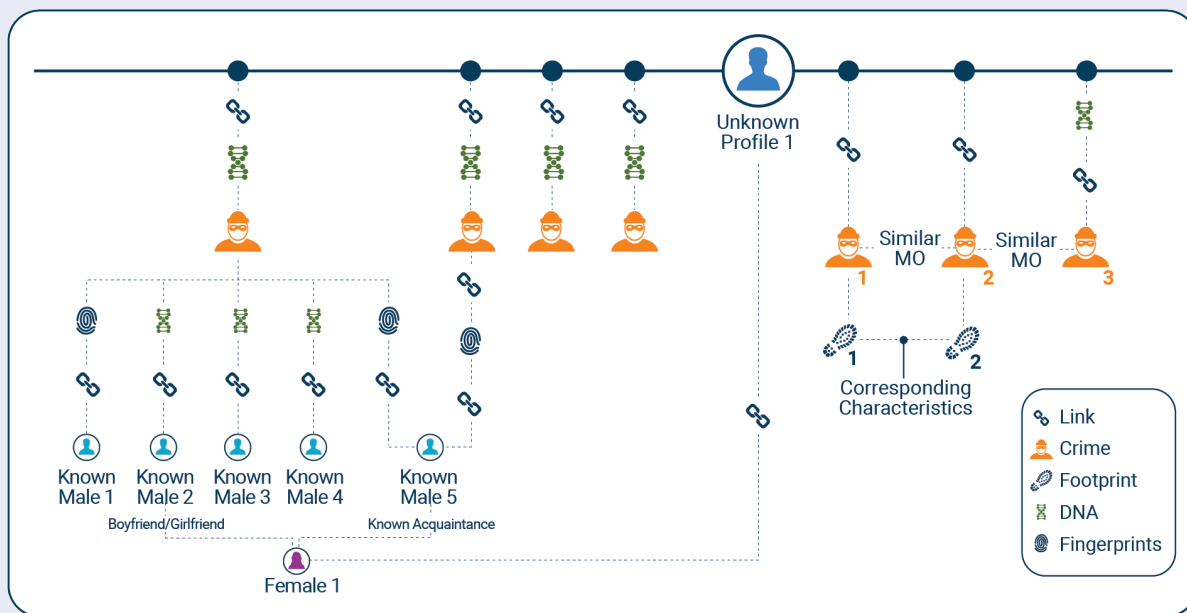
In this example, integration of DNA, footwear, and link analysis led to an apprehension. Fingerprint, DNA, and shoe print data from three burglaries all linked back to a single, anonymous female suspect (see exhibit 4).¹⁰

Exhibit 4. Linking multiple evidence in serial crimes



The female suspect’s DNA had been recovered from other crime scenes that also had evidence left behind from known male suspects (see exhibit 5). Social network analysis was then used to create a list of possible female suspects to evaluate against the unknown female’s DNA profile. A single female associate of two of the suspects from different crime scenes was increasingly coming to the attention of law enforcement for other behaviors, and this intelligence was sufficient cause for her arrest and, therefore, the collection of her DNA and fingerprints. Following confirmatory DNA comparison, the female identified through the social network analysis pleaded guilty to 22 counts of burglary.

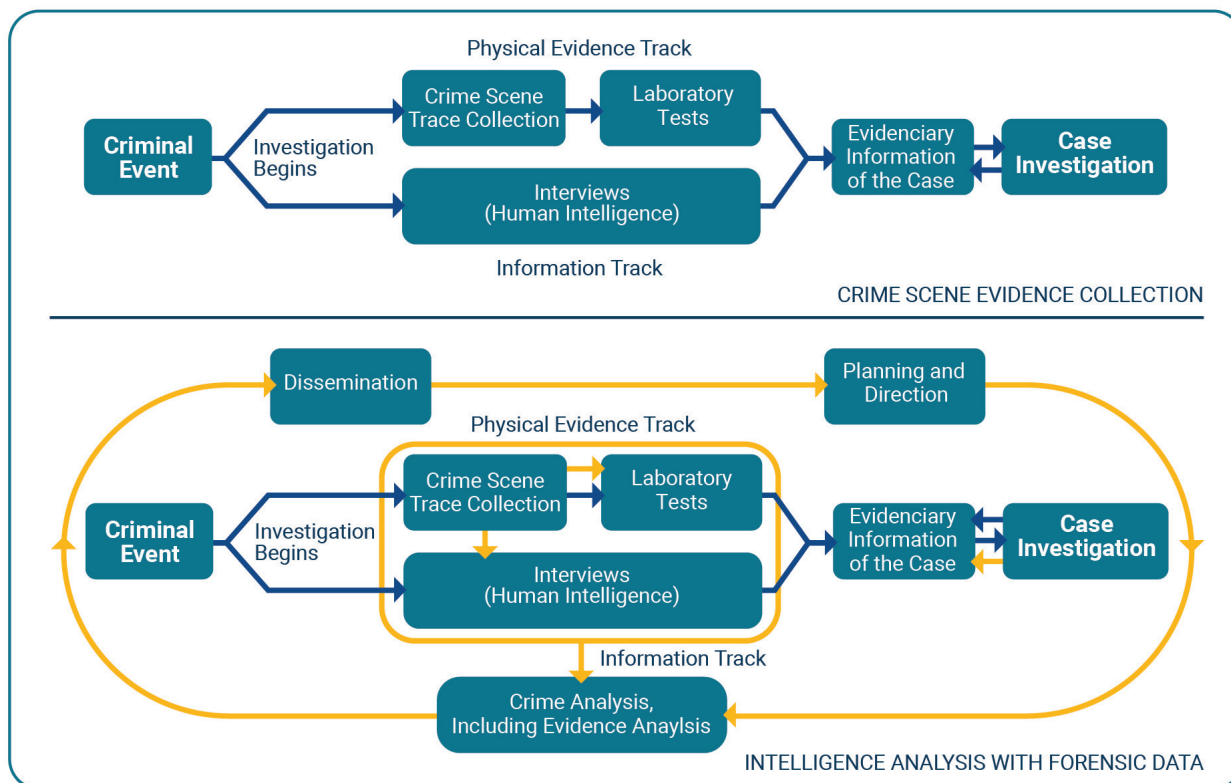
Exhibit 5. Forensic evidence used in link analysis



Forensic Intelligence Can Be Integrated Into Existing Processes

Implementation of a forensic intelligence model does not necessarily require a replacement of current intelligence, crime analysis, or investigative cycles. Instead, it requires a shift in which information is collected, how it is collected, and how and when participating agencies and internal units communicate (see exhibit 6).

Exhibit 6. Crime scene evidence collection and intelligence analysis



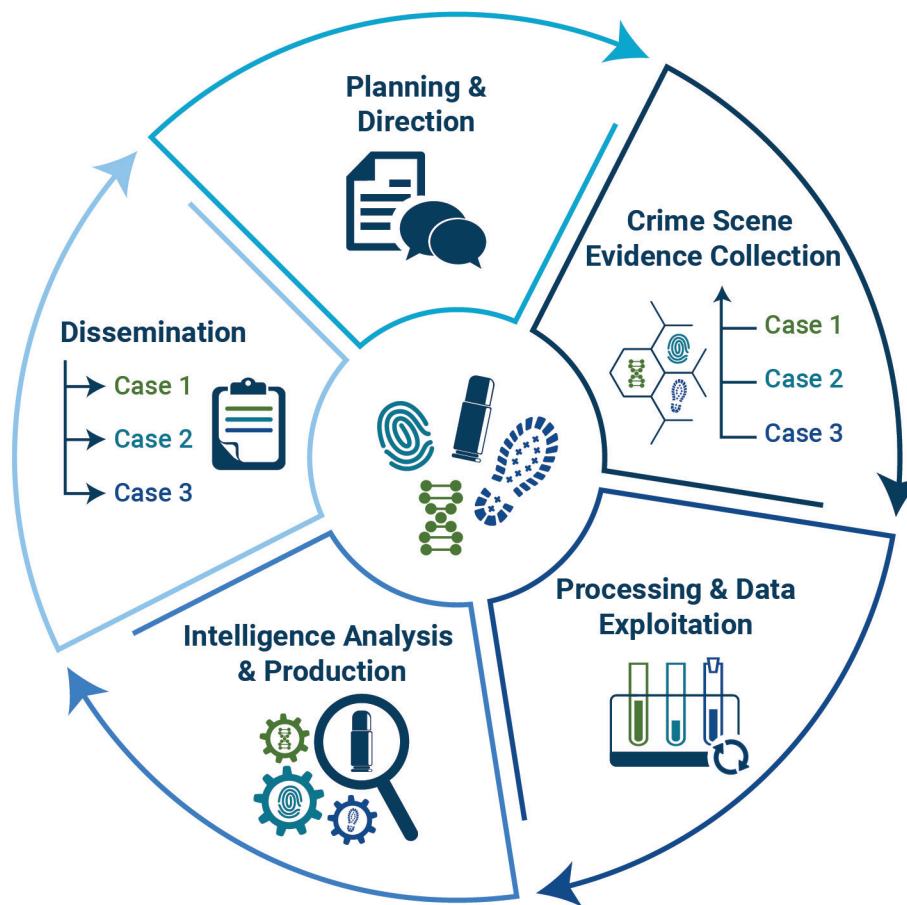
Note: Forensic intelligence approaches (yellow) can be integrated into existing investigation processes (blue) without significant rework of the entire process of investigating an individual case. Early use of forensic data in investigations and preliminary results can generate useful investigative leads and reduce case processing time. Development of a forensic intelligence program includes incorporation of some, or all of the modifications shown in yellow.

Many jurisdictions may already have organically developed programs that use forensic intelligence approaches. The NIJ FOR-INT Framework can enhance these initiatives by incorporating foundational pillars and guiding principles, and by establishing iterative evaluation of process changes and impacts.

Forensic intelligence can be applied by integrating and analyzing forensic data across cases to generate a more holistic picture of criminal activity, identify linkages across cases, and generate useful intelligence. For example, forensic intelligence approaches may help link individuals suspected in sexual assault cases to other kinds of crimes.

Under the NIJ FOR-INT Framework, processes that are typically linear or traditionally siloed will instead integrate forensic data early in the investigation, contribute to a cyclical and continuous process, and make use of tools to view data holistically, overcoming linkage blindness and allowing connections to be made that were not available prior to FOR-INT implementation (see exhibit 7).

Exhibit 7. Forensic data integration and analysis



When implementing a forensic intelligence program and integrating forensic information into this intelligence cycle, agencies must consider the role and application of the forensic laboratory’s existing quality assurance policies and accreditation standards. It is important to note that forensic laboratories have strict quality management systems in place to ensure that all reported results are fully confirmed and vetted using technical and administrative review processes.

While forensic intelligence relies on timely results to be integrated effectively into the intelligence cycle, the results must also remain accurate and reliable. Therefore, when an agency explores the workflow efficiencies, capacity enhancements, and resource requirements to reach the productivity levels required for developing actionable intelligence and timely examinations, the agency should also consider how those activities will align with a forensic laboratory’s quality system. It may be necessary to modify the laboratory’s reporting policies for results that are time-sensitive, based on the use-cases for this information. For example, any data that is generated from presumptive testing (e.g. handheld field drug testing technologies, including infrared or Raman devices; National Integrated Ballistic Network (NIBIN) firearms results; latent print investigative leads)¹¹ must be understood by the intelligence cycle to be “preliminary” and that final results would need to be confirmed through more comprehensive laboratory analysis. Numerous accredited laboratories have implemented policies that balance quality assurance and accreditation requirements with intelligence reporting timeliness.

Forensic intelligence programs also take care to separate the activities of the forensic scientist who is performing the forensic casework analysis from the team that is synthesizing and using the forensic intelligence information, analysis, and reports generated from this forensic analysis. Forensic intelligence programs should be aware of the risks of confirmation

bias and contextual bias, and should develop information-sharing workflows that mitigate these risks.”^{12, 13, 14} For example, forensic scientists should remain objective and should not be provided with investigative information or intelligence products that could bias the testing or interpretation of forensic evidence.¹⁵

Once the forensic analysis is complete, the results are shared with the intelligence analysts, who act as the “bridge” to synthesize and incorporate the data into intelligence products. As intelligence analysts are not forensic experts, they will be required to collaborate and coordinate with the forensic laboratory experts to ensure that forensic data is not misstated and that the information is accurately conveyed in a final product.

These adjustments should be feasible and are necessary to ensure the success and credibility of the forensic intelligence program. In resource-constrained environments, there can be competing priorities between newly established forensic intelligence activities and activities such as addressing casework backlogs, validating new technologies, training new staff, and preparing for court. Agencies that embrace forensic intelligence should acknowledge that a cultural shift may be necessary to ensure that resources and policies permit flexibility to perform rapid processing of the most probative evidence to generate actionable intelligence (for example, generation through the NIBIN of high-confidence correlations between fired cartridge cases).

It is important that participating agencies identify which sources and types of forensic data should be prioritized based on investigative requirements and institutional limitations. The raw results alone (e.g., a DNA profile from an evidentiary sample) are not sufficient for forensic intelligence program success. For example, an intelligence analyst must not attempt to interpret DNA profiles. Instead, analysis and contextualization of a piece of forensic data (e.g., DNA profile evidence developed for a known individual that is connected to DNA evidence from another case that includes latent print or footwear evidence attributed to the same or other individuals) are the keys to identifying a link between a person or organization and multiple crime events (see exhibit 7). Therefore, forensic reports and conclusions must be incorporated into data sharing systems that allow intelligence analysts to access results to formulate finished intelligence products.

As the need for objective data expands into policing practices, forensic science service providers will need to evolve their reporting strategies for sharing results with intelligence analysts to allow for the expanding role of intelligence-based testing protocols. Reports on forensic intelligence initiatives at the New Jersey State Police, Denver (Colorado) Police Department, and Philadelphia (Pennsylvania) Police Department have shown that training — combined with dedicated, streamlined workflows and process improvements that provide accurate and timely results — allow forensic scientists, crime and intelligence analysts, and investigators to maximize the use of forensic intelligence.¹⁶

Driving Forensic Intelligence Success Through Implementation and Impact Assessment

Using the NIJ FOR-INT Framework’s pillars and guiding principles will establish a foundation for iterative assessments of the program’s implementation progress and impact. To evaluate the implementation of a forensic intelligence program, it is necessary to establish systems to track and measure whether the use of the intelligence cycle in support of investigative processes is being implemented as planned and with fidelity. This requires interoperability, collaboration, organization, and commitment among members of the forensic intelligence team to routinely report on implementation goals and progress.

The framework ensures sustainability and maintenance of institutional knowledge through cross-training of criminal justice organizations involved with the forensic intelligence program. Changes to standard operating procedures, policies, and interagency agreements should be incorporated at the onset of the program so that changes are documented, comprehensive, sustainable, and supported by technologies, technical capabilities, resources, and infrastructure.

As actionable intelligence becomes available in new ways, it may be necessary to shift investigative resources to adapt to new technologies, personnel, and procedures. Agencies should be prepared to assess the impact of forensic intelligence and demonstrate its return-on-investment as justifications to garner the support and funding required to increase the capacity of forensic laboratories to meet the public safety demands in a timely manner. These assessments may also require soliciting outside support from academic institutions, nonprofit groups, or private sector organizations. Tools like Project FORESIGHT — developed by researchers at West Virginia University and used by over half of the forensic laboratories in the U.S. — can be leveraged to perform cost-benefit analyses for the various types of forensic services.¹⁷ For example, these datasets were recently used to calculate ROIs that combine both direct gains as well as indirect societal benefits to demonstrate the enormous ROI of up to \$646 for every \$1 spent testing sexual assault kits as soon as they arrive for testing at a highly efficient laboratory, as compared to a ROI of \$81 for every \$1 spent testing a sexual assault kit that is already part of a case backlog.¹⁸

The need for both implementation and impact evaluations should be considered during the planning of a forensic intelligence program. To establish a strong foundation, the program should be guided by the principles outlined above, such as integrity, justice, and accountability. This may require developing partnerships among public safety stakeholders that have not historically worked together but are part of the same investigative processes. Such partnerships will allow all members of a forensic intelligence team to identify implementation barriers across the program, devise mutually beneficial solutions, and develop specific implementation goals to evaluate progress.

Tracking implementation goals can monitor how planned system changes occur, allowing the forensic intelligence team to connect modifications to anticipated criminal justice outcomes. Examples of important investments specific to implementation include training and coaching on how to use new technologies and information sharing capabilities. Training should focus on the initial instruction and teaching of new skills, practices, and processes, while coaching is used after training to provide feedback on compliance with training goals. Coaching is particularly important for addressing drift in newly trained practices: situations in which, despite successful training, individuals may revert to a previous way of doing things.

Iterative evaluations of implementation goals can reveal how implementation resources support and sustain process changes within the forensic intelligence program. Regular monitoring allows resources (e.g., coaching) to be reallocated to parts of the program where implementation goals are not being met. Ultimately, process changes that improve information sharing, once implemented, can be further evaluated for their ability to produce new sources of actionable intelligence earlier in the investigative process and increase case linkages. The broader impact of a forensic intelligence program should only be assessed after leadership has ensured that the planned changes occurred as designed and are being sustained.

For more information on evaluation planning, see the Bureau of Justice Assistance's [Center for Research Partnerships and Program Evaluation guidance on using logic models](#) that considers Inputs, Activities, Outputs, and Outcomes when selecting, implementing, and evaluating a forensic intelligence program. NIJ recognizes that more research is needed on its forensic intelligence program elements to provide specific, evidence-based suggestions to criminal justice entities looking to build their own programs. NIJ's Forensic Intelligence Framework Initiative is an ongoing effort, so please check back often for updates and other support documents at [Forensic Intelligence | National Institute of Justice \(ojp.gov\)](#).

Acknowledgments

Authors: Tracey L. Johnson, Basia E. Lopez, Jonathan McGrath, Caleb D. Hudgins, Meaghan L. Pimsler, and Veronica White

NIJ Forensic Intelligence Framework Initiative Team Members (Current and Former)

- NIJ science staff: Basia E. Lopez, Jonathan McGrath, Joel Hunt, Tracey L. Johnson, Eric Martin, and Kyle Fox
- NIJ AAAS fellows: Rachel Anderson, Caleb D. Hudgins, Meaghan L. Pimsler, and Veronica Taylor
- NIJ graduate research assistants: Danielle Crimmins and Veronica White
- NIJ senior research advisor, IPA: Mallory O'Brien

External Reviewers

- Tara Garvey (Philadelphia Police Department Intelligence Bureau)
- Gregory LaBerge (Denver Police Department, Forensics and Evidence Division)
- Julie Wartell (Independent Consultant)
- Eoghan Casey (U.S. Department of Defense)
- David Carter (Michigan State University)
- Nancy Crump (Phoenix Police Department)
- William "Bill" King (Boise State University)
- Rachel Lovell (Cleveland State University)
- Richard Meyers (U.S. Drug Enforcement Administration)
- Stephanie Stoiloff (Miami-Dade Police Department)
- Peter Stout (Houston Forensic Science Center)

Endnotes

- ¹ Basia E. Lopez, Jonathan G. McGrath, and Veronica G. Taylor, "Using Forensic Intelligence To Combat Serial and Organized Violent Crimes," *NIJ Journal* 282, October 2020, <https://nij.ojp.gov/topics/articles/using-forensic-intelligence-combat-serial-and-organized-violent-crimes>.
- ² Lopez, McGrath, and Taylor, "Using Forensic Intelligence."
- ³ See Yaneisy Delgado et al., "Forensic Intelligence: Data Analytics as the Bridge Between Forensic Science and Investigation," *Forensic Science International: Synergy* 3 (2021): 100162, <https://doi.org/10.1016/j.fsisyn.2021.100162>; and Stephanie Stoiloff et al., "Using Forensic Intelligence Analysts To Drive Gun Crime Investigations," June 7, 2021, nij.ojp.gov: <https://nij.ojp.gov/topics/articles/using-forensic-intelligence-analysts-drive-gun-crime-investigations>.
- ⁴ Eva Bruenisholz, Sameer Prakash, and Alastair Ross, "The Intelligent Use of Forensic Data," Melbourne: Australia New Zealand Policing Advisory Agency, 2015.
- ⁵ François Marclay, "Perspectives for Forensic Intelligence in Anti-Doping and the Emergence of Smokeless Tobacco Consumption in Sport," Ph.D. thesis, Ecole des Sciences Criminelles, Institut de Police Scientifique, Université de Lausanne, 2014.
- ⁶ Such implementation may require a significant investment. If crime labs are not resourced to work the volume of evidence that is submitted, then forensic data will not be timely. Therefore, a shift from the traditional model of forensics for court to forensic intelligence requires an analysis of the lab's capacity, productivity, and resource needs. Based on this, the agency must decide whether the investment in facilities, staff, instruments, etc., is worthwhile. The literature shows the return on investment (ROI) is worth it. Please see the following publications regarding ROI: Ray Wickenheiser and Catherine Knutson, "Lead with Speed: Recasting the Forensic Laboratory Product Line and Service Delivery Model," *SSRN*, <https://dx.doi.org/10.2139/ssrn.4745595>; Ray Wickenheiser and Laurell Ferrell, "Collaborative Versus Traditional Method Validation Approach: Discussion and Business Case," *Forensic Science International: Synergy* 2 (2020): 230-237, <https://doi.org/10.1016%2Fj.fsisyn.2020.08.003>; and Paul J. Speaker, "Forensic Laboratory Financial Management/Return on Investment: Project FORESIGHT Revelations," *Monitoring the Business of Forensic Science—Project FORESIGHT*, <https://www.justice.gov/ncfs/page/file/958466/dl>.
- ⁷ Yaneisy Delgado et al., "Forensic Intelligence: Data Analytics as the Bridge."
- ⁸ Bruenisholz, Prakash, and Ross, "The Intelligent Use of Forensic Data"; Lopez, McGrath, and Taylor, "Using Forensic Intelligence."
- ⁹ Lopez, McGrath, and Taylor, "Using Forensic Intelligence."
- ¹⁰ Bruenisholz, Prakash, and Ross, "The Intelligent Use of Forensic Data."
- ¹¹ "Model Strategies for Field Drug Testing Programs," Forensic Technology Center of Excellence, January 2022, <https://forensiccoe.org/model-strategies-field-drug-testing-programs/>; National Integrated Ballistic Information Network (NIBIN), Bureau of Alcohol, Tobacco, Firearms and Explosives, <https://www.atf.gov/firearms/national-integrated-ballistic-information-network-nibin>; NIJ Report to Congress: Needs Assessment of Forensic Laboratories and Medical Examiner Coroner Offices, "Investigative Leads: Houston Forensic Science Center Latent Print Workflow", 2019; and Brett O. Gardner, Sharon Kelley, and Maddisen Neuman, "Latent Print Comparison and Examiner Conclusions: A Field Analysis of Case Processing in One Crime Laboratory," *Forensic Science International* 319, February 2021, <https://doi.org/10.1016/j.forsciint.2020.110642>.
- ¹² Yaneisy Delgado et al., "Forensic Intelligence: Data Analytics as the Bridge."
- ¹³ Laura Carlson, Jarrah Kennedy, Kimberly A. Zeller, Thomas Busey, "Describing communication during a forensic investigation using the Pebbles on a Scale metaphor," *Forensic Science International: Synergy*, Volume 4, 2022, 100199, <https://doi.org/10.1016/j.fsisyn.2021.100199>.
- ¹⁴ Forensic confirmation bias typically refers to how a forensic scientist's beliefs, motives, situational context, and exposure to case information can affect the way in which evidence is evaluated and interpreted. See Benedette Cuffari, "Forensic Confirmation Bias (Cognitive Bias in Forensics)," *News Medical: Life Sciences*, last updated April 8, 2021, [https://www.news-medical.net/life-sciences/Forensic-Confirmation-Bias-\(Cognitive-Bias-in-Forensics\).aspx](https://www.news-medical.net/life-sciences/Forensic-Confirmation-Bias-(Cognitive-Bias-in-Forensics).aspx).
- ¹⁵ Saul M. Kassin, Itiel E. Dror, and Jeff Kukucka, "The Forensic Confirmation Bias: Problems, Perspectives, and Proposed Solutions," *Journal of Applied Research in Memory and Cognition* 2 no. 1 (2013): 42-52, <https://psycnet.apa.org/doi/10.1016/j.jarmac.2013.01.001>.
- ¹⁶ Tara Garvey, Gregory LaBerge, and Julie Wartell, "Forensic Intelligence Models: Assessment of Current Practices in the United States and Internationally," Final report to the National Institute of Justice, February 2023, NCJ number 305898, <https://www.ojp.gov/pdffiles1/nij/305898.pdf>.
- ¹⁷ Project FORESIGHT, West Virginia University, <https://business.wvu.edu/research-outreach/forensic-business-studies/foresight>.
- ¹⁸ Paul J. Speaker, "Intelligence and the Value of Forensic Science," *Forensic Sciences* 4 no 1 (2024):184-200, <https://doi.org/10.3390/forensicsci4010011>.