OPENING THE BLACK BOX OF NIBIN: A DESCRIPTIVE PROCESS AND OUTCOME EVALUATION OF THE USE OF NIBIN AND ITS EFFECTS ON CRIMINAL INVESTIGATIONS

FINAL REPORT

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ABSTRACT

This report outlines the methods and findings from a study of the National Integrated Ballistic Information Network (NIBIN) that was funded by the National Institute of Justice (Grant # 2010-DN-BX-0001). This report begins with a brief description of ballistics imaging and the history and operation of NIBIN. Next, the research methodology and data sources are described. Finally, the findings and recommendations resulting from this study are presented. The study is based on data from four sources. NIBIN usage data (inputs and hits) for all NIBIN sites, detailed hit files from 19 NIBIN sites, survey data from crime labs and firearms sections within crime labs, and information derived from visits to 10 NIBIN sites including details on 65 criminal investigations that involved a NIBIN hit. The data reveal considerable variation in the local implementation of NIBIN and significant time delays in identifying hits. Generally, NIBIN hit reports do not aid investigators, in part because of delays in identifying hits. Although NIBIN has tremendous potential as a tactical and strategic tool, it is rarely used for strategic purposes. Despite these issues, the research team still identified a number of NBIN sites that use NIBIN effectively.

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CHAPTER I

INTRODUCTION

Firearms are composed of a variety of materials including numerous metal parts. The four most useful parts of a gun for ballistics imaging are the firing pin, the breech block, the ejector, and the lands inside the gun barrel. The machining process used to manufacture a gun creates unique, microscopic markings on these four parts. These markings are an unintentional byproduct of the machining process and are unique to a single part, such as one firing pin. In the terminology of forensic scientists, firing pins, breech blocks, ejectors, and the lands inside gun barrels possess individualization marks (Houck & Siegel, 2006, p. 61-62) which are analogous to human fingerprints in their distinctiveness.

When most firearms are fired, four individualizing marks are most commonly transferred as a "tool mark" from the metal firearm part to another object (either the spent cartridge case or the fired bullet). Three parts of the gun (the firing pin, the breech face, and, in the case of semi-automatic and automatic firearms, the ejector) usually leave tool marks impressed onto the spent cartridge case. The fourth tool mark is transferred from the lands inside the gun barrel onto the bullet after being fired. The presence, visibility, and quality of these four tool marks vary depending on factors including the make and condition of the firearm and the make and composition of the bullet and cartridge case.

Firearms identification (National Research Council [NRC], National Academy of Sciences [NAS], 2008, p.26) uses the visual comparison of used or spent cartridges retrieved from the scene of a gun crime to other used or spent cartridges (found at another crime scene) and/or spent cartridges produced by a firearm retrieved and test-fired by law enforcement. This comparison can help investigators link together multiple crimes involving a single gun. These

comparisons involve visually comparing impressions on fired cartridges from the firing pin, breech face, and ejector mark. Less often, bullets are compared by the striated tool marks imparted by the lands in the gun's barrel. If the gun is later retrieved by police, this analysis can help link a suspect's gun to specific crime scenes. Historically, the analysis of spent cartridges relies on a trained firearms examiner's visual comparison of cartridges, a process dating back to at least the mid-1920s and the work of Calvin Goddard (Nickell & Fischer, 1999, p. 105-106). This process of visually comparing cartridges and bullets, however, is time consuming and tedious.

The visual comparison of spent cartridges has been greatly advanced by computer analysis of ballistics evidence, or *ballistics imaging* (NRC, NAS, 2008, p. 26). IBIS™, the Integrated Ballistic Identification System, created by Forensic Technology, Inc. (FTI), is currently the most popular iteration of ballistics imaging technology. Ballistics imaging converts spent cartridges or bullets to a two- or three-dimensional image (NRC, NAS, 2008, p. 93-94). Using proprietary algorithms, these digitized images are converted into unique digital signatures (NRC, NAS, 2008, p. 101). The software can then search these signatures to identify possible matches using a correlation score. In the case of spent cartridges, IBIS™ calculates two or three different correlation scores; one each for the firing pin impression, breech face, and ejector mark. Correlations are usually presented as a list of possible matches rank ordered from most to less likely. Firearms technicians or examiners review these possible correlations, view digitized images of the two pieces of evidence on the computer screen, and designate the most likely matches in the computer system by marking them as *high confidence candidates*.

High confidence candidates must be manually confirmed in order to constitute a hit. Confirmation requires comparing each piece of original evidence (i.e., the actual fired cartridges

or bullets) using a comparison microscope. Once an examiner concludes that the evidence matches, the high confidence candidate is designated as a *hit*. Confirmed hits are then noted by the examiner in the digital database.

Forensics imaging databases hold great promise for linking firearms crimes that previously appeared unrelated. For instance, the use of a local ballistics imaging database (IBIS™) by the Boston Police Department improved the number of ballistics matches six-fold compared with processing ballistics evidence manually (Braga & Pierce, 2004). That said, locally operated databases are limited in their capacity to share information with other agencies. In theory, a national database linking local IBIS™ terminals provides a significant increase in the opportunities for linking gun crimes, particularly because offenders may commit gun-related offenses in more than one jurisdiction. This is the logic behind NIBIN.

NIBIN

The National Integrated Ballistic Information Network (NIBIN) is a national database of linked IBIS™ terminals. It is helpful to conceptualize NIBIN as having two dimensions: one technological and the other programmatic and organizational. In practice, these two conceptualizations or dimensions of NIBIN are invisible. However, for the purposes of this study, the distinction is vital. While we examine NIBIN's technological capacity to some extent, our primary focus is on its programmatic and organizational aspects.

From a technological perspective, NIBIN is a system of computer hardware and software coupled with a database which altogether is employed to acquire, transmit, store, compare, and retrieve digitized images of firearms evidence (fired or spent brass[1] and bullets from firearms).

[1] Hereafter, we use the term *spent brass* to refer to fired cartridge cases. This terminology is used because it is more flexible in writing (it is both singular and plural) and less cumbersome than terms such as *fired cartridge case(s)* or *spent cartridge(s).*

This dimension of NIBIN refers to a forensic analysis tool or *machine* that is usually located in criminalistics labs and operated by firearms examiners or technicians. The NIBIN hardware and software are engineered and sold by a privately held corporation called Forensic Technology, Inc. (FTI) located in Montreal, Canada. This report does not explore the operation of NIBIN technology such as how the database acquires the images, how the correlation algorithm compares images, or how the database stores and retrieves images. Some information specific to the hardware and software, like the operation of the search algorithm, is proprietary information owned by FTI and, thus, not readily accessible to researchers. Readers interested in the workings of the hardware and software of ballistics imaging systems are advised to begin with the 2008 report by the National Research Council of the National Academy of Science on ballistics imaging. Though we occasionally touch on technological issues, our primary concern is with NIBIN's programmatic or organizational aspects.

The second dimension of NIBIN is a *program* managed by the federal Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF).[2] ATF oversees and manages the operation of NIBIN hardware and software, funds its acquisition and maintenance, and provides technical support for agencies operating NIBIN hardware and software. ATF determines which labs or agencies will receive NIBIN hardware,[3] coordinates with the local lab about the system's operation, and pays for the equipment maintenance contract. The vast majority of NIBIN sites are housed, staffed, and managed by local crime lab or police agency personnel and ATF's role is to support these local sites. According to the National Academy of Sciences,

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[2] During its history, NIBIN has been housed in different organizational areas of ATF. For example, from March 2010 until April 2013, management of the NIBIN Branch was handled by ATF's Office of Science and Technology (OST). In April 2013, the NIBIN Branch was shifted to ATF's Firearms Operations Division, located in the Office of Field Operations.

[3] There are two methods to become a NIBIN partner site. First, ATF may select specific sites and provide them with hardware and support. The second option occurs when agencies purchase their equipment and pay the contract fee. The NYPD is the most notable example of a self-funded NIBIN site, but there are others.

> At its root, NIBIN is a grant-in-aid program that makes ballistic imaging technology available to law enforcement agencies to an extent that would not be possible if departments had to acquire the necessary equipment on their own. However, although ATF provides the equipment, the state and local law enforcement agencies must supply the resources for entering exhibits and populating the database. Accordingly, the incentive structures are complex: promoting top-down efforts by NIBIN administration to stimulate NIBIN entry necessarily incurs costs by the local departments. So, too, does suggesting that local NIBIN partners make concerted outreach efforts to acquire and process evidence from other agencies in their areas. (NRC, NAS, 2008, p. 166)

Thus, these relationships between ATF and local agencies are complicated.

This programmatic nature of NIBIN has been studied before by researchers from the U.S. Department of Justice's Office of the Inspector General, Audit Division [U.S. DOJ, OIG] (2005). Our report extends the OIG study by exploring the performance of select NIBIN sites in greater detail.

A Brief History of NIBIN

Automated ballistics imaging systems such as IBIS™ were not initially networked together. Instead, they functioned as local machines and local databases. The benefits of networking multiple local databases were obvious and, in the early 1990s, two federal law enforcement agencies sought to create national networks of ballistics image databases.

In the early 1990s, ATF implemented a ballistics imaging system called CEASEFIRE while the FBI implemented a different ballistics imaging system called DRUGFIRE (U.S. DOJ, OIG, 2005, p. v). In order to improve the efficiency of ballistics imaging, in December 1999 ATF and the FBI agreed to create a new system called NIBIN to replace both CEASEFIRE and DRUGFIRE. Initially, ATF and the FBI shared duties in running NIBIN, but in October 2003 the FBI assigned responsibility for running the data network to ATF, which currently retains this full responsibility (U.S. DOJ, OIG, 2005, p. 5). The NIBIN program uses new hardware called a "Remote Data Acquisition Station" (RDAS). The RDAS is more commonly referred to as a "NIBIN terminal" and was distributed to local sites (usually forensic crime labs) after June

2000.[4] By late summer of 2002, 231 agencies had received NIBIN equipment (U.S. DOJ, OIG, 2005). By May 2003, there were 227 NIBIN sites; in January 2005, there were 231 (U.S. DOJ, OIG, 2005, p. 19, footnote 30); and by May 2009, there were 203 sites (U.S. DOJ, ATF, 2009, p. 12).

The number of NIBIN sites has fluctuated since the program began operations. Additionally, some sites received equipment but never used it or never became fully operational NIBIN sites.[5] Other sites became operational only to be later shut down by ATF. For example, the NIBIN site with the Maine State Police in Augusta (ME-AGST-SP) was shut down by ATF around March 2007. Also, the number of NIBIN sites declined sharply in 2011 in response to budget cuts. In early 2011, ATF slashed NIBIN's budget by approximately 50% and closed sites in order to conserve resources. By August 2011, there were 192 sites (ATF NIBIN, 2011, p. 1) and by August 2012 there were 140 NIBIN sites (ATF, personal communication, August 24, 2012). During 2011 and 2012, sites closed by ATF were chosen because they either generated few NIBIN inputs or hits or were located in areas with low levels of gun crime. Some sites slated for closure opted to buy their NIBIN terminal from FTI and/or paid their own service contract to FTI so they could remain NIBIN sites. In most instances, however, NIBIN sites were closed when ATF removed their equipment.

According to news reports in early 2013, NIBIN's budget is $24 million, but is slated to increase to $50 million in 2014 in response to the shootings in Newtown, Connecticut (Feldmann, 2013). This new infusion of funding could recharge the NIBIN program after the

[4] A NIBIN site may have more than one terminal. In this report, the concern is with the organizational facilitators of NIBIN performance. Therefore, NIBIN sites are used as the unit of analysis and not NIBIN terminals.
[5] In an interview, a former chief from a Midwestern police agency that had received a NIBIN terminal described that it never became operational. The chief stated that the terminal appeared one day "like it was beamed down." The agency was unable to leverage the resources to use the terminal. The chief claimed the terminal sat in a garage behind the police station gathering dust.

severe budget cuts that hampered it in previous years. One of the most important conditions for enabling NIBIN to reach its promise as a potent tool for solving gun-related crime is stable and sufficient funding.

Despite fluctuations in funding and the movement of the NIBIN program to different units in ATF, the program has still been remarkably successful. By early 2012, the NIBIN program had produced more than 47,000 hits (U.S. DOJ, ATF. 2012). This large number illustrates NIBIN's scope as an investigative tool, provided the program is organized appropriately to make good tactical and strategic use of those hits.

The process of using NIBIN at the local level varies greatly across sites. Some are highly active while other sites are not. These differences in system use and performance are discussed below, but first the process of ballistics imaging at the local agency level is described as a normative series of steps.

How NIBIN is Supposed to Operate

Evidence for NIBIN comes from two sources: criminal events such as homicides and shootings (called "evidence" in the parlance of NIBIN data systems) or guns confiscated by the police and test-fired (usually called "test-fires" but referred to as "non-evidence" in NIBIN data systems). Thus, NIBIN partner labs receive both fired bullets and cartridges collected from crime scenes and guns confiscated from suspects to be test-fired.

Local agencies and labs, called NIBIN partners, input fired cartridge cases and fired bullets into the NIBIN database in a process called "acquiring an image." These images are then periodically uploaded to a regional server where they are stored and compared by the algorithm. Each time a new image is acquired and uploaded to the regional server, that image is automatically compared to other, similar images (i.e., 9mm semi-automatic brass is compared to

other 9mm semi-automatic brass, but not 7.62mm brass) already in the regional database. The regional servers are partitioned so the comparison of images occurs on a regional, not a national, level. In other words, NIBIN does not automatically search across all partitions in a server or against different regional servers. If a NIBIN site wishes to search in other regions' servers, they must resubmit the search for each individual region.

When the search is complete, NIBIN returns a list of correlations to the partner site. These correlations comprise the likely matches in descending rank-order. Possible matches are scored separately on two or, sometimes, three criteria: firing pin, breech face, and ejector. After the list of correlations is sent electronically to the site, firearms personnel must review the correlations. Generally, this process involves working down the list of correlations, from the most highly correlated items to the less correlated. An examiner or technician views each correlation on the computer screen, side-by-side. At this point, NIBIN designates viewed correlations as "viewed." Previous studies indicate some sites did not review correlations and, thus, could not confirm NIBIN hits (U.S. DOJ, OIG, 2005). Items appearing to match may be designated in the NIBIN system as "unconfirmed hits" by firearms personnel. These designations are recorded in the NIBIN database and the date a hit is marked as unconfirmed is recorded as the "creation date" (FTI, personal communication, April 09, 2013).

Unconfirmed hits must be confirmed. The confirmation process requires that a firearms examiner review both pieces of evidence (such as a fired cartridge case from a test-fire and a cartridge from a crime scene) with a comparison microscope. If the evidence is stored in another lab or law enforcement agency, the lab originating the unconfirmed hit must secure the evidence and examine it themselves. Only after a visual examination can the hit be confirmed. The unconfirmed designation in the NIBIN database must then be changed to a confirmed hit and the

date of confirmation manually entered by firearms personnel. A hit report is generated by the confirming lab and that report is transmitted to law enforcement personnel.

Law enforcement personnel may use the hit report for two purposes. First, they may research the crimes involved in both halves of the hit and, ideally, this information leads to better investigations in crimes involving a NIBIN hit, perhaps by helping identify a suspect. This first use is referred to as *tactical.* Second, they may use patterns of hits to reveal latent patterns in gun usage, gun sharing, gang activity, and even criminal conspiracy networks. These patterns can assist in investigating and prosecuting these criminal networks. This second use is referred to as *strategic*.[6]

How NIBIN Operates in Reality

At the request of ATF, the Audit Division of the Office of the Inspector General of the U.S. Department of Justice audited NIBIN (2005). The OIG report is detailed and highlights evidence of the differential implementation of NIBIN by partner sites. The OIG found that some NIBIN sites input a large amount of evidence while other sites did not. Some sites produced many hits while other sites did not. Some sites had large numbers of un-reviewed hits stretching over years. Our analyses of NIBIN data also reveal considerable variation in use and implementation by partner sites. The section below details the data collection methods and sources as well as describes indicators of program performance believed useful for determining successful NIBIN usage.

[6] Thus, *tactical* refers to uses or goals associated with a particular crime or event. In other words, "…information that is generated over the short term which has immediate relevance and value to a particular event or series of related events" (Gagliardi, 2010, p. 5). When NIBIN is used to help solve a criminal case, it is referred to as a tactical use. The term *strategic* is employed to refer to uses that are longer term or may involve networks of crimes, offenders, or criminal groups. Strategic information, "…is collected over the long term which can be used to identify patterns and trends…" (Gagliardi, 2010, p. 5).

CHAPTER II

DATA AND METHODS USED IN THE CURRENT PROJECT

This project had four goals, which are addressed in this report. This report describes the current state of NIBIN implementation nationally and at partner sites, and documents the impediments and facilitators of successful implementation of NIBIN. We also report on the extent to which NIBIN helps identify suspects and increase arrests for firearms crimes. Finally, this report describes NIBIN best practices for implementation at agencies and for criminal investigations.

This project relies on data gathered from four sources. First, ATF provided two types of NIBIN usage files, including overall monthly usage and hit data for all NIBIN sites between June 2006 and July 2012. ATF also provided data files that reported every hit (n=8,231 hits) produced by 19 NIBIN sites between 2007 and 2012, although there was some variation in reporting.[7] Second, all crime labs in the U.S. were surveyed along with firearms section within these labs to assess structure, operations, and opinions about NIBIN. Third, site visits were conducted with 10 NIBIN partner sites. These site visits entailed interviews with crime lab managers, firearms section personnel, and police personnel (such as officers in special gun or violent crime units, police operations, property room, and planning/research). Fourth, investigators who led the investigation in 65 criminal cases involving a NIBIN hit were interviewed.

Shortly after being awarded the grant for this project, ATF personnel was consulted at a meeting at ATF's headquarters in Washington, DC, on October 8, 2010. The research purposes

[7] Sites typically reported 2007-2012 but some did not. Austin: 2005-2012, Baltimore: 2006-2012, CBI Denver: 2007-2012, Denver: 2007-2012, Houston: 2006-2012, Marion Co./Indianapolis: 2007-2011, Milwaukee: 2007-2012, Kansas City: 2007-2012, New Orleans: 2009-2012, New York: 2007-2011, Onondaga Co.: 2003-2012, OSP Portland: 2007-2012, Prince George's Co.: 2006-2012, Phoenix: 2007-2011, Richmond: 2007-2012, Santa Ana: 2007-2012, St. Louis Co.: 2007-2012, Stockton: 2007-2013,WSP Tacoma: 2007-2012.

were discussed and ATF provided input on proposed methodologies.[8] On November 4 and 5, 2010, two representatives from FTI were met and consulted to learn about the history and operation of NIBIN. The representatives advised on how to determine NIBIN site performance and which NIBIN sites were considered high-performers. In early 2011, after receiving permission from an attorney at the Justice Department, members of the OIG's evaluation team (the team that wrote the 2005 audit of NIBIN) were identified and interviewed via telephone (on February 1 and 3, 2011).

This interview with the OIG team, in conjunction with their published report, revealed that OIG had been provided with a very extensive database of NIBIN inputs[9] and hits. The OIG data consisted of Microsoft Access files of hits, cases, and firearms. These data allowed OIG to determine which agencies, both NIBIN partner sites and non-partner agencies, were acquiring the greatest percentage of images, producing the most hits, and confirming hits quickly. These data also revealed considerable variation across NIBIN sites in inputs, production of hits, and confirmation of hits. The lesson was clear: these data are important to understand the nature and usage of NIBIN.

Access to this extensive NIBIN database was requested from ATF on April 27, 2011. ATF was unwilling to provide the data for a variety of reasons, but the request eventually made its way through multiple offices and attorneys at ATF. During 2011, ATF slashed the NIBIN

[8] These two meetings, the first in Washington, DC, and the second at Sam Houston State University (SHSU) in Texas, were funded in part by the CJ Center at SHSU and the participants themselves. The two FTI employees paid for their airfare to Houston, Texas and the CJ Center provided local transportation, room, and meals. Likewise, research team members self-financed the travel to Texas and the CJ Center paid for hotel rooms and meals. Grant funds were not used to fund either trip as the grant award period did not begin until January 2011.

[9] In this report the term *inputs* and not *acquisitions* is used to refer to ballistics evidence put into NIBIN and associated with a single criminal case or incident, such as a test-fire. Firearms examiners often use the term *acquisitions* to refer to images loaded into NIBIN. A single crime or incident may involve multiple image acquisitions. The data received from ATF include cases and events and not individual acquisitions; therefore the term inputs is used. This is an important distinction because in tables presented later in this report the data refer to criminal cases and not separate images.

budget by 50%. Site contractors and intelligence analysts were laid-off or reassigned to other programs. ATF cited this cut in manpower and budget as part of the reason for being unable to grant the data request. This suggests that ATF cuts were so substantial that obtaining basic information from its own databases was difficult and that the cuts had a meaningful impact on their ability to respond to violent gun crime in the nation. Also, during mid-2011, ATF began a process of closing NIBIN sites. By November 2011, they had closed 40 of the 220 sites and had plans to close another 60 sites. As sites are closed and their NIBIN terminals unplugged from the network, their data become unavailable to us. Given these budget, manpower, and logistical constraints, ATF was unable to provide the full, disaggregated data from all NIBIN sites. On September 2, 2011, ATF agreed to provide relatively detailed information on NIBIN usage for a limited number of sites. This may suggest that ATF has limited analytical and intelligence capacity for processing NIBIN data; even less than most medium to large local police departments. This concern is addressed later in this report.

Overall, despite the limited access to NIBIN data, personnel at ATF were helpful, accessible, and accommodating. A letter of support was provided for the survey of crime labs and firearms sections. ATF contacted field offices in some cities to facilitate site visits. ATF personnel provided meetings in Washington, DC and some ATF personnel regularly answered questions, replied to emails, and supported efforts. Most ATF personnel were found to be remarkably open to this work and some welcomed this research project.

In the initial grant proposal, efforts were allocated to use the full ATF NIBIN data to identify a random sample of 500 NIBIN hits. The plan was to survey investigators working cases associated with these hits to determine the utility of the NIBIN hit information for each particular investigation. The initial plan to draw this sample was necessarily changed due to the nature of

the data files provided by ATF. Resources devoted to surveying investigators were allocated to the surveys of crime lab managers and firearms managers in crime labs. Thus, the proposal of administering two waves of the crime lab and firearms surveys changed to administering four waves of surveys.

Overall NIBIN Usage Files for All NIBIN Sites

In 2011 and again in 2012, electronic files from ATF were received which reported on the overall usage of NIBIN at all NIBIN sites on a per-month basis between June 2006 and July 2012. For each site, these files reported tallies (for both bullets and spent brass) of NIBIN inputs, images acquired, and confirmed hits. These data reveal noteworthy differences across sites in both the usage of NIBIN and the production of confirmed hits.

Detailed NIBIN Hit Files for 19 Sites

ATF provided detailed data files on NIBIN hits produced by 19 sites.[10] Each data file reported on hit dyads for a single NIBIN site over a five year period of time, detailing 8,231 hits. After cleaning the data to eliminate hits not generated by these 19 sites, a file containing 8,004 legitimate hits was left.[11] Each hit dyad included the date of the crime or incident, the agency-assigned case/crime number, and when the hit was confirmed. Some data files reported the caliber of the exhibit involved and the shape of the firing pin impression. The category of criminal case (usually operationalized as homicide, assault with a deadly weapon, other, and test-

[10] A data file from a 20th site (in the Northeast) was received, but the file contained information on only three hits and was not usable. When ATF's Office of Science and Technology was asked why there were only three hits in this agency's file, they responded that, "With only 3 hits. It appears that _____has not properly marked "HITS" within the NIBIN database for the past five years." This site has produced more than 750 hits since 1995 (FTI, personal communication, March 09, 2013). Thus, data is used from 19 NIBIN sites and not 20.

[11] See the Appendix where issues with some of the NIBIN data are detailed and how these 8,004 legitimate hits are isolated is explained.

fire) was reported by some agencies. The data from these 19 sites and 8,004 hits represents approximately 17% of all hits produced by NIBIN since its inception.[12]

These NIBIN hit files contain useful and actionable criminal intelligence for police agencies and ATF. While the tactical potential of NIBIN for solving individual offenses is discussed regularly, NIBIN data also have tremendous potential at a more strategic level. For instance, crime analysts who carry out strategic analyses of crime could derive great value from these data files, particularly when combined with other types of data on gun seizures, gun tracing, and gun offending. Similarly, these data also have great potential for administrative purposes, both within individual labs or police agencies and at ATF. They can be used to construct performance measures, detect lapses or surges in performance, and for planning purposes when considering staffing and workload issues. Unfortunately, these data files are rarely used by analysts for strategic or administrative purposes. In part, this is due to the accessibility of the data files, but there are also serious concerns about the level of quality control invested in these data. All of the files received from ATF (in Microsoft Excel format) required many hours of careful cleaning before they could be utilized to carry out any kind of meaningful analysis. These quality control and data integrity issues are addressed in the Appendix.

Survey of Crime Labs and Firearms Sections

A mailed survey of every identifiable public crime lab in the U.S. was conducted, including both NIBIN partner labs and non-NIBIN labs (total=459). The firearms sections within these crime labs were also surveyed. Three survey instruments were crafted for the lab survey although each lab received only two different survey instruments. All crime labs received a

[12] Thesample size of agencies (n=19) and confirmed hits (n=8,004) constitutes neither a random sample of all NIBIN hits nor of NIBIN sites. Sites were selected purposely for a variety of reasons. Ten of the 19 NIBIN sites were visited to gather detailed qualitative data on the nature and role of NIBIN as an investigative tool. Other sites were chosen because of hope for a site visit but access could not be gained or because of information that a site was especially productive or had implemented innovative practices related to NIBIN.

single point of contact (SPOC) survey to be completed by the crime lab director. This SPOC survey asked questions not addressed by the Bureau of Justice Statistics (BJS) Census of Publicly Funded Crime Laboratories such as issues of lab processes, opinions about NIBIN, and various measures of organizational structure. Each lab also received one of two surveys that were instructed to be routed to the lab's firearms section. NIBIN sites received a NIBIN firearms survey which asked questions specific to the operation of NIBIN, such as inputs, throughputs, and outputs, and specific processes, policies, and practices. Non-NIBIN labs received a firearms survey which asked about the processes and practices used by the firearms section but did not ask about NIBIN. [13] In total, 459 crime labs received survey instruments. These included 233 labs using NIBIN (NIBIN partner sites) and 218 non-NIBIN crime labs. Surveys were administered between January and September 2012 including four waves of mailings intended to maximize response rates.

Surveying the population of publicly-funded crime laboratories in the United States and its territories is challenging for a variety of reasons. Multiple sources were used to compile a mailing list of all eligible crime laboratories and their addresses. First, BJS provided a list of 409 crime laboratories. This list was used to identify the population of crime laboratories for the most recent BJS Census of Publicly Funded Crime Laboratories (U.S. Department of Justice [U.S. DOJ], BJS, 2009). Second, ATF's National Directory of NIBIN Users (U.S. DOJ, ATF, 2010) was reviewed, which identified 233 NIBIN sites. Third, intensive Google searches identified crime laboratories not present in the BJS Census or the ATF NIBIN Users Directory. This three-

[13] While all NIBIN sites (n=233) were identified, a list of labs with firearms sections that were not NIBIN sites could not be found. Thus, every non-NIBIN lab (n=218) was sent a firearms survey. The population of non-NIBIN labs with a firearms section is unknown, so an accurate response rate for the non-NIBIN firearms surveys cannot be calculated. It is most likely that labs without firearms sections simply discarded the survey since respondents were instructed to route the survey to their firearms sections. Seventeen completed non-NIBIN firearms surveys were received.

stage search process identified 459 publicly funded crime laboratories eligible for inclusion in the survey. A variety of sources was used to locate accurate mailing addresses for each laboratory, including a list of accredited laboratories (n=392) maintained by the American Society of Crime Laboratory Directors (ASCLD). In total, 459 crime laboratories were identified which appeared eligible for survey participation.

Laboratories were sent an envelope containing both surveys (crime lab director surveys and firearms section surveys) as well as information describing the project and highlighting the importance of their participation. The letter of support from ATF was also included. Additionally, before the fourth wave was mailed, ASCLD published an announcement about the survey in their newsletter. A printed copy of the ASCLD newsletter was included during wave four. Each outgoing envelope contained prepaid return envelopes for each survey (both the lab director/SPOC survey and the firearms section survey).

The first wave of surveys was mailed in January of 2012 and three additional mailings for nonrespondents were sent in subsequent months. Following wave one, several surveys were returned as undeliverable due to incorrect addresses. Google was used in an effort to locate correct addresses for those laboratories. Response rates for all four waves are listed below in Table 1. Response rates were adjusted to account for ineligible laboratories including those that had closed or did not have firearms sections.[14] After accounting for ineligible agencies, the final list included 223 labs that participated in NIBIN and 218 labs that did not participate in NIBIN. A total of 111 surveys was received from labs participating in NIBIN and 109 of those surveys provided data that could be utilized for further analysis.

[14] Labs in Alabama, Arizona, and Georgia were found to be closed for budgetary reasons. Additionally, two labs in Alabama had voluntarily revoked their ASCLD accreditation and subsequently disbanded. Finally, one lab in Illinois was closed for renovations following extensive water damage. Throughout the survey administration process, seven labs not participating in NIBIN were discovered to not have firearms sections and ten NIBIN labs indicated they did not have a firearms section.

Table 1
Survey Response Rates by Wave

SPOC-Crime Lab Manager Response Rates	Number of Surveys	Wave Rate	Cumulative Percent
Wave 1 Response Rate	74/459	16.12	16.12
Wave 2 Response Rate	50/385	12.99	27.02
Wave 3 Response Rate	10/335	2.99	29.19
Wave 4 Response Rate	18/325	5.54	33.12
NIBIN Firearms Response Rates			
Wave 1 Response Rate	58/223	26.01	26.01
Wave 2 Response Rate	27/165	16.36	38.12
Wave 3 Response Rate	12/138	8.70	43.50
Wave 4 Response Rate	14/126	11.11	49.78

Site Visit Interviews and Observations for 10 NIBIN Sites

Site visits to 10 NIBIN sites across the U.S occurred in 2012 and early 2013. Some of the sites were chosen because they were viewed by key informants (experts knowledgeable about NIBIN) as productive or innovative NIBIN sites. Others were chosen based on a combination of their volume of gun-crime and their geographic convenience. The geographic criterion was useful for controlling research costs and increasing the number of site visits given the limited funding available. Key informants suggested that regional or state labs face a different set of constraints when processing ballistics evidence as compared to labs embedded within a single police agency. Therefore, one regional lab (Onondaga County, NY) was visited which serves a municipal police agency (Syracuse PD) and the county sheriff's office. One lab was selected as part of a state-run lab system (Ohio Bureau of Criminal Investigation Lab, in Bowling Green, OH). Nine of the ten sites are located in metropolitan areas but one site (BCI, Bowling Green) is in a rural part of the Midwest. Finally, nine of the sites were NIBIN partners at the time of the visits, but one site (BCI, Bowling Green) was no longer a NIBIN site. Their NIBIN terminal was removed in early 2011 because they had produced only three hits during their entire history with NIBIN. Table 2 presents demographic data for the populations served by the 10 agencies visited

(shaded rows) as well as the other 10 sites with detailed NIBIN use data and data from 2 cities contained within counties that provided NIBIN data (St. Louis, Missouri, and Syracuse, New York).[15]

[15] Crime or demographic data for state or regional crime labs are not provided because the populations served by these regional or state labs cannot be easily determined or the crime rates for their jurisdictions easily measured.

Table 2
2010 Demographic and Crime Data for 22 Jurisdictions

Site	2000 Population	2010 Population	% Poverty	% Unemployed	% Single Parent Household	Violent Crime	Violent Crime Rate	Murder/ Manslaughter	Murder/ Manslaughter Rate	Forcible Rape	Robbery	Aggravated Assault
Phoenix, AZ	1,321,045	1,445,632	20.3	5.9	12.7	8,001	553.5	116	8.0	522	3,250	4,113
Santa Ana, CA	337,977	324,528	19.5	6.9	12.1	1,510	465.3	28	8.6	88	719	675
Stockton, CA	243,771	291,707	22.1	9.7	15.2	4,033	1,382.6	49	16.8	107	1,413	2,464
Denver, CO	554,346	600,158	18.8	5.9	7.9	3,387	564.4	28	4.7	371	943	2,045
CBI – Denver, CO												
Marion Co./ Indianapolis, IN	781,870	820,445	18.9	7.4	13.2	9,646	1,160.2	92	11.1	461	3,367	5,726
New Orleans, LA	484,674	343,829	25.7	7.1	13.0	2,593	754.2	175	50.9	144	953	1,321
Baltimore, MD	651,154	620,961	22.4	7.9	14.0	9,316	1,500.3	223	35.9	265	3,336	5,492
Prince George's Co., MD	801,515	863,420	8.2	6.5	12.8	4,941	572.3	81	9.4	169	2,472	2,219
Kansas City, MO	441,545	459,787	18.2	6.6	11.7	5,643	1,227.3	102	22.2	241	1,671	3,629
St. Louis, MO	348,189	319,294	26.0	9.1	12.5	6,205	1,943.4	144	45.1	188	2,125	3,748
St. Louis Co., MO	1,016,315	998,954	9.7	5.2	9.6	1,090	109.1	17	1.7	70	286	717
New York, NY	8,008,278	8,175,133	19.4	6.0	10.8	48,489	593.1	536	6.6	1,036	19,608	27,309
Onondaga Co., NY	458,336	467,026	13.8	4.3	10.5	157	33.6	1	0.2	29	36	91
Syracuse, NY	147,306	145,170	32.3	6.0	16.2	1,291	889.3	15	10.3	68	377	831
BCI – Bowling Green, OH												
OSP – Portland, OR												
Austin, TX	656,562	790,390	18.5	5.1	8.5	3,790	479.5	38	4.8	265	1,231	2,256
Houston, TX	1,953,631	2,099,451	21.5	5.7	11.5	22,491	1,071.3	269	12.8	712	9,449	12,061
DFS – Richmond, VA												
WSP – Tacoma, WA												
WDOJ – Milwaukee, WI												

Site visits were conducted based on a 14-page site visit protocol (Frank, Katz, King, Maguire, & Wells, 2012).[16] Site visitors toured crime labs, the firearms sections within labs, and police facilities. Interviews were conducted with crime lab directors, firearms section personnel, police commanders and line-level workers, including analysts, investigators, and police officers whose assignments were relevant to the study. Site visitors sometimes met with ATF personnel and NIBIN contractors.[17] Visits focused on the ways in which NIBIN processing is facilitated, impeded, or otherwise influenced by local conditions, policies, and practices. The different ways NIBIN hit information is communicated and routed to police personnel was also investigated. Some sites use hit reports solely for tactical or criminal investigation purposes. Other sites use them for more strategic purposes such as to identify patterns of gang gun activity or identify repeat offenders. One site (Project NoVA in Kansas City) uses NIBIN hits as part of sophisticated social network analyses that inform so-called "pulling levers;" police operations meant to reduce gang and gun-related offending.

Table 3 describes the length and content of the 10 site visits. Site visitors spent a total of 167 hours conducting interviews and observations at the 10 sites. The allocation of these 167 hours is presented by site and by category of interviewee.

Table 4 provides summary information about the 10 site visits, including the name of the site and the nature and number of people interviewed at each site. In total, 133 respondents were interviewed. The number of respondents ranged from three in the rural, state-run lab that was no longer a NIBIN site (Bowling Green, OH) to 25 in Kansas City.

[16] The site visit protocol was approved by the Institutional Review Board at Sam Houston State University, March 28, 2012 (Protocol Number 2012-02-002).

[17] NIBIN contractors are experienced law enforcement personnel, usually retired, who are paid by ATF to serve as liaisons between NIBIN sites and the law enforcement agencies to which they were assigned. Contractors generally followed up on NIBIN hits by gathering criminal information related to hits and relaying that information to ATF and the local police agency. One key informant referred to contractors as "hit hunters," an apt term for their role. All NIBIN contractor positions were eliminated in early 2011 when the NIBIN budget was cut. Contractors later returned to work in late 2012. See also U.S. DOJ, OIG, 2005, p. 116.

Table 3
Site Visit Hours by Site and Activity Category

Site	Total Hours Onsite	Lab Director	Firearms Head	Firearms Personnel	Other Lab Personnel	Police Chief/ Sheriff	Police Commander(s)	Police Officer(s)	Crime Analyst(s)	DA or ADA	Observed While Working	Tour of Facility	Other (activity)	Other (people)
Phoenix, AZ	17.25	1.0	–	2.0	1.0	–	3.5	3.25	–	–	3.5	–	1.0	2.0
Santa Ana, CA	28.95	0.97	4.52	–	2.07	0.42	3.41	5.74	–	0.5	8.66	2.33	0.33	–
Stockton, CA	27.64	–	3.66	2.91	1.2	0.83	2.67	5.6	0.66	–	8.41	0.7	1.0	–
Marion Co./ Indianapolis, IN	16.96	0.97	4.29	5.71	–	–	2.82	–	–	–	0.71	1.96	0.5	–
New Orleans, LA	13.72	2.41	2.83	0.5	–	–	0.83	1.0	–	–	3.0	0.66	0.33	2.16
Kansas City, MO	12.49	2.0	0.66	0.83	–	0.08	3.92	3.58	–	–	–	0.17	–	1.25
Onondaga Co., NY	18.00	1.75	2.0	–	1.0	1.0	4.0	3.5	1.0	1.0	–	1.0	1.0	0.75
Bowling Green, OH	2.99	0.83	1.66	–	–	–	0.5	–	–	–	–	–	–	–
Austin, TX	16.60	0.91	2.0	1.74	0.16	0.58	0.48	1.51	4.89	–	1.33	3.0	–	–
Houston, TX	12.66	–	1.42	1.0	–	–	3.74	4.0	–	–	2.5	–	–	–
TOTAL	167.26	10.84	23.04	14.69	5.43	2.91	25.87	28.18	6.55	1.5	28.11	9.82	4.16	6.16

Table 4
Number of Interviewees by Category and Site

Site	Lab Director	Firearms Head	Firearms Personnel	Other Lab Personnel	Police Chief/ Sheriff	Police Commander(s)	Police Officer(s)	Crime Analyst(s)	DA or ADA	Other (people)	Total People Interviewed
Phoenix, AZ	1	–	2	1	–	2	5	–	–	2	13
Santa Ana, CA	1	1	1	2	1	3	5	–	1	–	15
Stockton, CA	–	1	1	1	1	4	7	1	–	–	16
Marion Co./Indianapolis, IN	1	1	5	–	–	2	–	–	–	–	9
New Orleans, LA	1	1	1	–	–	2	2	–	–	2	9
Kansas City, MO	1	1	2	–	1	5	14	–	–	1	25
Onondaga Co., NY	2	1	–	1	1	4	–	1	1	1	12
Bowling Green, OH	1	1	–	–	–	1	–	–	–	–	3
Austin, TX	2	1	4	1	1	1	3	3	–	–	16
Houston, TX	–	1	1	–	–	4	9	–	–	–	15
TOTAL	10	9	17	6	5	28	45	5	2	6	133

Site visitors also conducted in-person interviews with criminal investigators about 65 specific criminal cases involving a NIBIN hit. These cases were purposively chosen. Prior to site visits, ATF hit data from each site was used to identify recent criminal cases involving a NIBIN hit. Recent homicide cases were usually selected. For some sites, such as Kansas City, the catchment period covered two years. For other sites, however, the catchment period was necessarily extended to capture a sufficient number of cases. For example, in order to identify 12 homicides with NIBIN hits in Santa Ana, the required time period ranged from January 2009 to March 2012. Austin had only two homicides with NIBIN hits (one from 2005, the other from 2006). Therefore, any assault with a deadly weapon (ADW) case was also selected which occurred since January 2010. Site visitors conducted face-to-face interviews with investigators in six sites (Santa Ana, Kansas City, Houston, Phoenix, Onondaga Co., and New Orleans) to learn about the details of each case, particularly the specific role played by NIBIN and, more generally, by ballistic evidence. In one additional site (Marion Co./Indianapolis), investigators provided written details about each case to the site visitor. In another site, a criminal investigator extracted information from the police agency's electronic records system to provide information about the disposition of each case (Austin). One site (the state lab in a rural community) produced just three NIBIN hits. Since their NIBIN terminal had been removed, information was unavailable about this case from either ATF or the lab itself. Overall, data were gathered on a sample of 65 criminal cases in which investigators received information about a NIBIN hit.

Performance Metrics for NIBIN Usage

Two prior studies of NIBIN (NRC, NAS, 2008; U.S. DOJ, OIG, 2005) described the nature of NIBIN and highlighted differences in NIBIN usage across sites. Both reports stopped short of assessing the performance of NIBIN sites via outcome measures. At best, both reports

counted the number of hits each site produced, discussed if sites had backlogs of unconfirmed hits, and addressed which sites acquired many images and which sites few. This analysis builds upon the prior work by creating two new metrics of NIBIN performance.

We seek to describe and predict the differential implementation and usage of NIBIN by NIBIN partner sites. Discussions with numerous personnel involved with NIBIN indicate that only two performance metrics have been available to ATF: the number of inputs at a site (used by ATF as a process indicator to determine if a site is actively using NIBIN) and the number of hits produced by a site (an output indicator of NIBIN performance or success). A March 2011 publication by ATF reported the "most successful NIBIN Partners" are the five sites with the greatest number of hits (U.S. DOJ, ATF, 2011, no page).[18] ATF has not created additional performance metrics, including indicators of outcome performance such as how helpful NIBIN hits are for criminal investigators or prosecutors. The National Research Council noted the importance of outcome evaluations of NIBIN, saying

> …a full evaluation of the program's performance would consider what happens after a "hit" is made using NIBIN- whether the information leads to an arrest or a conviction and how large a role the ballistics evidence "hit" played in achieving those results. Those "post-hit" data are apparently not maintained in any systematic collection. (NRC, NAS, 2008, p.146)

In this report, four metrics are used to measure the performance of NIBIN sites. First, the number of inputs into NIBIN by NIBIN partner sites (both bullets and spent brass, including both criminal evidence and test-fires) are counted. This is a process-indicator that measures each site's capacity to put evidence into NIBIN. Second, the number of hits produced by each site (for bullets and for spent brass) are used as a performance metric to determine the output

[18] These five sites are: NYPD with 3,000+ hits, Allegheny County, PA Medical Examiner's Office with 2,300+ hits, Illinois State Police, Chicago with 2,100+ hits, Newark PD with 1,200+ hits, and Santa Ana, CA PD with 1,100+ hits.

performance of NIBIN sites. These two metrics have been used by ATF to assess the performance of NIBIN sites.

A third performance indicator is calculated for 19 NIBIN sites: the elapsed time between the most recent crime or event (event, in the case of a test-fire) in a hit dyad and the date the hit was confirmed by that site. This elapsed time variable measures how long each site takes to confirm a hit after the more recent of the two crimes occurs. Quick sites confirm a hit in a few days and slow sites may take hundreds of days. Timely hits *might* help criminal investigations while older hits are less likely to prove helpful. In other words, not all hits have equal value for criminal investigations. The speed with which hits are generated is very important. This performance indicator is related to the recent research on lag times in processing forensic evidence (Peterson, Sommers, Baskin, & Johnson, 2010).

Fourth, data are used from interviews with criminal investigators about 65 criminal cases in which a NIBIN hit was confirmed to assess the overall outcome performance of NIBIN. Ultimately, NIBIN is a criminal investigations and intelligence tool. Labs produce hits and count their hits as measures of accomplishment but labs do not *act* on the hits; law enforcement and investigators do. One goal was to see how useful NIBIN hits are for investigators who receive a hit. This is an outcome variable and, this study contends, one of the most important outcome variables for a forensics processing/information system. A recent Department of Justice Inspector General's report (U.S. DOJ, OIG, 2005) and a report from the National Research Committee of the National Academy of Sciences (NRC, NAS, 2008) note that NIBIN matches or hits may help clear unsolved firearms crimes. These reports state that no research has addressed the ways in which investigators use information produced by NIBIN.

The fourth performance indicator uses multiple variables to determine the utility of NIBIN hits for specific criminal investigations. It seeks to answer questions of how hits advance investigations, if hits help identify previously unidentified suspects or whether criminal cases are cleared by arrest at the time NIBIN hits are identified. This indicator is multi-faceted because criminal investigations are complicated and unfold differentially depending on the particular circumstances of each case. At this point, the different ways NIBIN has been implemented in crime labs is examined.

CHAPTER III

THE DIFFERENTIAL NATURE OF NIBIN IMPLEMENTATION IN CRIME LABS

This section describes the nature of NIBIN implementation by NIBIN partner sites (crime labs). These data are presented in tabular form as univariate descriptive statistics. The data are derived mostly from mailed surveys of NIBIN firearms sections and are based on 111 survey responses.

Equipment, Staffing of Firearms Sections and NIBIN Inputs by Staff

The staffing of firearms sections within labs and the types of personnel used for NIBIN are presented in Table 5 below. These data reveal considerable variation across different NIBIN sites. Most of the labs surveyed were still active NIBIN partner sites (80.9%) during 2012. Twenty-one firearms sections (19.1%) had been but were no longer NIBIN sites when the survey was administered in 2012. The majority (78.6%) of survey respondents used NIBIN Heritage rather than the newer BRASSTRAX-3D™.[19]

Table 5
Staffing, Personnel, and Equipment for NIBIN Sites (N=111)

Variable	N	Median	Mean	SD	Min	Max.
Staffing of Firearms Sections:						
Full-Time Examiners	109	2.00	3.46	3.47	0	17
Part-Time Examiners	109	0.00	0.19	0.50	0	3
Full-Time Technicians	109	0.00	0.67	1.13	0	8
Part-Time Technicians	109	0.00	0.28	0.65	0	3
Full-Time Support Staff	109	0.00	0.26	0.73	0	4
Part-Time Support Staff	109	0.00	0.09	0.54	0	5

[19] NIBIN Heritage refers to older NIBIN hardware that, as of early 2013, is still being replaced with the newer, BRASSTRAX-3D™ system. Among the many advantages of BRASSTRAX-3D™ is its ability to acquire images with less chance of operator error and with improved image quality.

Table 5 cont.
Staffing, Personnel, and Equipment for NIBIN Sites (N=111)

Variable	N	Median	Mean	SD	Min	Max.
What percent of items of evidence are entered into NIBIN by examiners?	104	70.50	55.67	44.32	0	100
What percent of items of evidence are entered into NIBIN by technicians?	104	29.50	44.08	44.45	0	100
What percent of items of evidence are entered into NIBIN by support staff?	104	0.00	0.02	0.20	0	2

Is your firearms section a site for ATF's NIBIN program? (N=110)		
We are currently a site for ATF's NIBIN program.	89	80.9
We were a NIBIN site, but we are not currently a NIBIN site.	21	19.1

Variable	N	Valid Percent
What type of NIBIN equipment does (or did) your lab have? (N=98)		
Heritage System	77	78.6
Brass TRAX-3D	20	20.4
Bullet TRAX-3D	1	1.0
Only examiners enter NIBIN inputs	43	41.3
Only technicians enter NIBIN inputs	23	22.1
Examiners and technicians enter NIBIN inputs	38	36.5

Labs differ in the staffing of their firearms sections. The majority of firearms section employees at NIBIN sites are full-time firearms examiners. The size of firearms sections varies (mean = 3.46, median = 2.0) from zero full-time firearms examiners to the largest section with 17 full-time examiners. Firearms sections infrequently utilized part-time examiners, full-time technicians, or part-time technicians for staffing (the median number of employees in any of these three categories was = 0). Labs report that most (mean = 55.6%) of a lab's NIBIN inputs[20] are input by firearms examiners. Although firearms sections do not employ many firearms

[20] The term "input" describes evidence associated with a case or incident being uploaded into the NIBIN database. Each input may involve multiple images of evidence and, thus, may involve multiple image acquisitions.

technicians (as compared to examiners), technicians enter a considerable (mean = 44.0%) amount of evidence into NIBIN. Labs rarely use support staff to input evidence into NIBIN (mean = .02% of lab's NIBIN inputs). Additionally, 41.3% of labs exclusively use examiners to input evidence into NIBIN while 22.1% of labs use only technicians. About one third of labs (36.5%) use both examiners and technicians to enter NIBIN inputs.

Lab Inputs and Processing

The NIBIN firearms sections that responded to the survey also reveals considerable variation in the nature of ballistics inputs and how these inputs are processed. These data are presented in the tables below. One of the most relevant findings to note is that labs experience delays in processing and inputting evidence into NIBIN. In some cases, these delays are attributable to crime lab policies and procedures that cannot be fixed at the level of the firearms section. This important finding is discussed below.

Sources of Inputs

Labs receive inputs from a variety of law enforcement agencies and in different forms, such as guns to be test-fired and evidence from crime scenes. The amount of evidence received annually by NIBIN partner sites varies considerably (see Table 6). On average (mean), labs receive approximately 715 criminal cases, 530 test-fires, and 102 "other" pieces of firearms evidence annually. Labs often receive evidence from a number of different law enforcement agencies. NIBIN partner firearms sections receive ballistics evidence from a mean of 39 law enforcement agencies (median = 15.5). Participants were asked to categorize received evidence as criminal cases, test-fires, and "other." Some respondents (n= 6) were unable to separate evidence from criminal cases and test-fires and instead classified all evidence received in the "other" category. The majority of the ballistics evidence put into NIBIN is spent brass from test-

fires of confiscated guns (Table 6). Approximately 86% of the total NIBIN database is comprised of spent brass; only 14% is comprised of fired bullets (see Table 9 below). Most of the spent brass inputs in NIBIN are from test-fires of confiscated firearms (median = 75%) and 26.5% of the spent brass is recovered from crime scenes. Key informants shared their belief that a productive NIBIN site should have a greater portion of brass from crime scenes than from test-fires because too many test-fires (and not enough crime scene brass) will not produce NIBIN hits. Inputting bullets into NIBIN is a somewhat rare event compared to spent brass. Some sites do enter a lot of bullets but most do not. The proportion of test-fire to crime scene bullets put into NIBIN differs from that of spent brass. Most bullets (mean = 17.73%) are from test-fires, but 13.15% (mean) of bullets input into NIBIN come from crime scenes.[21]

Table 6
Annual Inputs and Types of NIBIN Inputs for NIBIN Sites (N=111)

Variable	N	Median	Mean	SD	Min.	Max.
How much firearms evidence does your section receive annually? Criminal Cases	92	327.50	715.21	1023.55	0	6000
How much firearms evidence does your section receive annually? Test-Fires	90	322.50	530.71	668.83	0	2900
How much firearms evidence does your section receive annually? Other	94	0.00	102.30	418.59	0	3176
Over the past year how many different law enforcement agencies did your section input NIBIN evidence for?	96	15.50	39.02	110.96	0	1,050
What percent of brass input into NIBIN is from test-fires of confiscated firearms?	96	75.00	70.70	21.81	0	100
What percent of brass input into NIBIN is from brass removed at crime scenes?	96	26.50	36.06	27.44	0	100
What percent of bullets input into NIBIN is from test-fires of confiscated firearms?	91	0.00	17.73	34.16	0	100
What percent of bullets input into NIBIN is from bullets removed at crime scenes?	91	0.00	13.15	28.94	0	100

[21] This survey asked firearms sections to report the percentage of bullets acquired by NIBIN which were test-fires and which were from crime scenes. Firearms sections did not generally report percentages that summed to 100%. This reflects the percentages that sections reported.

Procedures and Processing Time

Labs use different procedures for processing ballistics evidence and inputting it into NIBIN. Respondents were asked to rank the importance of processing various types of evidence on a scale from zero (not important at all) to 10 (very important). These rankings are presented in Table 7. Of highest priority is brass from semi-automatic handguns and semi-automatic long guns. Labs view entering brass from revolvers as being the least important category for entry into NIBIN. Of equally low priority are fired bullets from test-fires and crime scenes. Firearms sections also prioritize based on the type of crime, with homicides viewed as the most important. Labs view requests for analysis from investigators and prosecutors as important. The least important priority for labs is test-firing confiscated firearms (Table 7).

Table 7
Prioritization of Evidence Types for NIBIN Sites (N=111)

Variable	N	Median	Mean	SD	Min.	Max.
Brass from revolvers	102	1.00	2.33	2.99	0	10
Spent bullets from criminal cases	93	0.00	2.70	3.77	0	10
Bullets from test-fires	91	0.00	2.35	3.32	0	10
Spent brass from pump-action shotguns	104	5.00	5.41	3.45	0	10
Spent brass from double-barrel shotguns	104	3.00	4.02	3.46	0	10
Spent brass from semi-automatic handguns (e.g., 9mm, .40 cal.)	105	10.00	9.76	0.82	5	10
Spent brass from automatic or semi-automatic long arms (e.g., AK-47, AR-15)	105	10.00	8.64	2.13	0	10
Inputting evidence from homicides	103	10.00	9.39	1.61	0	10
Inputting serious criminal firearms evidence (e.g., shootings, but not homicides)	103	9.00	8.61	1.73	0	10
Inputting all criminal firearms evidence	103	7.00	7.14	2.30	0	10
Test-fires of confiscated firearms	103	6.00	6.49	2.40	0	10
Inputting evidence if an investigator requests it to be prioritized	103	10.00	8.75	2.00	0	10
Inputting evidence if a district attorney requests it to be prioritized	102	9.75	8.39	2.52	0	10

Labs report a mean elapsed time between receipt of evidence and its input into NIBIN of 58 days. Elapsed times between receipt of evidence and input into NIBIN range from zero days

to 730 days. Some of the time associated with these delays is due to law enforcement policies and practices, some due to lab policies and practices, and some is attributable to firearms sections. For example, most labs (85.5 % of NIBIN labs) mandate that firearms and/or ballistics evidence must be routed to DNA or fingerprints before it can proceed to the firearms section (Table 8). Half (50.5 %) of NIBIN firearms sections report that firearms are checked for DNA *and* fingerprints before the weapons are sent to firearms. This process of collecting DNA and fingerprints from ballistics evidence varies considerably across sites. In some agencies, DNA or fingerprints are processed at the crime scene and, therefore, the firearm is routed to the firearms section quickly. In other agencies, however, a firearm sent to the DNA or fingerprint section may wait for months before being processed and then routed to the firearms section. Policies vary by lab. Some labs route all firearms to DNA or fingerprints while others only route evidence if an investigator requests DNA or fingerprints. In one agency (Houston), firearms were held at the property storage facility for five days so DNA or fingerprints could retrieve the weapons first. If a gun had sat for more than five days, the firearms section could then retrieve the weapon. In Marion Co./Indianapolis, the period was 10 days. Sixty-three percent of firearms sections surveyed reported that the routing of ballistics evidence to DNA or fingerprint sections contributed to delays in processing evidence. The majority of bullet evidence (76.4%) is sent directly to the firearms section and not routed through the DNA or fingerprint sections first. This practice is less prominent for brass evidence (45.2%).

Table 8
Evidence Processing and Routing Procedures for NIBIN Sites (N=111)

Variable and Response Categories	N	Valid Percent
Which of the following best describes your lab's process for handling firearms retrieved from crime scenes? (N=103)		
Evidence is checked for DNA, then fingerprints, and then sent to firearms.	52	50.5
Evidence is checked for fingerprints, then DNA, and then sent to firearms.	22	21.4
Evidence is checked for DNA, and then sent to firearms.	1	1.0
Evidence is checked for fingerprints, and then sent to firearms.	13	12.6
Evidence is sent to firearms.	15	14.6
Which of the following best describes your lab's process for handling spent brass retrieved from crime scenes? (N=104)		
Evidence is checked for DNA, then fingerprints, and then sent to firearms.	27	26.0
Evidence is checked for fingerprints, then DNA, and then sent to firearms.	9	8.7
Evidence is checked for DNA, and then sent to firearms.	4	3.8
Evidence is checked for fingerprints, and then sent to firearms.	17	16.3
Evidence is sent to firearms.	47	45.2
Which of the following best describes your lab's process for handling fired-bullets retrieved from crime scenes? (N=106)		
Evidence is checked for DNA, then fingerprints, and then sent to firearms.	7	6.6
Evidence is checked for fingerprints, then DNA, and then sent to firearms.	3	2.8
Evidence is checked for DNA, and then sent to firearms.	14	13.2
Evidence is checked for fingerprints, and then sent to firearms.	1	0.9
Evidence is sent to firearms.	81	76.4
Is this routing procedure for firearms evidence (above) responsible for slowdowns in processing firearms? (N=106)		
Causes significant slowdowns	14	13.2
Causes some slowdowns	53	50.0
Neither slows nor facilitates processing	31	29.2
Increases processing time	7	6.6
Increases processing time greatly	1	0.9
Where is firearm evidence (firearms, spent brass, and fired bullets) stored before it is analyzed? (N=99)		
At the local police agency	21	21.2
At the lab	63	63.6
With the detective or investigator	0	0.0
Other (Please specify):	15	15.2
Where is firearm evidence (firearms, spent brass, and fired bullets) stored after it is analyzed? (N=104)		
At the local police agency	60	57.7
At the lab	16	15.4
With the detective or investigator	3	2.9
Other (Please specify):	25	24.0

Table 9
Percent of NIBIN Site Inputs that are Bullets and Brass

Variable	N	Median	Mean	SD	Min	Max
Percent of Inputs, Bullet	223	11.81	14.22	12.41	0.0	50.0
Percent of Inputs, Brass	223	88.19	85.78	12.41	50.0	100

Other lab processes, such as a lab's evidence storage policies, can also affect processing times. For example, most labs (63.6%) store firearms evidence at the lab prior to analysis. After analysis, however, most labs (57.7%) return the evidence to the police agency for storage, which can delay later confirmation of a hit by the lab.[22] There is no easy solution to the problem of evidence storage at labs given that most labs have limited storage space. Additionally, asking regional and state labs to store evidence from a myriad of law enforcement agencies (and potentially being responsible for routing the evidence to court or another lab for analysis or confirmation) places a significant burden upon labs already plagued by backlogs and insufficient budgets.

Labs and law enforcement agencies also differ in the nature and comprehensiveness of the processes used for routing firearms evidence from a police agency to the crime lab. For example, in some labs, a firearm is processed by the firearms unit only if an investigator requests an analysis. In these agencies, a portion of criminal firearms (and most firearms confiscated by police for safekeeping) will not be processed by the lab and will not be entered into NIBIN. Instead, these firearms sit unanalyzed in a property storage facility; usually a police facility. In other labs, <u>all</u> firearms are routed to the lab for analysis and entry into NIBIN. Routing all firearms to the lab for testing is no panacea. The head of one firearms section (not a site visit or data site for this study) complained that the local police routed *all* firearms to the lab including guns kept for safekeeping. The firearms were submitted to the lab without sufficient

[22] According to NIBIN procedure, hits must be confirmed by the lab that identified the hit through visual analysis of both pieces of evidence. The process of confirming a hit may entail transporting evidence from one agency or lab to another lab so the hit may be confirmed.

documentation to distinguish between guns used in crimes and guns kept for safekeeping. The local police were told to submit all guns to the lab and they were doing what they thought was best. The head of the firearms unit complained the firearms staff was wasting its time test-firing safekeeping guns and acquiring the images with NIBIN. Improved communication between labs and law enforcement agencies would help in these situations as would a process of attaching additional information to submitted firearms so that labs can determine if the firearm is suitable for NIBIN.

The issues of routing, storing, and attaching information to ballistics evidence deserve serious attention. There is room for multiple constituencies to play a role in improving this state of affairs. For example, the Phoenix Police Department coordinates the NIBIN activities of nearby police agencies with the Phoenix Metro NIBIN Program. Among the issues addressed by this partnership is the effective routing of evidence to Phoenix PD's NIBIN terminal. Local police and crime laboratories should begin discussing these procedures to ensure that investigators have the necessary information to solve gun-related offenses. The ATF should work with leaders in the forensics industry to develop a set of best practices for storage and retrieval of ballistics evidence, routing ballistics evidence through different lab sections, and attaching additional information to ballistics evidence.

Integration of NIBIN into Section Procedures

Some firearms sections structure NIBIN as an integral part of processing ballistics evidence. For example, in Houston all weapons are test-fired first (whether an investigator requests a test-fire or analysis or not) and the brass is quickly acquired by NIBIN. The acquisition of ballistics evidence from test-fires is the first step in processing a firearm. In effect, Houston front-loads all their ballistics analysis with acquisition of an image by NIBIN and views

NIBIN as a central and crucial part of their ballistics processing. Not surprisingly, the lab is located in a major metropolitan area and has produced more than 1,000 hits. Another site experimented with front-loading NIBIN inputs by putting crime scene evidence into NIBIN before the case was processed. Evidence was unpacked as soon as possible, loaded into NIBIN, and then repacked for later case work. This process led to confusion about the location of evidence in the lab and firearms unit. The firearms manager referred to this experiment as "an epic fail" and the lab discontinued the process.

NIBIN Processes

Firearms sections differ in the processes they use for NIBIN. Most (approximately 60%) firearms sections claim to acquire images daily while about 4% input NIBIN evidence less than once per quarter (see Table 10). Almost all (95.2%) labs screen evidence before entry into NIBIN to choose the best tool marks for acquisition. When processing brass, all participants noted they "always" or "often" capture the breech face and firing pin marks, though there is less consistency with ejector marks. Almost one-third (29.8%) of firearms sections claim they never capture ejector marks with NIBIN.

Labs also differ in how many correlations they review and how often they review their correlations. Approximately half of participants have a policy related to how many correlations must be checked. All labs report that they check more than the top five correlations, but almost a third (31.6%) check only the top 20. More than 40% of labs (41.8%) selected the "other" category for this question and then reported the number of correlations they review. Two questions were asked concerning how often correlations are reviewed: one question was categorical, the other was interval-level. In response to the categorical questions, most labs review their correlations daily (44.6%) or at least once per week (41.6%) although 6% of labs

report they review correlations no more than once per quarter. The interval-level responses indicate that most labs review correlations quickly, but a small number of labs are exceptionally slow. Half of the respondents (51.0%) claim they review correlations within 1.5 days while 9.2% of labs take more than 20 days to review correlations.

Table 10
Firearms Section Policies and Practices for Reviewing NIBIN Correlations (N=111)

Variable and Response Categories	N	Valid Percent
On average, how often does the firearms staff input evidence into the NIBIN System? (N=104)		
Daily	63	60.6
At least once per week	31	29.8
At least once per month	6	5.8
Once per quarter	0	0.0
Less than once per quarter	4	3.8
Do your examiners or technicians screen brass (from the same firearm) before deciding which specific piece of brass to input into NIBIN? (N=104)		
No	5	4.8
Yes	99	95.2
Typically, what spent brass marks do you capture? Breech Face. (N=103)		
Never	0	0.0
Sometimes	0	0.0
Often	4	3.9
Always	99	96.1
Typically, what spent brass marks do you capture? Firing Pin. (N=102)		
Never	0	0.0
Sometimes	0	0.0
Often	3	2.9
Always	99	97.1
Typically, what spent brass marks do you capture? Ejector Mark. (N=104)		
Never	31	29.8
Sometimes	40	38.5
Often	22	21.2
Always	11	10.6

Table 10 cont.
Firearms Section Policies and Practices for Reviewing NIBIN Correlations (N=111)

Variable and Response Categories	N	Valid Percent
On average, how often does the firearms staff review the NIBIN correlations? (N=101)		
Daily	45	44.6
At least once per week	42	41.6
At least once per month	8	7.9
Once per quarter	4	4.0
Less than once per quarter	2	2.0
Labs may have a procedure for checking the candidates produced by the NIBIN correlator. Does your lab have a policy about how many candidates to check? (N=100)		
No	48	48.0
Yes	52	52.0
In practice, when NIBIN produces a correlation list, usually how many candidates do your technicians or examiners check? Please select the answer that most closely corresponds to your lab's practice. (N=98)		
Top 5 correlations	0	0.0
Top 10 correlations	11	11.2
Top 20 correlations	31	31.6
Top 50 correlations	15	15.3
Other (Please specify):[23]	41	41.8

Communication of Hits to Law Enforcement Agencies and Investigators

A confirmed hit is notable and laudable for a crime lab. The real utility of a hit, however, is the information attached to that hit and the ways this information may help criminal investigators and other law enforcement personnel solve cases and hold offenders accountable. Hits are important pieces of criminal intelligence that can be used for both tactical and strategic purposes. Firearms sections were questioned about their processes for communicating NIBIN hits to law enforcement agencies and, again, the results reveal considerable variation across NIBIN partner sites (see Table 11).

[23] Of the 41 firearms sections reporting "other," 21 sections reported checking all correlations, 9 sections reported checking a number greater than the top 50 correlations (but less than all). Nine sections reported a number less than the top 50, but a number that did not fit the categories provided in the survey (e.g., top 30 correlations).

Table 11
NIBIN Hit Communication Processes for Firearms Sections at NIBIN Sites (N=111)

Variable and Response Categories	N	Valid Percent
How often does your lab communicate information about a possible hit, to an agency or investigator, before a visual confirmation of the brass or bullet? (N=104)		
Never	48	46.2
Sometimes	19	18.3
Often	11	10.6
Very often	26	25.0
When NIBIN correlates two or more cases, generally how does the firearms section or lab inform the investigators? (Regional crime labs may use multiple methods, because they serve multiple agencies. Please check all that apply.) (N=104)		
A single, designated point of contact in the agency (e.g., the District Attorney's office or a local police department) is informed.	15	14.4
Different points of contact in the agency (i.e., for homicide cases, the head of homicide is informed. For gang cases, the head of the gang unit is informed, etc.).	30	28.8
The investigator for the case is informed.	83	79.8
The investigator is informed via the telephone.	47	45.2
The investigator is informed via e-mail of LIMS.	32	30.8
The investigator is informed via mail or fax.	21	20.2
Other	20	19.2
The lab or firearms section does not inform the investigator or a point of contact unless the lab or firearms section is contacted by the investigator or point of contact.	0	0.0
In your opinion, is this method (above) for communicating hits to investigators effective? (N=103)		
Very Ineffective	17	16.5
Somewhat ineffective	8	7.8
Neutral	13	12.6
Effective	44	42.7
Very effective	21	20.4

Table 11 cont.
NIBIN Hit Communication Processes for Firearms Sections at NIBIN Sites (N=111)

Variable and Response Categories	N	Valid Percent
Besides the investigators or point of contact in an agency, are other parties regularly informed of a hit? (N=101)		
No	50	49.5
Yes. A crime analysis unit is informed.	4	4.0
Yes. A fusion center or other strategic crime analysis unit is informed.	4	4.0
Yes. Other (Please specify):	43	42.6
Is information about hits involving three or more cases routed differently (i.e., routed to different people or units) than cases with two hits? (N=101)		
No	90	89.1
Yes (Please describe):	11	10.9

First, a notable percentage (35.6%) of labs report that they inform agencies or investigators of a hit (before the hit was confirmed) either "often" or "very often." Some respondents wrote additional notes to highlight that they are very clear that the hits are unconfirmed and should be treated as unconfirmed information. There is a tension between the timely communication of hit information to law enforcement and a careful process ensuring lab analyses are conducted properly. Rapid communication about hits is good for investigators. On the other hand, communicating information about unconfirmed hits runs contrary to the spirit of recommendations contained in NRC NAS's report on improving forensic science (Committee on Identifying the Needs of the Forensic Sciences Community [Committee], 2009). Many respondents (46.2%) claim their firearms section never report hits before they have been confirmed. Site visits sometimes revealed disparities between formal policy and actual practice. In one lab, the firearms manager said they never communicate hit information until a hit report is produced. In a later interview with an examiner in the same lab, it was explained that examiners sometimes contact an investigator by telephone or text message with hit information before the hit has been confirmed or a hit report produced. Similar informal practices were described in

other labs as well. Personal cell phones and text messages are easy ways for investigators to ask examiners about cases and for examiners to communicate information about unconfirmed hits.

All labs report that they actively sent hit reports to agencies or investigators. In other words, no labs report that they wait for an investigator to contact the lab to receive a hit report. About 14.4% of labs send hit reports to only one point of contact in an agency. About one quarter of NIBIN partner sites send hit reports to multiple points of contact in an agency, depending upon the unit associated with the hit. Thus, a NIBIN hit for a homicide case might be routed to the homicide unit and robbery case hits to the robbery unit. In the majority of sites (79.8%), the investigator assigned to the case (usually at the time the case occurred) is notified of the hit. Some sites also route a hit report to the commander of the relevant unit (e.g., the homicide commander for homicide cases). When investigators are notified of a hit, many sites (45.2%) do so by telephone. More than half the labs (51.0%) use some form of written notification for the investigator such as email, LIMS (lab information management system) message, mail, or fax. Most (63.1%) labs view their methods of communicating hits as effective or very effective. One of the agencies visited (Santa Ana) revealed an especially rapid form of communicating information about hits. The site visitor observed as a hit was identified using NIBIN, the evidence was compared under a microscope, and the hit was confirmed. Immediately following confirmation, the head of the firearms section walked down the hall to the detectives' offices and informed the investigator working the case about the hit. This process of immediately notifying investigators of a NIBIN hit via face-to-face communication is more challenging in sites where the lab and investigators are housed in different locations. Proximity matters.

While hit reports are routinely routed to investigators or other single points of contact within an agency, these reports are rarely routed by labs to crime analysis or planning units,

intelligence units, or fusion centers. Sometimes hit reports are sent to district commanders, the head of a special unit (such as homicide or robbery), or even an upper division commander. Interviews with crime analysis and planning personnel in law enforcement agencies reveal that they rarely receive hit reports and, when they do, they do not analyze these reports. A law enforcement agency or prosecutor's office might forward a hit report to other agencies or units when relevant, but labs rarely share these reports with others who might derive strategic or administrative value from them. Hits involving three or more criminal incidents are important because they may involve gangs, criminal enterprises, or serial criminals. Only 10.9% of labs report that they route hits involving three or more crimes to different points of contact in law enforcement or crime analysis units or organizations (as compared to hits involving two crimes).

Site visits also reveal important differences in the nature of hit reports. Even when sites use a written format to communicate hit reports, most employ a simple, information-sparse format. These formats extract information about cases from the NIBIN database but are relatively simple and devoid of background information. For example, in Kansas City hits are communicated via a plain-text email listing the criminal case numbers and dates of the two offenses. Such a simple hit report requires investigators to research the case numbers in order to recall the cases and get additional background information. Conversely, Houston's hit reports are relatively detailed because the lab adds information about each case not provided by the NIBIN database. Houston's hit reports list the offense numbers and dates and provides the address of each crime, the complainant's name, and the suspect's name. Prior research indicates that geocoding hit locations in this way can assist with identifying likely hits in IBIS™ systems (Yang, Koffman, Hocherman, & Wein, 2011). Houston's reports also include detailed

classifications of the crime type, as opposed to the four-category crime type used on most NIBIN hit reports (ADW, HOM, TF, or OTH).[24]

The lack of pertinent information included with hit reports is a missed opportunity to maximize their utility for criminal investigators. As described later in this report, interviews with criminal investigators who received a NIBIN hit report reveal that investigators rarely use the report to identify a suspect. Hit reports with little information require an investigator to research the cases involved in the hit. In answer to this issue, ATF implemented a program in which NIBIN contractors compiled hit reports and added information about each case. Contractors added information about the suspects, victims, and weapons in each case. They generally sought to supply useful criminal intelligence to each hit report so the report would prove more useful to investigators. One key informant referred to the NIBIN contractors as "hit hunters." Contractors not only added information to hit reports, they also worked with investigators to help them use the hit information and analyzed hits to make strategic inferences about criminal networks or emerging crime patterns. This ATF NIBIN contractor program was eliminated due to the budget cuts of 2011. As of late 2012, however, ATF rehired some NIBIN contractors. As a general principle, it is a beneficial idea to implement programs and practices which help police agencies make better use of NIBIN information, particularly those that will turn the information into useful, practical, actionable intelligence. NIBIN contains a gold mine of information for the police agencies and crime laboratories with the creativity and foresight to make use of it.

Santa Ana, California provides a useful example of how a police agency working together with a crime laboratory can derive significant benefits from NIBIN. Santa Ana's firearms examiner worked closely with a police sergeant from the gang unit to develop software useful for investigating gun crimes. The software helped automate the manual processes for

[24] Assault with deadly weapon, homicide, test-fire, and other.

linking cases which the firearms examiner had developed over the years. This software, called *GunOps*, serves as a database for all ballistic evidence processed by the firearms section of a crime laboratory. *GunOps* evolved over time from a simple Microsoft Access database to a much more sophisticated, commercially available software product. It includes information on the evidence type (firearm, bullet, or shell casing), the nature of the evidence (caliber, rifling, etc.), the incident location, and additional characteristics of the incident which generated the evidence. One important aspect of *GunOps* is its ability to map incidents by geographic location. Users can provide additional geographic information like gang territories to help augment their search capacity. *GunOps* is a useful tool for helping analysts catalog evidence and conduct sophisticated searches that increase their ability to link cases. Used together with NIBIN, *GunOps* helps explain how a crime lab located in a relatively small city managed to become one of the most productive in the nation at achieving NIBIN hits.[25] *GunOps* had also been recently acquired by the Stockton Police Department prior to their agency's site visit. The search capacity has helped the Stockton PD achieve a number of NIBIN hits very quickly.

End User Feedback to Labs

Few sites systematically query the end users of NIBIN hits about the utility of the hits. Labs generally do not survey investigators, police officers, or prosecutors regarding how (or if) they use NIBIN hits. When asked if systematic feedback would be beneficial, most crime lab employees replied that it would. In most instances, however, crime lab personnel feel overwhelmed with normal duties and do not see a feasible way to solicit systematic feedback from end users. Before Stockton hired its own firearms examiner in early 2013, the police

[25] Santa Ana enters a relatively modest amount of brass and bullets into NIBIN (73rd percentile for raw amount of brass and 60th percentile for bullets). Nonetheless, as measured by NIBIN hits, they are very productive. Since 2007, they rank at the 93rd percentile in terms of raw number of hits. Put differently, Santa Ana is the fifth most productive NIBIN site in the nation at producing hits, which is impressive given its size. *GunOps* appears to augment an agency's search capacity when used in concert with NIBIN, thus enabling an agency to achieve more NIBIN hits.

department relied on a state laboratory to analyze its ballistic evidence. While the state lab was viewed as highly competent, it was unable to keep up with the demands of a city facing a significant illegal gun problem. Due to its own capacity issues, the state lab was forced to limit the number of submissions it would accept from the Stockton Police Department (and other agencies). The amount of evidence the police department could submit represented a tiny portion of the ballistic evidence in need of analysis, thus leading to a significant backlog. Moreover, the submitted evidence took a long time, on average, to process. This study was not designed to draw inferences about the effectiveness of these types of arrangements in which state, regional, or county laboratories service local communities. However, a brief exposure to such arrangements suggests that surveying end users in sites with these types of interagency relationships might provide valuable feedback about the reality of firearms evidence processing in many areas throughout the U.S.

Crime laboratories and police agencies are part of an interdependent system for processing inputs and turning them into outputs. In this complicated system, police agencies provide the inputs (firearms, brass, and bullets) and crime laboratories process these inputs and turn them into outputs (reports of various types including NIBIN hit reports) for use by police agencies. These outputs vary in quality and utility and may be more or less useful. In the case of NIBIN hit reports, if a report is produced slowly and is bereft of information, it may be of little value to a criminal investigator. If a report is produced rapidly and contains relevant information about the cases involved, it may make a difference between whether a case is cleared or not. Therefore, it makes sense for this interdependent system to measure its collective performance in providing and processing inputs and generating outputs. Implementing a collective performance measurement is relatively easy in instances where the crime laboratory is located within the

police agency. It is complicated when the laboratory is a separate agency. In either case, the use of this type of performance feedback is highly recommended for improving performance (King & Maguire, 2009).

Innovative NIBIN Practices

During this research, key informants described various crime lab practices they view as innovative. For example, some NIBIN sites permit outside agencies to access their NIBIN equipment on evenings or weekends so they can acquire images with NIBIN. The Pheonix PD helps train personnel from local agencies as NIBIN technicians, who can then input evidence and review correlations with Phoenix's equipment. NIBIN partner sites were surveyed about their use of four innovative NIBIN practices (see Table 12).

Table 12
Innovative NIBIN Practices and Attitudes about NIBIN

Does your section use any of the following programs to get more firearms evidence into NIBIN? (Please check all that apply.) (N=100)		
Conduct regional "shoots" where your lab invites local agencies to bring confiscated guns to a non-lab location where they are test-fired and entered into NIBIN?	5	5.0
Permit a non-lab employee (e.g., a firearms examiner from another lab or police agency) to use your NIBIN equipment after-hours or on weekends?	8	8.0
Publically invite other agencies to bring their evidence to your lab for entry in NIBIN?	21	21.0
Let agencies test-fire their own confiscated firearms and ship the bullets and/or brass to your lab?	25	25.0
NIBIN is a useful investigative tool for detectives and prosecutors. (N=102)		
Strongly Disagree	7	6.9
Disagree	7	6.9
Neutral	11	10.8
Agree	32	31.4
Strongly Agree	45	44.1
NIBIN imposes a significant burden on the firearms section's resources. (N=103)		
Strongly Disagree	16	15.5
Disagree	31	30.1
Neutral	23	22.3
Agree	27	26.2
Strongly Agree	6	5.8
NIBIN has improved the morale in the firearms section. (N=102)		
Strongly Disagree	6	5.9
Disagree	10	9.8
Neutral	60	58.8
Agree	15	14.7
Strongly Agree	11	10.8
Our firearms section could become a better user of NIBIN if we: (check all that apply). (N=101)		
Received more training from ATF and/or FTI	14	13.9
Had more firearms examiners.	49	48.5
Had more firearms technicians.	41	40.6
Had more/better equipment.	36	35.6
Had money for overtime pay.	31	30.7

Key informants suggested at least four innovative practices that would improve the utility of NIBIN. These innovations are presented in Table 12 and all address efforts to acquire more inputs from non-NIBIN partner agencies. Survey data reveal these four innovative NIBIN practices are relatively rare. Only 5% of labs conduct regional "shoots" where law enforcement agencies gather to test-fire weapons so the brass can be acquired by NIBIN. Likewise, only 8% of labs permit access to their NIBIN equipment so that outside agencies can input evidence. Twenty-one percent of labs invite other agencies to put their evidence into NIBIN and 25% of labs let other law enforcement agencies ship in ballistics evidence for entry into NIBIN. These four innovative practices are included in the survey based on suggestions from key informants knowledgeable about national NIBIN. However, these findings did not allow access into other innovative practices that may not be well-known. Local agencies sometimes develop remarkable "homegrown" innovations enabling them to achieve outstanding performance in the face of such constraints as limited staffing or resources. Though these homegrown innovations were unable to be addressed in the survey, they were available for observation during the site visit portion of the project.

Managing a NIBIN site involves considerable effort and 32% of respondents note that NIBIN imposes a significant burden on their firearms section. It is likely that many NIBIN sites are too busy with their own firearms evidence to actively solicit additional evidence from other agencies. Most respondents from firearms sections view NIBIN favorably. Most (75.5%) see NIBIN as a useful investigative tool. Most firearms respondents (58.8%) express neutral attitudes about NIBIN's effect on morale in their firearms section. Finally, firearms sections list additional employees as the most important key to improve NIBIN performance. Conversely, only 13.9% of labs state additional training would improve their NIBIN performance. Overall, the data and

information obtained from interviews reveal many labs are constrained by limited resources and unable to implement innovative NIBIN practices. As demonstrated next, labs also face problems identifying NIBIN hits quickly enough to be useful to investigators.

CHAPTER IV

THE PERFORMANCE OF NIBIN SITES

This section presents four performance metrics for NIBIN sites. Two of these metrics were used by ATF in the past to assess the productivity of NIBIN sites. These previously used metrics are counts of a site's NIBIN inputs (both bullets and brass) and the number of NIBIN hits a site produces. Multivariate statistical methods are used here to build on these simplistic metrics to determine whether the volume of gun crime in 45 NIBIN jurisdictions is associated with its NIBIN productivity. Two unique performance metrics for NIBIN sites are also presented: the elapsed time between when a criminal offense occurs and when that crime is identified as a hit by a NIBIN site and the impact of NIBIN hit reports on criminal investigations.

Performance Metric #1: NIBIN Utilization and Productivity

First, the overall usage and productivity of NIBIN sites as of July 2012 is reviewed. NIBIN data from ATF is used examining the total number of inputs entered by each NIBIN site as well as the total number of hits produced (see Table 13). These data represent the total number of inputs and hits over the period of a site's involvement in NIBIN. Some sites were no longer active NIBIN sites as of July 2012. In most cases, if a site was not a NIBIN site in July 2012 but was included in the ATF data, that site had been recently pulled from NIBIN during early or mid-2011. The data below do not include every NIBIN partner site that ever participated in the program. Sites dropped from the NIBIN program before approximately 2009 are not included in Table 13 because they were not in the data files provided by ATF.

Table 13
Inputs for 223 NIBIN Partner Sites as of July 2012

	Median	Mean	SD	Min	Max
Brass (number)	4,719.0	8,551.63	12,655.44	16.0	121,829.0
% of Inputs Brass	88.19	85.78	12.41	50.0	100.0
Bullets (number)	463.0	1,559.56	3,374.06	0.0	36,703.0
% of Inputs Bullets	11.80	14.20	12.40	0.0	50.0

The data in Table 13 reveal considerable variation across NIBIN sites in terms of inputs and hits. Sites acquired a median of 4,719 brass inputs and 463 bullet inputs. It is typical for sites to acquire a far greater number of brass inputs than bullets. Across sites, a median of 88% of inputs are brass. These averages, however, conceal considerable variation in the volume of inputs. While sites acquired a median of 4,719 brass inputs, three sites acquired less than 100 pieces of brass and 25% of sites acquired less than 2,317 pieces of brass. On the other extreme, 22% of sites acquired more than 10,000 brass inputs and one site acquired more than 121,000 brass inputs.[26]

Bullet inputs are less common than brass inputs. Some sites (7.6%) acquired no bullet inputs at all but the median number of inputs for a site was 463 bullet inputs. Twenty-five percent of NIBIN sites entered less than 99 bullets but 33.6% of NIBIN sites acquired more than 1,000 bullets. Six sites acquired more than 10,000 bullets including one site with more than 36,000 bullets.

Multiple key informants explained that NIBIN sites which produce a large number of hits are successful because they have a significant proportion of inputs from criminal cases versus test-fires. Low performing sites entered too many test-fires and too few criminal cases. This is intuitive. A test-fire involves a gun confiscated by the police because it was illegally concealed,

[26] The site with 121,829 brass inputs is an outlier. The NIBIN site with the next highest number of brass inputs had 57,710 brass inputs.

carried by a felon, etc. NIBIN will not produce a hit unless that gun was also used in a criminal event.[27] Criminal cases should hit to one another in NIBIN provided the same firearm was used; therefore, criminal cases are more likely to produce hits than test-fires. Put another way, the optimal inputs for NIBIN are criminal cases and not test-fires.[28] Test-fires may be helpful because they often involve a suspect who was apprehended by police while in possession of a firearm. If the test-fire produces a hit, the associated suspect may provide useful information about prior criminal uses of the firearm or may be a suspect in the prior crimes. Table 14 displays data from ATF on the percent of inputs for bullets and brass from test-fires as opposed to criminal cases. The majority of NIBIN inputs at most sites are test-fires (80.9% of bullet inputs and 72.9% of brass inputs).

Table 14
Percent of NIBIN Inputs from Test-Fires: Bullets and Brass (N=223)

Variable	N	Median	Mean	SD	Min.	Max.
Percent Bullet Inputs from Test-Fires	206	80.94	72.75	24.26	0.0	100.0
Percent Brass Inputs from Test-Fires	223	72.91	71.11	15.70	7.0	99.0

Performance Metric #2: Number of Hits

Table 15 presents descriptive statistics on the number of brass and bullet hits for 223 NIBIN sites as of July 2012. Again, the hits in these 223 sites are not normally distributed (in the shape of a bell curve) because most sites produce few hits while a small number of sites produce a large number of hits. The number of brass hits is depicted graphically in Figure 1 and the number of bullet hits in Figure 2. Twenty-nine NIBIN sites (13.0%) produced zero brass hits and 150 sites (67.3% of sites) produced zero bullet hits. Most sites produced relatively few hits; 25%

[27] One test-fire should not hit with another test-fire, unless the gun has been stolen from police custody, sold by the police, or returned to its owner after some legal proceedings. In other words, test-fire to test-fire hits should be exceedingly rare in NIBIN.
[28] The bivariate relationship between the percent of a site's brass inputs that are non-evidence and a site's number of NIBIN brass hits is -.152 (sig. .034) for sites with one or more brass hits. This analysis supports the conclusions of key informants. Evidence from crime scenes tend to produce more hits than test fires.

of sites produced 9 or fewer brass hits and 93.7% of sites produced 10 or fewer bullet hits. Sites produced a median of 76 hits from brass and zero hits from bullets. Some sites, though, were far more productive than average, especially with brass hits. Eleven sites (4.5% of NIBIN sites) produced more than 1,000 brass hits each. The most productive site in terms of producing brass hits generated more than 3,000 brass hits. The most productive site in terms of bullet hits produced 61 hits from bullets.

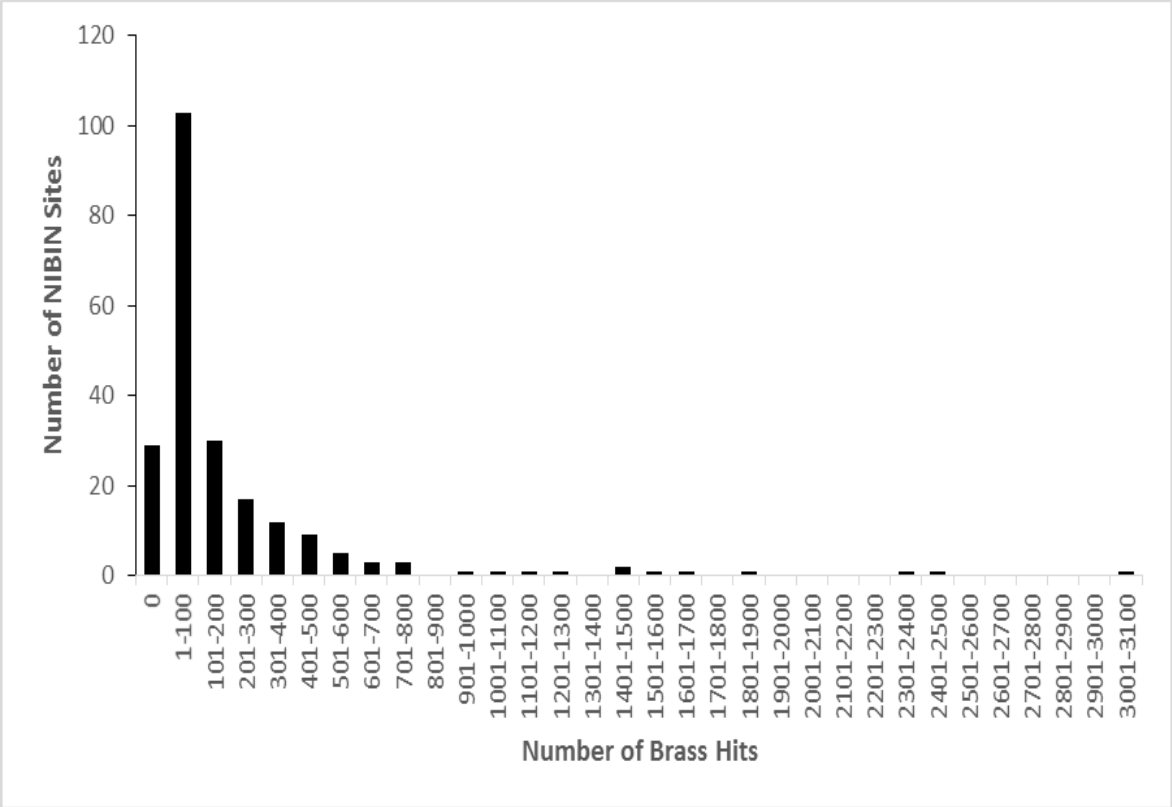

Figure 1: Total Number of Brass Hits for 223 NIBIN Sites

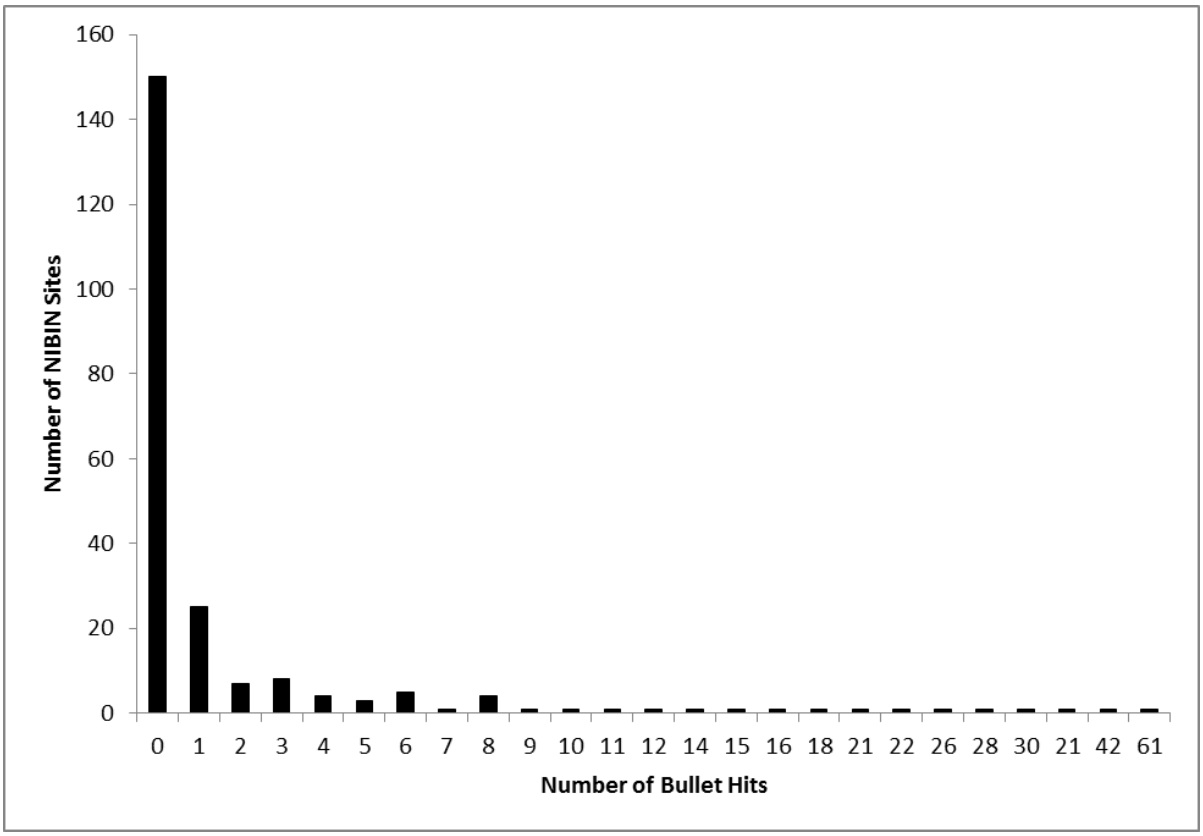

Figure 2: Total Number of Bullet Hits for 223 NIBIN Sites

Table 15
Number of NIBIN Hits by Site as of July 2012 (N=223)

Variable	N	Median	Mean	SD	Min.	Max.
Number of Brass Hits	223	76.00	214.29	415.63	0.0	3072.0
Number of Bullet Hits	223	0.00	2.37	6.93	0.0	61.0

Table 16 presents the two performance metrics (inputs and hits) for 19 sites. These data help contextualize the 10 visited sites and the 9 other sites used in this section. The "percentile" columns display each site's ranking in comparison to all other NIBIN sites. Therefore, it is clear to see the NYPD inputs the greatest amount of brass and bullets of any NIBIN site.

Table 16
Inputs and Hits (October 1, 2007 to July 2012) for 20 NIBIN Sites[29]

Site	Brass Inputs	Brass Inputs Percentile	Bullet Inputs	Bullet Inputs Percentile	Hits	Hits Percentile
Phoenix, AZ	30,405	93.7	752	58.5	262	83.4
Santa Ana, CA	8,249	74.0	810	60.0	425	93.7
Stockton, CA	18,115	87.9	3,712	88.0	372	90.1
Denver, CO	5,764	57.4	596	55.8	392	91.5
CBI – Denver, CO	3,008	37.7	557	53.1	63	56.5
Marion Co./ Indianapolis, IN	31,364	94.6	3,275	86.6	304	86.5
New Orleans, LA	50,768	98.2	17,084	99.1	363	89.2
Baltimore, MD	17,157	87.0	112	27.3	347	88.8
Prince George's Co., MD	20,068	91.5	351	46.8	33	48.4
Kansas City, MO	9,535	77.1	1,951	78.6	388	91.0
St. Louis Co., MO	6,113	61.0	347	46.4	372	90.1
New York, NY	121,829	100	36,703	100	1,367	98.2
Onondaga Co., NY	6,717	66.4	33	17.4	418	92.8
BCI – Bowling Green, OH	2,144	23.3	216	35.7	3	22.9
OSP – Portland, OR[30]						
Austin, TX	4,981	52.5	166	31.3	66	58.3
Houston, TX	40,574	97.3	2,643	83.5	423	93.3
DFS – Richmond, VA	18,537	88.8	931	63.3	278	84.8
WSP – Tacoma, WA	30,768	94.2	1,907	77.7	312	87.4
WDOJ – Milwaukee, WI	7,995	72.6	1	9.0	111	65.5

[29] Shaded rows identify agencies where site visits were conducted.
[30] OSP – Portland, OR is not included. OSP Portland uses their NIBIN database to count exhibits instead of inputs for cases. Exhibits always outnumber inputs. Therefore, OSP Portland's brass and bullet inputs are inflated. The ATF data file listed 1,676 hits but after duplicate entries from the same cases were eliminated, there were 275 unique hits since October 1, 2007. This finding illustrates the types of data integrity issues identified later in this report.

A Multivariate Model Predicting NIBIN Usage in Cities

If NIBIN terminals are being used rationally, there would be greater NIBIN usage in places with more gun violence. The most reliable measure of gun violence at the city level is the gun homicide variable available in the Supplemental Homicide Reports data series administered by the Federal Bureau of Investigation. This data set does not contain other potential measures of gun violence like shots fired, shootings not resulting in death, or gun use in crimes (like robbery) where shots are not fired. These offense types, however, tend to not be reliably measured across cities. Therefore, gun homicides serve as the best available proxy for gun violence.

To test the hypothesis that NIBIN usage is associated with gun violence, data on gun homicides from the 2009 Supplemental Homicide Reports was merged with NIBIN usage data for 117 cities.[31] Included in the NIBIN data were 45 cities where the NIBIN terminal was within a municipal police department and 72 cities with a NIBIN terminal at a state or regional crime lab. Since, by definition, the state or regional crime labs serve multiple jurisdictions, there is no reason to expect an association between NIBIN usage and homicides in the cities where they are located. For that reason, analysis was restricted to the 45 cities where the NIBIN terminal is located within a municipal police department.

Four measures of NIBIN usage are employed: casings entered into evidence, bullets entered into evidence, NIBIN hits on casings, and NIBIN hits on bullets. Since the primary research question asks whether these indicators are associated with gun violence, usage indicators are treated as dependent variables in a series of regression models where gun homicides are the primary independent variable of interest. City population is included as a control variable in each regression. Though gun homicides and population have a significant

[31] Cities were selected with at least three homicides in 2009. At the time of analysis, the latest year for which SHR data were available was 2009 and the latest 12 months for which NIBIN usage data were available was from July 2010 to June 2011.

positive correlation (r=.61), the diagnostics revealed that collinearity was not problematic.[32] The results of this analysis are presented in Table 17.

NIBIN Entries

The first step of analysis is to look at evidence entered into NIBIN. The research question is whether the amount of evidence entered into NIBIN is a function of the amount of gun crime. Separate regressions are estimated for the effects of the independent variables (gun homicides and populations) on entries for shell casings (Model 1) and entries for bullets (Model 2). Preliminary diagnostics reveal that, for each model, some influential cases exert undue influence on the regression estimates. As a result, three cases were removed from Model 1 and two cases from Model 2.[33]

Table 17
The Effects of Gun Homicides on NIBIN Processing

Model	B	β	*P*	n
Model 1: Casing entries	2.520	0.405	0.021	42
Model 2: Bullet entries	0.009	0.020	0.660	43
Model 3: Casing hits	0.263	0.122	0.038	41
Model 4: Bullet hits	-0.002	0.127	0.515	45

Table 17 shows unstandardized regression coefficients (B), standardized regression coefficients (β), and p-values (p) for the effects of the gun homicide variable in Models 1-4. The F-statistic for Model 1 (entries for shell casings) is statistically significant (p<0.000) and the adjusted R^2 value suggests that the model explains 40.7% of the variation across cities in the number of shell casings entered. The coefficient for gun homicides is positive and statistically significant at the 0.05 level suggesting that cities with more gun crime load more shell casings

[32] Statisticians rely on different criteria for diagnosing collinearity (Belsley, Kuh, & Welsch, 1980; O'Brien, 2007). Here the variance inflation factor is only 1.59 falling well below any commonly used thresholds for inferring the presence of a collinearity problem.

[33] There are many decision rules available for deciding how to handle cases with large residuals or disproportionate leverage. Here Cook's D is employed as a summary measure of the influence of a case. Those cases were eliminated in which the value of D exceeded 4/n, meaning the threshold of D in this case is 0.089 (4/45=0.089).

into NIBIN, as expected. The coefficient for population, however, is not significantly different from zero for either casing or bullet entries.

The F-statistic for Model 2 (entries for bullets) is not statistically significant (p=0.856) so it is concluded that the independent variables, taken together, do not exert a statistically significant effect on the number of bullets entered. Put differently, the number of bullets a city enters into NIBIN is not a linear function of its size (like with shell casings) or its number of gun homicides (unlike with shell casings).

NIBIN Hits

The next step of analysis looks at the number of NIBIN hits produced by each agency and whether this number is a function of the amount of gun crime in a city. Separate regressions are estimated for the effects of the independent variables (gun homicides and populations) on hits from shell casings (Model 3) and bullets (Model 4). Preliminary diagnostics for Model 3 reveal certain cases exert undue influence on the regression estimates so four cases were removed based on the value of Cook's D. It was not necessary to remove any cases from Model 4.

The F-statistic for Model 3 (hits from shell casings) is statistically significant (p<0.000) and the adjusted R^2 value suggests that the model explains 49.2% of the variation across cities in the number of NIBIN hits from shell casings. The coefficient for gun homicides is positive and statistically significant at the 0.05 level suggesting that cities with more gun crime have more NIBIN hits. The coefficient for population is also positive and statistically significant suggesting that, independent of the amount of gun crime in a city, larger cities achieve more NIBIN casing hits.

This finding is worthy of further examination with a larger and more complete data set. In statistical models at the aggregate level, population can sometimes serve as an unintentional

proxy for other variables that correlate strongly with it, like resource availability, cosmopolitanism, police strength, etc. Given this data set, it is not clear how to interpret the population effect.

The F-statistic for Model 4 (hits from bullets) is not statistically significant (p=0.800),suggesting that bullet hits are not a linear function of the amount of gun crime and population.

Conclusions and Recommendations

In these 45 cities, there is a statistically significant, positive relationship between gun homicides and NIBIN entries and hits for shell casings. Cities with more gun homicides enter more shell casings into evidence and discover more NIBIN casing hits. The discovery of this linear relationship between gun homicides and NIBIN processing suggests two possibilities. First, the presence of such an effect reveals some level of concordance between gun crime and gun crime processing. The absence of this effect would raise concern that perhaps something other than the level of gun violence is driving NIBIN processing.

Second, after further development and refinement, it is possible to use regression models like the one here to discover agencies underperforming in relation to their peers. In these regression models, a residual value is calculated for each agency. Agencies with large, positive residuals are over-performing in that they have more NIBIN casing entries or hits than expected given their population and gun homicide levels. Similarly, those with large, negative residuals are underperforming in that they have fewer NIBIN casing entries or hits than expected. This approach can be used as an administrative measure to monitor the performance of local NIBIN sites relative to their size and level of gun crime.

The analysis shown is based on a small number of agencies due to data limitations. However, it illustrates an important point. ATF data, if maintained properly, can be used to develop useful measures and models for assessing the performance of NIBIN sites. Based on this general framework, ATF should work with scholars to establish a more robust set of multivariate statistical measures for the ongoing evaluation of NIBIN site performance. Although such a system is complicated to implement, the complexity would not be apparent to the system's end users and the resulting measures would be simple and intuitive. The use of these types of performance measures would serve as an important signal that ATF is committed to evidence-based government.[34]

The relationships identified for shell casings do not hold for bullets. Gun crime and population do not exert a statistically significant effect on NIBIN bullet entries or hits. Qualitative impressions from site visits suggest bullet analysis is significantly more uneven than casing analysis. Many agencies simply do not have a well-developed capacity to analyze bullets with the same level of detail they can invest in shell casings. The processing of bullets is not yet sufficiently consistent to develop meaningful performance measures of the type recommended for shell casings.

[34] The advocated performance measurement system is based on multivariate regression analysis. The use of regression-based performance measurement systems helps administrators compare sites with different mixes of risk factors, which is why they are often referred to as "risk-adjusted performance measures." In this case, cities have different staffing levels, gun crime problems, and capacities for addressing these issues. These differences between sites render simplistic performance measurement systems vulnerable to the criticism that they are comparing apples to oranges. Risk-adjusted performance measures should be developed to account for these local variations, thus creating more valid measures to be used for practical purposes like identifying high-performing and low-performing sites, identifying sites in need of technical assistance, and monitoring sites with inconsistent performance. For a general reading on these types of performance measures, see the book *Organizational Report Cards* by Gormley and Weimer (1999).

Performance Metric #3: Elapsed Time between Crime and Hit Confirmation for 19 NIBIN Sites

The timeliness with which forensic analysis results are made available to criminal investigators is crucial during the investigation phase. Receiving hit information earlier in an investigation is obviously better than receiving it later (King & Maguire, 2009, p. 166-167; Smith, 1976, p. 14). When investigators do not receive forensic evidence in a timely manner, they are forced to rely solely on more basic investigative methods (canvassing, interviewing, talking to people, etc…) without the benefit of information forensic evidence can provide. Delays in the processing or communication of forensic evidence can render even the most sophisticated forensic analyses meaningless for criminal investigators. For instance, during a visit to a major U.S. police agency (as part of another study), when homicide investigators were asked about the use of ballistic evidence, they laughed and said the lab takes so long to provide results that they don't even bother asking anymore.

Thus, the third performance metric uses the elapsed time between the more recent of two crimes in a hit dyad and the date when the hit was confirmed. Hit data were received from ATF for 19 NIBIN sites. These data files are structured as hit dyads where two cases are linked to a common firearm. In this database structure, a hit involving a test-fire (Case A) of a gun and a crime involving the same gun (Case B) appear as a single row representing the hit. Sometimes a gun is involved in multiple hits, which is represented as a series of dyads. For example, a hit involving a test-fire of a gun (Case C) and two crimes involving the same gun (Cases D and E) appears as two rows (and two hits) in the database. The first hit appears as Case C hit with Case D. The second hit appears as Case C and Case E (or as Case D and Case E).

Logically, a hit can only be produced after the occurrence of the second crime or event involving the same firearm. In other words, a firearm used once in a crime and never recovered by police or a gun recovered by police but never involved in a crime will never produce a NIBIN hit. When a gun is used in two different crimes, the elapsed time is measured from the date of the most recent crime to when the hit was identified. The time elapsed was, therefore, calculated between the most recent criminal event and the date the hit was confirmed. Elapsed time forms the basis for computing useful performance metrics to summarize the capacity of NIBIN sites to process ballistics evidence quickly.

Performance metrics computed using elapsed times are nuanced and must be interpreted with caution. They are most useful when viewed through the lens of multiple descriptive statistics, each with its own strengths and weaknesses. For example, while on the surface it may seem appropriate to rely on mean elapsed times (the mean is the arithmetic average), the mean can be overly inflated when sites are working diligently to process backlogs of very old cases. Put differently, an agency that processes new evidence very quickly would have a low mean elapsed time. However, if that same agency were to process very old cases in their backlog at the same time, their mean elapsed time would be artificially inflated, making it appear that they process quite slowly. Thus, it is not recommended to use mean elapsed times for performance assessment of NIBIN sites since doing so creates a perverse incentive to discontinue processing site backlogs.

One alternative is to use median elapsed times. The median is the middle score in a distribution. Statisticians frequently use the median as an alternative measure of central tendency (or average) when a distribution is skewed. When agencies work on a backlog, their elapsed processing times are naturally skewed by the long-elapsed time measures resulting from working

old cases. The skewed distribution of elapsed processing times is what makes the use of mean elapsed times such a poor performance measure. This raises the question of whether the median might constitute a more appropriate alternative. However, even median elapsed times may be overly inflated if more than half of a site's casework involves backlogged cases. Eliminating backlogs is an important task for labs and an overly simplistic performance metric may create a perverse incentive for labs to ignore backlogs. Alternative measures are provided below.

Table 18 presents descriptive statistics for elapsed time between crime and hit confirmation for all 19 sites.[35] The top row indicates that, overall, the 19 sites take a median of 101 days between the time when a gun crime is committed and a hit is confirmed. As noted earlier, the distribution is skewed. This is evident from the substantial difference between the mean (337 days) and the median (101 days). Data from these 19 sites provide a useful of example of why it is inappropriate to use mean elapsed processing times as a performance measure for NIBIN sites.

Across sites, elapsed times differ greatly. By any measure in Table 18, Denver PD's firearms section has the shortest elapsed times of all 19 sites (median = 27 days, mean = 85.5 days). Santa Ana PD is also very fast (median = 43.5 days) but Santa Ana's large mean elapsed time (608.6 days) indicates they are also processing an evidence backlog. Some NIBIN sites have considerable elapsed times. Stockton PD posts the longest elapsed times (mean = 1,911 days, median = 2,103 days). To their credit, the Stockton PD recently put in place a suite of innovative practices to address this issue. Their experience with identifying a processing time problem and instituting appropriate solutions is worthy of further study for elucidating the change process.

[35] Table 18 uses data on legitimate site hits, as defined in Appendix Table A1.

Figure 3 (below) depicts the medians reported in Table 18. Table 18 confirms that sites are capable of fast-tracking or expediting some cases. For example, eight sites confirmed at least one hit within one day or less.

Table 18
Number of Hits and Elapsed Time in Days between Crime and Hit Confirmation

Site	N	Median	Mean	SD	Min	Max
All Sites	7,141	101.0	337.04	655.40	0	5,987
Phoenix, AZ	336	416.5	641.04	739.34	15	5,948
Santa Ana, CA	492	43.5	608.66	1,281.27	0	5,987
Stockton, CA	391	2,103.0	1,911.93	953.85	7	3,568
Denver, CO	471	27.0	85.50	177.97	1	1,464
CBI – Denver	49	256.0	313.36	250.06	11	1,089
Marion Co./ Indianapolis, IN	295	83.0	186.39	342.81	2	3,018
New Orleans, LA	412	273.0	387.19	368.21	1	1,689
Baltimore, MD	431	162.0	177.04	128.76	3	750
Prince George's Co., MD	48	130.0	171.62	187.09	10	1,030
Kansas City, MO	414	86.0	185.70	323.82	1	2,465
St. Louis Co., MO	413	59.0	71.80	69.65	1	537
Onondaga Co., NY	594	55.5	334.61	604.72	7	3,089
New York, NY	1,179	75.0	149.76	169.66	0	1,224
OSP – Portland	274	125.5	179.32	187.27	6	1,352
Austin, TX	98	101.5	133.24	188.19	7	1,472
Houston, TX	575	112.0	147.26	164.66	0	1,539
DFS – Richmond	357	68.0	101.54	131.39	5	1,591
WSP – Tacoma	137	474.0	643.16	495.96	25	2,222
Milwaukee, WI	175	164.0	209.15	211.70	0	1,922

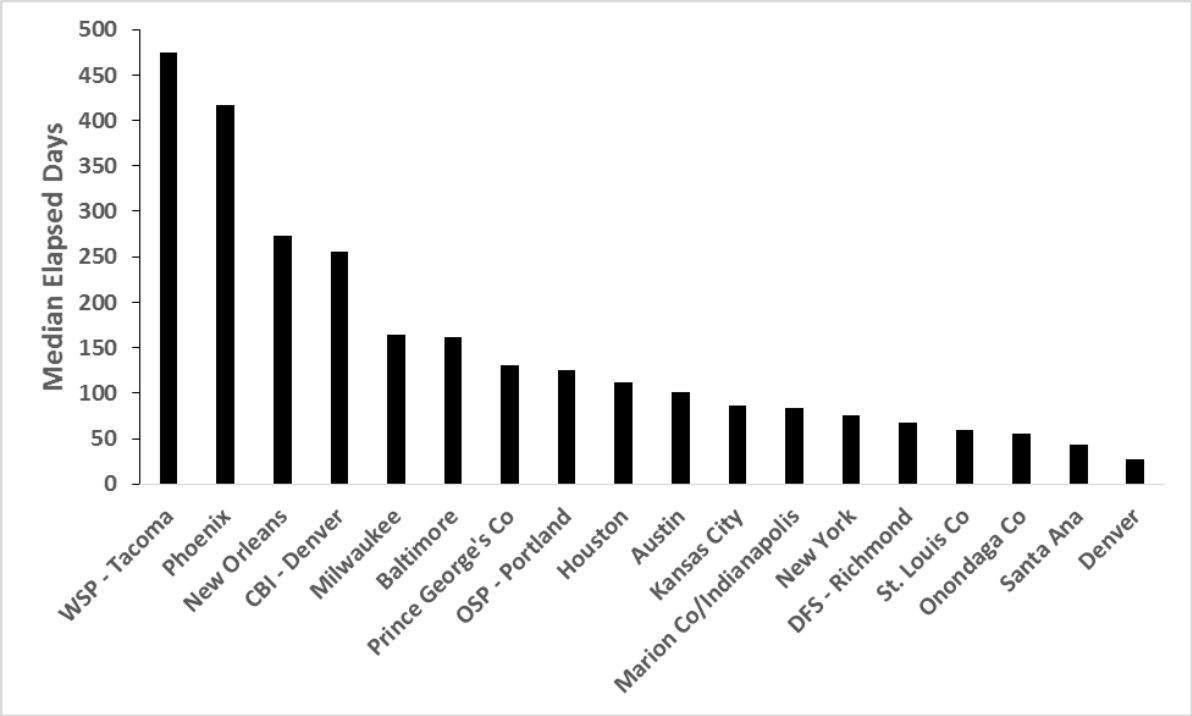

Figure 3: Median Elapsed Days between Crime and Hit Confirmation for 18 Sites

Table 19 provides additional descriptive statistics on the elapsed times for the 19 sites. Specifically, elapsed times are divided into percentiles for the fastest 5, 10, 25, 75, 90, and 95% of cases. The top row of Table 19, based on data from all sites, shows the fastest 5% of hits are identified in one week (7 days) or less. Similarly, the fastest 10% of hits are identified in two weeks (14 days) or less and the fastest 25% of hits are identified in 36 days or less. Data are presented in this format to demonstrate that some sites are remarkably effective at expediting some analyses while working on older cases or backlogs. On the other hand, some sites appear to work older cases in a lock-step manner without expediting any analyses. Thus, as before, there is considerable variation across sites.

Table 19
Elapsed Days between Most Recent Crime and Hit Confirmation

Site	N	5%	10%	25%	75%	90%	95%
All Sites	7,141	7	14	36	287	879	1,780
Phoenix, AZ	336	78	125	240	770	1,230	1,867
Santa Ana, CA	492	1	2	8	269	2,261	4,410
Stockton, CA	391	156	335	1,288	2,628	3,015	3,203
Denver, CO	471	3	5	9	53	202	565
CBI – Denver	49	21	53	118	424	732	880
Marion Co./Indianapolis, IN	295	25	31	44	172	369	881
New Orleans, LA	412	12	25	74	611	1,015	1,114
Baltimore, MD	431	11	19	73	279	339	393
Prince George's Co., MD	48	11	17	32	248	333	573
Kansas City, MO	414	11	17	30	174	460	649
St. Louis Co., MO	413	3	4	18	106	148	184
Onondaga Co., NY	594	12	16	26	242	1,354	1,794
New York, NY	1,179	15	23	39	201	391	496
OSP – Portland	274	22	40	64	234	363	517
Austin, TX	98	18	23	47	160	218	283
Houston, TX	575	5	11	38	193	315	416
DFS – Richmond	357	17	24	39	121	177	261
WSP – Tacoma	137	80	109	289	884	1,458	1,758
Milwaukee, WI	175	12	30	71	293	430	453

Santa Ana stands out as the site most capable of processing some (presumably high priority) cases quickly. Santa Ana confirms 10% of its hits within 2 days of the crime, and 25% of hits within 8 days of the crime. St. Louis County, Denver PD, and Houston PD are the next three labs with the fastest 5% and 10% elapsed times. These short elapsed times suggest that all four labs have flexible processes allowing them to process some cases very quickly after a crime has occurred. Note that the data in Table 19 are based on the elapsed days from crime to confirmed hit, not from when a request was issued or a DA or investigator requested a case be expedited. On the other end of the spectrum are NIBIN sites that appear incapable of processing any criminal cases quickly.

The 90 and 95 percentiles at the right-hand side of the table reveal some sites are actively working on backlogs, like Santa Ana and Stockton. The right-hand columns in Table 19 also show sites that do not have (or are not working) old backlogs, such as St. Louis County, Richmond, and Austin. It is not possible to determine from these data if sites have older backlogs and are not working these cases or if they do not have old backlogs. In instances where the 90 and 95 percentiles are large, however, these long elapsed times can be attributed to labs working on old backlogs. Taken together, the data in Table 19 show some sites, such as Santa Ana, expedite certain cases very quickly while processing their backlogs. This is an indicator of firearms sections that are attentive to the needs of investigators and allocate scarce resources carefully. Other labs appear to be crushed with cases and backlogs and face considerable challenges in expediting cases. Understanding and addressing these challenges is vital for helping NIBIN reach its full potential as an investigative and analytical tool.

The data in this section reveal major variations in the speed with which firearms sections process ballistic evidence and generate hit reports. Mean processing time as a performance measure for NIBIN sites can be misleading, sometimes making the very best sites appear slow if they are working on processing a backlog. Median processing times are a better option than the mean and can be useful in some circumstances but are subject to some of the same issues as mean processing time. Over the long term, a more complex and defensible multivariate performance measurement process for NIBIN sites should be developed based on the principles of statistical quality control. However, this option takes time and resources to develop. Univariate descriptive statistics like those presented in this section are much simpler and readily available once ATF addresses some of the quality control issues previously raised in regards to NIBIN data. Among the available univariate descriptive statistics, percentiles like those

presented in Table 19 represent the best immediate option for selecting performance measures. These nuanced measures are useful for helping sites understand how they compare with one another, for helping ATF identify high and low performing sites, and for making administrative decisions about which sites to showcase as success stories and which to provide with comprehensive technical assistance.

The data presented in this section are also somewhat bleak. At most selected NIBIN sites, investigators are unlikely to receive a NIBIN hit report within a few weeks of a crime. Most investigators work cases for over three months without the benefit of a NIBIN hit report. Interviews with investigators who received a NIBIN hit report reveal that, in some instances, when investigators receive the report their case has already been cleared by arrest or moved to the back burner and been re-prioritized due to other cases. To explore this issue further, the next section addresses the evaluations of NIBIN information received by investigators in specific cases.

Performance Metric #4: Investigators' Assessments of NIBIN Hit Reports in Specific Criminal Cases

Research on the utility of forensic evidence in police investigations has produced mixed findings. Some studies indicate forensic evidence is usually not available during the course of an investigation and, when present, is often not tested (Eck, 1983; Horvath & Meesig, 1996; Peterson, Mihajlovic, & Gilliland, 1984; Peterson et al., 2010). Some research also suggests that when forensic evidence is available, it does not assist in criminal investigations but is instead useful during prosecution stages (Horvath & Meesig, 1996). Other research finds forensic evidence valuable during the investigation process to link suspects to crimes and less important during the prosecution process (Peterson et al., 1984; Peterson, Ryan, Houlden, & Mihajlovic,

1987). Furthermore, research finds the value of forensic evidence is dependent on the type of criminal offense (Roman et al., 2008; Schroeder & White, 2009).

In order to address the role hit intelligence plays tactically in a criminal investigation, nine of the ATF site hit data files were used to identify criminal cases that occurred at a site visit agency involving a NIBIN hit report. The sample was limited to cases occurring within the past few years to increase the likelihood of identifying and making contact with the investigating officer. The initial plan involved selecting 10 homicide cases at each site. Various issues inhibited efforts to carry out this portion of the study as intended. In New Orleans, ATF was unable to provide the NIBIN hit file before the site visit. Therefore, a sample of homicide cases could not be selected in order to identify the investigators and arrange interviews prior to the visit. By chance, one homicide investigator was encountered who received a NIBIN hit report and he was interviewed. In Bowling Green, OH, neither the lab nor ATF could provide any information about the cases associated with the three hits the site produced, so no detective interviews were conducted there. Some sites, such as Phoenix, Onondaga County, and Austin have relatively few homicides and even with the eligible time period extended, 10 homicides could not be found about which to interview investigators in these sites. Eventually, 104 homicide cases were selected for study.

Investigators were interviewed face-to-face in seven sites (Santa Ana, Kansas City, Houston, Phoenix, Onondaga County, Stockton, and New Orleans). In one site (Marion Co./Indianapolis), investigators provided written details on-site about each case, but face-to-face interviews could not be arranged. In another site (Austin), a supervisor in a criminal investigation unit extracted information from the police agency's electronic records system to provide information about the disposition of each case. One site (Bowling Green, the state lab in a rural

community) produced just three NIBIN hits. Since their NIBIN terminal was removed, information about this case was unavailable from either ATF or the lab itself. Data were gathered on 65 of the 104 homicide cases selected (a 62.5% completion rate). The results of these interviews from nine sites are presented in Table 20 below.

Table 20
Detective Interview Case Frequencies (N=65)

Variable and Response Categories	N	Valid Percent
Agency (N=65)		
Austin Police Department	7	10.8
Houston Police Department	11	16.9
Indianapolis Metro Police Department	13	20.0
Kansas City Police Department	14	21.5
New Orleans Police Department	1	1.5
Syracuse Police Department	4	6.2
Phoenix Police Department	3	4.6
Santa Ana Police Department	4	6.2
Stockton Police Department	8	12.3
Type of Criminal Case (Case A) (N=65)		
Homicide	54	83.1
Robbery	2	3.1
Assault with a Deadly Weapon	5	7.7
Other	4	6.2
Type of Criminal Case (Case B) (N=63)		
Homicide	11	17.5
Robbery	6	9.5
Felon in Possession/Test-Fire	2	3.2
Assault with a Deadly Weapon	15	23.8
Test-Fire/Unlawful Carrying of a Weapon	2	3.2
Aggravated Assault	3	4.8
Deadly Conduct	1	1.6
Test-Fire	10	15.9
Unknown	1	1.6
Other	12	19.0
Number of Cases Linked to Focal Case (N=64)		
One other Case (i.e., a hit dyad)	36	56.3
Two	17	26.6
Three	5	7.8
Four	5	7.8
Five	1	1.6

Table 20 cont.
Detective Interview Case Frequencies (N=65)

Variable and Response Categories	N	Valid Percent
Detective's Assigned Investigative Unit at time of Crime (N=61)		
Homicide	53	86.9
Robbery	1	1.6
Aggravated Assault	1	1.6
Gang	2	3.3
Criminal Investigations Department	4	6.6
How Detectives Usually Receive Hit Reports (N=65)		
Email from Lab	52	80.0
From Supervisor	4	6.2
Telephone	1	1.5
Other	3	4.6
Was the Suspect Identified before the NIBIN Hit (N=60)		
No	29	48.3
Yes	30	50.0
Unknown	1	1.7
Was the Suspect Arrested before the NIBIN Hit (N=58)		
No	36	62.1
Yes	20	34.5
Unknown	1	1.9
Suspect Dead	1	1.9
Was the Suspect Charged/Pleaded before the NIBIN Hit (N=55)		
No	43	78.2
Yes	10	18.2
Unknown	1	1.8
Suspect Dead	1	1.8
Was the Suspect Sentenced before the NIBIN Hit (N=52)		
No	48	92.3
Yes	2	3.8
Unknown	1	1.9
Suspect Dead	1	1.9
Did the NIBIN Hit Identify a Suspect (N=62)		
No	55	88.7
Yes	6	9.7
Unknown	1	1.6
Did the NIBIN Hit Lead to an Arrest (N=61)		
No	59	96.7
Yes	1	1.6
Unknown	1	1.6
Did the NIBIN Hit Help with Obtaining Charges or a Plea (N=61)		
No	57	93.4
Yes	3	4.9
Unknown	1	1.6

Table 20 cont.
Detective Interview Case Frequencies (N=65)

Variable and Response Categories	N	Valid Percent
Did the NIBIN Hit Help with Sentencing the Suspect (N=58)		
No	56	96.6
Yes	1	1.7
Unknown	1	1.7
Current Case Status at Time of the Interview (N=63)		
Open	33	52.4
Suspended	1	1.6
Suspect Arrested/Charged	6	9.5
Convicted	9	14.3
Awaiting Grand Jury	1	1.6
Inactivated	1	1.6
Known but Flown	1	1.6
Cleared	1	1.6
Suspect Identified	3	4.8
Cleared by Exception	1	1.6
Dismissed/Acquitted	2	3.2
Charged Awaiting Trial	4	6.3

The majority of the cases selected for interviews were homicides (83.1%). During the interviews, some cases were discovered to actually be assaults (e.g., the victim was shot multiple times but did not die). For some sites, a few robberies (n=2) were included to improve the number of interviews. The majority of detectives interviewed were assigned to homicide investigations at the time of the case (86.9% of cases). Most of the cases selected for interviews were associated with only one other case by a NIBIN hit (a hit dyad) at 56.3%. Some cases had two NIBIN hits (26.6%) and a small portion of cases had NIBIN hits on three, four, or five other cases. The cases (Case B) linked to the focal case (Case A) by NIBIN varied by type, including assault with a deadly weapon (23.8% of cases) and test-fires (19.1%).

Investigators provided a brief summary of the crime and their investigation. The vast majority of investigators report they had received a NIBIN hit report. Investigators were asked about the status of their case at the time they received the NIBIN hit report in order to ascertain

whether cases were cleared by arrest, if suspects were identified (but not yet arrested), or if suspects had progressed to the plea bargaining or conviction stage. A probable suspect[36] had been identified in half the cases (50.0% of cases) and an arrest made in one third of the cases (34.5%) by the time the investigator received the hit report. In 18.2% of cases, a suspect had been charged or pled out by the time of the NIBIN hit report. In 3.8% of cases, a suspect was already sentenced for the present crime by the time the report arrived.

Next, investigators were asked about the role the hit report played in investigating the case. Specifically, investigators were asked if the NIBIN hit report had helped identify a suspect in their case (yes in 9.7% cases), led to an arrest (yes in 1.6% of cases), helped in charging a suspect or obtaining a plea (4.9% of cases), or helped with sentencing the suspect (1.7% of cases). Rarely did the hit report definitively help identify a previously unknown suspect. In the few cases where a suspect was identified due to the hit report, investigators were vocal about NIBIN's utility. In these six cases, the NIBIN hit report turned the investigation in a new and more productive direction. In some instances, the NIBIN hit eliminated a pursued suspect from consideration. One investigator in Santa Ana noted that ruling-out a particular suspect let him focus his investigation on more productive leads. He articulated that he would have otherwise wasted a lot of time and effort on dead-end leads.

Overall, the contributions of NIBIN hit reports to investigations are modest and less obvious than expected. In the sample of examined cases, NIBIN hit reports were rarely used to identify an unknown suspect, make an arrest, or contribute to charging, plea bargaining, or sentencing. Interviews closed with the status of cases as of the interview date. Slightly more than half of cases were reported still open and active (52.4%).

[36] Cases were only counted where a likely suspect was under consideration at the time of the NIBIN hit report. Instances where a suspect had been arrested but released and no longer viewed as a suspect were not counted as "suspect identified."

Although investigators did not rely on NIBIN for most of the cases selected in this study, investigators still express that they find NIBIN hit reports useful and want to use any intelligence or information they can to help solve their cases. Investigators like the possibility that a hit may provide useful information, background, context, some history of the gun involved, or the gangs or individuals thought to be associated with the gun. One of the most useful contributions of a hit report for investigators is the ability to confirm suspicions about the suspect or case even when a suspect has already been identified or arrested. For example, if a suspect is a known member of a particular gang and the gun used in the crime is linked to other crimes committed by that gang, investigators take the hit as validation for their suspicion of that suspect.

Detectives also use the results of hit reports to parse out which witness or informant statements are bogus from those that are useful. Investigators with the Syracuse PD subject an informant's claims to verification by NIBIN. For example, if an informant said a suspect used the same gun in two different crimes and provided specifics about each crime, the detectives ask the lab to verify this association in NIBIN. If NIBIN verifies the informant's claims, investigators view the informant as credible and trustworthy.

Even when NIBIN does not lead to an arrest, detectives report they like how NIBIN helps "highlight suspects' activities and associates to target suspects by special units. For instance, an investigator in Kansas City notes NIBIN hits often lead to additional attention from their "Gun Squad" (a joint KCPD and ATF unit targeting guns and gun criminals). In other cities not so intently focused on guns and gun-related crimes, detectives may be less likely to see the utility of NIBIN hits without clear units with responsibility for targeting suspects.

In some instances, a NIBIN hit helps push a case forward. In Kansas City, a suspect was identified (by eyewitnesses) in a homicide, but was not yet arrested because detectives were

strengthening the case. In the meantime, the suspect was arrested after a carjacking while driving the stolen car with the gun from the homicide and was quickly charged with felon in possession (FIP) and carjacking. When the recovered gun generated a NIBIN hit on the homicide, detectives charged the suspect with homicide. In essence, NIBIN sped up the process of charging the suspect, but the hit did not initially identify him in the homicide. Detectives felt his possession of the murder weapon was sufficient evidence to file charges against him for the homicide.

Investigators routinely express that they like the *idea* of receiving NIBIN hit reports. A hit report brings the possibility of useful information or a lead. In the sample of examined cases, however, hit reports rarely led to suspect identifications or other tangible investigative outcomes. This can be explained by several reasons.

First, as detailed above in the analysis of elapsed time between a crime and the hit report, investigators rarely receive hit reports quickly. Previous research indicates that about 50% of homicides in the U.S. are cleared within 7 to 17 days (Regoeczi, Jarvis, & Riedel, 2008; Wellford & Cronin, 1999). Most of the violent crime cases examined were either solved or slipping into the cold case file by the time the NIBIN hit report arrived. In a few (n=6) instances, the hit report contributed to solving the case by identifying a previously unknown suspect. In most instances, the hit information arrived too late to greatly advance the case. A key recommendation of this study is that NIBIN hit reports must be delivered to investigators more quickly in order to be useful. Some sites maneuver around the time constraints imposed by confirming hits. Stockton routinely provides information about high confidence candidates (i.e., unconfirmed hits) to investigators before hits are confirmed. Investigators treat the unconfirmed hits as leads instead of as formal lab reports. If a case goes to trial, the hit is then confirmed. By

providing unconfirmed hits, Stockton accelerates the flow of information between lab and investigator.[37]

Second, many NIBIN hit reports contain sparse information. It is hypothesized that hit reports will be more meaningful if they contain more information about the two cases in a hit dyad, such as addresses, crime details, intelligence about possible suspects and motives, affiliations of witnesses and victims, etc. A NIBIN hit can be thought of as a key with the potential to unlock two vaults of potentially useful information. In their present form, though, hit reports are not easy to use and thereby make it more difficult than necessary to access the information contained in those vaults. Thus, their practical utility for investigators is somewhat diminished.

A more general way of conceptualizing this problem comes from the field of "human factors" in psychology. Human factors is the study of how human beings interact with the world around them. The human factors field is particularly helpful for illuminating the importance of "information design" in optimizing the way people use information. Taking information design seriously means "to clarify, to simplify, and to make information accessible to the people who will need it and use it to make important decisions. Information needs to be in a form they can understand and use meaningfully…" (Katz, 2012, p. 10). ATF is encouraged to think carefully about the design and utility of NIBIN hit reports. One possibility is to carry out experiments testing the utility of hit reports with different characteristics, such as the inclusion of different types of information and different methods of delivery from the lab to investigators (in-person versus other formats). ATF can use the results of these experiments to provide "model" hit

[37] Prior to February 2013, Stockton PD sent evidence from high confidence candidates to the California Department of Justice's Bureau of Forensic Service's Central Valley Crime Lab for hits to be confirmed, greatly slowing the process. Stockton was also limited to sending just 10 cases per month, further impeding the timely confirmation of hits.

reports and processes for local agencies around the country to use to improve the utility of their NIBIN programs.

This concern has been partially addressed by ATF through its contractor program. Contractors are viewed as "hit hunters" and are tasked with adding information to hit reports from a range of sources, including eTrace and criminal history checks. Contractors are supposed to add intelligence value to the hit reports to help investigators make sense of the hits. This program is laudable but limited to some extent because it focuses on people rather than processes. ATF should create a process for all NIBIN sites where information is regularly added and distributed to key law enforcement personnel. Such a process must be more ambitious than the current contractor program. The true promise of NIBIN involves its use as a central node in a gun/crime intelligence system. The strategic potential of NIBIN is addressed in the next chapter.

CHAPTER V

THE STRATEGIC USE AND POTENTIAL OF NIBIN

NIBIN hits are a source of *tactical* intelligence to help investigators solve individual cases. However, NIBIN also represents a source of *strategic* intelligence to help law enforcement agencies understand larger patterns of gun crime within and across communities. NIBIN has tremendous capacity to reveal latent patterns in gun use, gun sharing, and the gun-related criminal activities of groups like street gangs, drug cartels, outlaw motorcycle gangs, and other organized crime entities. This research suggests that NIBIN data are rarely leveraged for these kinds of comprehensive, analytical, and strategic purposes by either ATF or local law enforcement agencies.

This chapter begins by reviewing the activities of NIBIN contractors since some of them perform tasks strategic in nature. These largely individual efforts are laudable but inconsistent and only begin to scratch the surface of NIBIN's strategic value. Second, though most sites are not taking full advantage of NIBIN's strategic capacity, some of the practices discovered during site visits do use NIBIN as a source of strategic intelligence. There are probably other agencies in the U.S. using NIBIN sites in innovative and strategic ways not yet discovered. Finally, potentially innovative ways NIBIN can be strategically used are described. Impediments to the use of NIBIN for strategic crime analysis are also addressed. Note that many of the findings and recommendations reported in this chapter echo the best practices in processing ballistic evidence outlined by Gagliardi (2010).

NIBIN Contractors

NIBIN contractors are usually retired law enforcement officers paid by ATF to coordinate NIBIN activities in certain sites. Contractors have a number of duties. Most salient for this discussion of NIBIN's strategic criminal intelligence potential is the role contractors play in exploring and charting hits. Contractors are charged with adding information to NIBIN hits. Contractors check the criminal histories of people associated with NIBIN hits, trace guns through eTtrace, talk with investigators, and add useful information to NIBIN hits. If hits involve a network of related offenses or cases, contractors explore the commonalities among the offenses. Ideally, contractors assemble a big picture of the network and forward this information to police units and ATF. The ATF contractors interviewed here stated police investigators often have too many cases to do this kind of legwork. They are too busy investigating individual cases to carry out the more time-consuming strategic analyses necessary to construct the bigger picture of networks and associations among criminals.

Among the most visible outputs created by contractors are charts summarizing NIBIN hits. Many of the NIBIN sites visited have paper versions of these charts on display, usually in the firearms section of their lab. These charts visually document the links among different crimes that were correlated together with NIBIN hits. These charts usually display the crime, the weapon, and the names and gang affiliations of suspects with lines joining the associated crimes. Some of the charts are enormous. For example, one chart in New Orleans involves 19 hits and a myriad of guns.

Charts are visual representations of data but they are not actual data. The charts are usually printed on paper and, thus, are not interactive. In other words, investigators do not access

additional information from the chart and charts cannot be updated easily. Furthermore, the process for making charts is cumbersome because it requires software and a trained technician. The idea of charts is beneficial because they are compelling and visually show the relationships among different groups, crimes, and suspects. ATF should take NIBIN data in even more strategic directions, a recommendation addressed again shortly.

Strategic Uses of NIBIN

NIBIN was used strategically during site visits and described as such during conversations with key informants. One of the most noteworthy sites in this regard was Onondaga County, New York (which runs the crime lab) and the Syracuse Police Department. Onondaga and Syracuse PD have a history of using NIBIN for Racketeer Influenced and Corrupt Organizations (RICO) prosecutions of criminal gangs. In Syracuse, NIBIN hits add additional depth to RICO prosecutions by demonstrating that a group is a criminal gang, its members conspire to commit crimes, they share guns, and they claim a particular geographic territory. Officials interviewed in Syracuse noted that NIBIN assisted greatly in five RICO prosecutions of gangs. For instance, one stated:

> These guys are bad guys so you don't know who is telling the truth, so you can use NIBIN to tell who is telling the truth. Cases that are cold we can solve through NIBIN and getting violent guys off the street. They have community guns here. If you have a gun that has been used in 5 incidents, you might not be able to tie it to a person but you can use it to tie to a group. It is a phenomenal tool. It is one of the most powerful tools in law enforcement.

Syracuse's strategic use of NIBIN is well-organized. The police department operates a special Gang Violence Taskforce with eight members, has a Gun Violence Analyst on staff, and an AUSA assigned to work on gang cases.

Other sites also provide evidence of strategic NIBIN use, often by special units that focus on gun crimes and violent offenders and in conjunction with prosecutors. Officials

knowledgeable about NIBIN described other agencies using NIBIN in strategic ways, but these agencies were unable to be visited during this study. For instance, St. Louis, MO is highly successful with using NIBIN for RICO prosecutions. In Kansas City, a joint ATF/KCPD gun unit targets criminals associated with guns and gun crimes. Kansas City recently created a "lever pulling" project called NoVA to target and deter high rate, violent offenders. The strategic analysis at the heart of NoVA, a network analysis of high rate offenders, includes NIBIN hit data (Draper 2013; Rizzo 2013).

Overall, strategic uses of NIBIN data are the exception rather than the rule. Gun crimes are treated in a piecemeal fashion with investigators doing a competent job of investigating *individual* cases but failing to identify links and patterns between cases. In many cities, a gun homicide is investigated by the homicide unit and a gun robbery is investigated by the robbery unit. These stovepipes are difficult to overcome. NIBIN data often sit as emails or paper hit reports in three-ring binders or folders and not as electronic records to be searched and retrieved easily. The organizational structures (e.g., special units, task forces), inter-organizational processes (e.g., involving prosecutors in investigations, teaming lab analysts up with detectives), and availability of useful and useable data have not yet coalesced to create seamless and effective systems for investigating gun crimes. More strategic approaches capable of identifying trends, patterns, and links between cases are sorely needed. There exists a substantial need for American police agencies and crime laboratories to work together in adopting a more problem-oriented approach allowing for more strategic thinking.

Consider the Stockton Police Department in California. Facing a significant firearms backlog, Stockton hired a firearms analyst and acquired the *GunOps* software to manage its ballistic evidence data. The backlog, as with many cities, was simply too large to begin taking on

in its entirety so Stockton began to dip into its backlog in a strategic manner. By mapping crimes with similar firearm, case, and location characteristics, Stockton is pulling backlogged cases that appear to relate to one another. This process very quickly enabled Stockton to generate NIBIN hits, including some cases in which there was a suspect for one offense but not the other. This strategic thinking is enabling Stockton to begin processing its backlog in an efficient manner by identifying hits, linking cases, and providing valuable information to investigators about the linked cases.

Realizing the Strategic Potential of NIBIN

In those instances when NIBIN is used for its strategic value beyond its contribution to solving an individual case, the process typically begins with a hit. Conceptualizing NIBIN as a tool only useful for producing hits places unnecessary limits upon its potential as a strategic intelligence source. NIBIN contains vast information on crimes and weapons extending well beyond just hits, but the majority of evidence in NIBIN is never connected with other offenses, events, or weapons. In other words, the strategic analysis of NIBIN data should encompass all the information in NIBIN, not just the hits. To make NIBIN data more impactful, more information must be attached to each NIBIN entry. For example, each event or crime should be geocoded, the names of suspects and victims (and witnesses) should be attached, and eTtrace data should be added. In this way, hit reports will include more information and the strategic analysis of *all* NIBIN data will be more meaningful because of more available information to make connections.

In reality, adding additional information to NIBIN entries may be difficult under current circumstances. As already demonstrated, many crime labs struggle to process ballistics evidence quickly and acquire images with NIBIN. The proposal to augment NIBIN entries adds an extra

information burden to firearms sections. Moreover, some firearms sections may not have ready access to eTrace data, criminal records, offense reports, etc. Thus, some firearms sections may struggle to implement the proposed changes. Those agencies with the capacity to implement the proposed changes, though, will enhance their capacity to investigated gun-related crime at both a tactical and strategic level.

At present, the data in NIBIN are bottlenecked within the NIBIN system. Labs can only access NIBIN data by viewing it on a screen or printing paper reports. There are currently no easy mechanisms in place allowing a NIBIN site to retrieve data in an electronic format. This bottleneck is the reason hits exit NIBIN terminals in the form of paper reports and there is rarely extra information attached to the hit report. To compound the problem, investigators and analysts wishing to search NIBIN must gain access from a firearms section in a crime lab. This access is not easy for investigators to attain and requests for searches create additional work for firearms personnel.

The data contained in NIBIN should be made more accessible to law enforcement agencies and analysts without requiring they obtain it from firearms sections and crime labs. This may mean creating a new software application that takes the principles of information design seriously and makes NIBIN data available in a way that maximizes its utility for investigators and analysts. This application should treat NIBIN data as something very different than just a source of hits. The software should be conceptualized as a "force multiplier" in the sense of providing information to local agencies but also allowing local agencies to augment it. For instance, law enforcement personnel could add information like eTrace results, suspect and victim information, and additional intelligence to each NIBIN entry. This parallel system would not permit anyone outside of the lab to alter or delete information in NIBIN. The transfer of

information would be one-way, from lab to law enforcement. This system would open the bottleneck of strategic intelligence now locked up in NIBIN terminals. This data system of firearms evidence could serve as the nucleus of a comprehensive and useful criminal firearms intelligence database for law enforcement. NIBIN hits are very useful tool but the vast information contained in NIBIN has greater potential utility than its current configuration allows.

Additionally, firearms sections should add geocodes to NIBIN inputs. At present, the fields for geocodes do not exist. New iterations of NIBIN software should create geocode fields and integrate geolocations into the search algorithm. The benefits are significant not only for strategic purposes, but for tactical goals as well. For example, in a recent study, researchers found that utilizing geographic information (e.g., the geographic proximity of gun crimes) in conjunction with the traditional image algorithm improved the ability of the IBIS™ correlator to correctly match ballistics hits (Yang et al., 2011).

CHAPTER VI

RECOMMENDATIONS

NIBIN holds great promise as an effective tool for combating violent firearms crime. This tool should be conceptualized as having both tactical and strategic value. At present the program is severely under-resourced. Moreover, its potential value for law enforcement is not fully recognized by either ATF or the agencies that use it. Its current configuration and data systems make it very difficult for ATF to monitor the program's performance. Very little technical support is provided to localities and there is not an ongoing process of continuous system improvement allowing for the NIBIN program to remain on the cutting edge. In short, it is a tool with massive untapped potential due in part to chronic underfunding and to a limited vision of its true capacity.

In this chapter, a broad set of recommendations is outlined for improving NIBIN's performance by building ATF's capacity to oversee and manage NIBIN operations. In order to increase the tactical and strategic uses of NIBIN, NIBIN information should be disseminated to local law enforcement agencies. An ambitious program is presented for developing regional NIBIN Centers of Excellence to help spread innovative practices to local agencies. Finally, a program of experimentation should be established at NIBIN sites. Acting on these recommendations will greatly enhance NIBIN's effectiveness but require a significant infusion of additional funding to support ATF and NIBIN.

Enhance ATF's Capacity to Monitor the Performance of Local NIBIN Sites Using Meaningful Metrics

ATF's management and oversight of NIBIN is hampered by information bottlenecks in NIBIN databases and an insufficient number of ATF personnel to analyze and disseminate NIBIN data, issue reports and policy briefs, and generally monitor the performance of local NIBIN sites. At present, ATF's NIBIN Branch has only three employees working in a management or administrative capacity.[38] This is wholly insufficient for a national program with such promise for investigating and reducing gun crime in the United States. ATF cannot effectively monitor the performance of NIBIN partner sites because it cannot readily access the data that can be used to measure site performance. ATF needs to invest in building an appropriate data infrastructure with clean and well-maintained data and a performance measurement framework around the regular analysis of these data. The number of non-crime lab employees assigned to ATF's NIBIN Branch should be increased considerably. The NIBIN Branch needs technically skilled personnel (programmers, data analysts, and managers) to liberate the wealth of data currently locked in NIBIN.

Building a well-designed and appropriately maintained data infrastructure for NIBIN is a crucial ingredient in ATF's ability to manage NIBIN effectively. Currently, the only performance indicators for NIBIN are the number of inputs and the number of hits. The number of inputs into a system is useful for gauging workload but is incomplete as a performance measure as it is not clearly indicative of any meaningful outcome like an arrest, a clearance, or a successful prosecution. Hits are a useful output measure but even they are not clearly tied to outcomes. Previous work in an agency outside the U.S. revealed that IBIS™ was used to

[38] As of April 25, 2013, NIBIN Branch had 13 employees, ten of whom are lab employees.

generate many hits but these hits were not used by investigators. Work in the current project reveals that delays in the production of hits are so significant they often render hit information meaningless for the work of criminal investigators. Thus, like inputs, hits are an incomplete performance measure for local NIBIN sites and for the overall NIBIN program. These incomplete measures need to be supplemented by a suite of more robust, complete measures which tap into the utility of NIBIN information for outcomes valued by law enforcement agencies. This study reveals that the swiftness with which hits are produced should be included in this suite of performance measures. A standardized set of performance measures that are thoughtful and well-validated should be created that ATF can use to rate the performance of NIBIN sites. Sites performing exceptionally well should be studied to understand the "secrets" behind their success. Their practices could be highlighted by ATF in publications disseminated to all NIBIN sites. Agencies performing poorly should be flagged for technical assistance and remedial measures put in place to shore up their performance.

Evidence of quality control issues was discovered in the acquired NIBIN data. For instance, one site used its NIBIN terminals as clerical or record-keeping devices to track relations among different images. In the process, the site has greatly inflated their number of hits. Their hit file indicates they identified 1,676 hits over a five year period. At a closer look, however, it was discovered that most of these hits involved different exhibits associated with the same criminal events. In reality, this site actually identified 275 hits. This over-counting of hits is possible in a system in which the "accounting rules" of NIBIN hits are not clearly communicated or enforced. This is one area where ATF can draw lessons from the FBI. The Uniform Crime Reports system developed by the FBI is based on accounting rules that guide thousands of state and local agencies in determining how to count crimes reported and cleared. The FBI then

consolidates these reports. Here it is recommended that ATF do something similar, though on a significantly smaller scale. State and local agencies need a clear set of accounting rules for computing inputs and hits and ATF should have the in-house capacity to detect when agencies are clearly not following these rules. The Appendix provides more detail about the quality control issues discovered in the NIBIN data.

Building this performance *measurement* and performance *management* capacity involves hiring a team of professionals capable of this kind of work. This team should consist of information technology professionals to build and manage the data infrastructure, analysts to process the data and write reports, and agents with sufficient field credibility to communicate the findings to state and local agencies.

Foster the Strategic and Tactical Uses of NIBIN by Local Law Enforcement Agencies by Improving NIBIN Data and Making Them Available to State and Local Agencies

This research finds that data bottlenecks impede the strategic and tactical utility of NIBIN for local law enforcement. Resources should be allocated to extract information from NIBIN on all evidence (not just hits). NIBIN information should be accessible to local law enforcement agencies and augmented with information from other sources such as eTrace, criminal records, geocodes (to facilitate mapping of gun crimes), gunshot detection software etc. ATF should enhance the utility of NIBIN by finding ways to share NIBIN data with state and local law enforcement agencies in a user-friendly format. These agencies should ideally be provided with training and technical assistance from ATF on how to access and use the data for both tactical and strategic purposes.

NIBIN is currently structured around hits. NIBIN sites and ATF both treat hits as the principle measure of NIBIN's success. However, NIBIN data have substantial utility beyond just

the hit information they contain. There is a wealth of information in the associations among evidence that has never produced a hit. This information must be freed from the system since local NIBIN partners cannot readily download or access data from their terminals. These data should be supplemented with other forms of criminal information. For instance, if properly compiled, NIBIN information should be amenable to spatial analysis (as is done in the *GunOps* software developed in Santa Ana) or social network analysis (as is done in Kansas City). However, local sites cannot access or unlock their data. ATF does not have access to the types of additional information that should be added to NIBIN information since it typically resides in local law enforcement agencies. In effect, a myriad of locally maintained criminal information databases should be built around a backbone of NIBIN information. Helping local agencies establish this capacity expands the utility of NIBIN beyond its current role as a source of hits.

Establish an Ongoing Program of Research and Development Intended to Discover Effective Practices and Improve Performance at NIBIN Sites

Just as healthy business firms have robust research and development operations to stay on the cutting edge, NIBIN will benefit significantly from establishing a research and development program to improve the performance of NIBIN sites. There is a tendency with technology to think of research and development in solely technological terms. This proposed program is much broader and is envisioned to help discover, cultivate, stimulate, and test innovative practices. Some of these practices would be technological in nature but others include structures, policies, practices, or a combination of these. The envisioned program of research and development represents a reciprocal relationship between ATF and NIBIN sites. In this relationship, ATF's performance measurement framework (as previously described in this chapter) will allow the agency to identify high-performing sites. ATF will then invest in identifying what practices set

the successful sites apart from less successful sites. ATF will then test these practices in other sites in a systematic way, seeking to determine which effective practices are portable and which may not transfer as easily. Similarly, local NIBIN sites interested in improving their performance can turn to NIBIN's research and development staff for assistance. In this way, ATF's NIBIN program becomes part of a much broader, more robust effort to improve the investigation of gun crime in the United States.

A research and development apparatus within NIBIN will immediately have much to do. For instance, studies are immediately necessary on how to decrease elapsed times between when crimes occur and hits are identified. Delays in processing ballistic evidence are the single greatest threat to the utility of NIBIN as an investigative tool.[39] A second group of vital studies is to examine the forms of information most helpful to investigators. A third group should address the utility and feasibility of augmenting NIBIN information with other information sources such as geocodes to permit spatial analysis of gun crime patterns (as in Santa Ana's *GunOps* program) or social network analysis information (as in Kansas City). Much of this work is best done internally within ATF, assuming the agency can hire people with the appropriate skills for this kind of work. For larger-scale experiments or quasi-experiments testing the effects of interventions, ATF will need to supplement their internal R&D efforts with scientific evaluations carried out by external researchers. Establishing a robust research and development infrastructure within ATF requires additional technical personnel, additional software and hardware, effective management for this new role, and the unflinching support of the organization's leaders.

[39] One stream of research in this genre should test an initiative to fast-track test-fires. For instance, participating agencies should locate test-fire facilities (such as a water tank and a NIBIN terminal) near a booking facility or jail. Whenever an arrestee is apprehended with an illegal firearm, that firearm would be *immediately* test-fired and the image of the spent brass acquired by NIBIN and checked. Ideally, NIBIN results would be obtained before the arrestee leaves jail on pre-trial release. This is just an example of how the NIBIN program, with proper funding and support, can be reconceptualized as a support mechanism for improving gun crime investigation, testing innovative practices, and disseminating the results to the field.

Provide Funds and Resources to Establish NIBIN Centers of Excellence

ATF should begin to leverage innovations from the field by establishing regional NIBIN Centers of Excellence. The reality of criminal justice innovation in the United States is that the best ideas do not always come from Washington. They emerge from the creativity and passion of committed professionals working in agencies around the country, doing the best they can with limited resources and other constraints. The proper steps for federal agencies interested in supporting and diffusing innovation is to locate those agencies doing the best jobs, recognize and support them, and create mechanisms through which they can serve as role models for other regional agencies. Thus, ATF should establish regional NIBIN Centers of Excellence and work with those Centers to influence the spread of effective practice in gun crime investigation. These Centers can provide training and technical assistance, host regional conferences, establish websites and publications intended to raise the level of professional activity, and create networking opportunities for those involved in investigative gun crime, such as criminal investigators, firearms examiners, and firearms techs. Washington may not have all the answers but through regional Centers of Excellence, it can stimulate regional training, technical assistance, networking, and other professional development opportunities centered around NIBIN, eTrace, and other ATF services. The selected sites will need to be accessible to visitors from other agencies so they can learn first-hand how to establish effective structures, policies and practices for leveraging the power of NIBIN.

The selection of sites to serve as Centers of Excellence will be difficult, especially with the weak measures of NIBIN site performance currently available to ATF. Though difficult, it is possible to identify innovative sites. Presently, no single NIBIN site does *everything* well. Some sites produce hits quickly. Other sites use NIBIN for RICO prosecutions while still others

generate an impressive number of hits. ATF could certainly select NIBIN sites with different types of expertise. However, to the greatest extent possible, the NIBIN partner sites selected as Centers of Excellence need to exemplify best practices in multiple aspects of gun crime investigation relying on NIBIN (such as rapid hit identification, effective strategic and tactical use of NIBIN information, effective hit report formats, and feedback loops from NIBIN end users). The most challenging aspect of turning this recommendation into reality will not be selecting sites; it will be paying for it. This ambitious proposal simply cannot occur without a substantial federal investment in ATF.

REFERENCES

ATF NIBIN. (2011). NIBIN Users Congress Meeting minutes, August 23-24, 2011.

Belsley, D. A., Kuh, E., & Welsch, R. E. (1980). *Regression diagnostics: Identifying influential data and sources of collinearity*. New York, NY: John Wiley.

Braga, A., & Pierce, G. (2004). Linking crime guns: The impact of ballistics imaging technology on the productivity of the Boston Police Department's ballistics unit. *Journal of Forensic Sciences, 49,* 701-706.

Committee on Identifying the Needs of the Forensic Sciences Community, National Research Council. (2009). *Strengthening forensic science in the United States: A path forward*. Washington, DC: National Academies Press.

Draper, B. (2013). *KC Fights Violent Crime with Carrot-Stick Program.* Associated Press. http://bigstory.ap.org/article/kc-fights-violent-crime-carrot-stick-program

Eck, J. E. (1983). *Solving crimes: The investigation of burglary and robbery*. Washington, DC: Police Executive Research Forum.

Feldmann, L. (2013). White House, gun advocates find small piece of common ground. *Christian Science Monitor*. Retrieved January 23, 2013 from http://www.minnpost.com/christian-science-monitor/2013/01/white-house-gun-advocates-find-small-piece-common-ground

Frank, J., Katz, C., King, W., Maguire, E., & Wells, W. (2012). *Opening the black box of NIBIN: Site visit protocol*. Huntsville, TX: Sam Houston State University.

Gagliardi, P. (2010). *The thirteen critical tasks: An inside-out approach to solving more gun crime*. Montreal, Canada: Forensic Technology, Inc.

Gormley, W., Jr., & Weimer, D. (1999). *Organizational report cards*. Cambridge, MA: Harvard University Press.

Horvath, F., & Meesig, R. (1996). The criminal investigation process and the role of forensic evidence: A review of empirical findings. *Journal of Forensic Science*, *41*, 963–969.

Houck, M. M., & Siegel, J. A. (2006). *Fundamentals of forensic science*. Boston, MA: Elsevier.

Katz, J. (2012). *Designing information: Human factors and common sense in information design*. Hoboken, NJ: John Wiley and Sons.

King, W. R., & Maguire, E. R. (2009). Assessing the performance of systems designed to process criminal forensic evidence. *Forensic Science Policy and Management: An International Journal*, *1,* 159–170.

National Research Council, National Academy of Sciences. (2008). *Ballistic imaging*. Washington, DC: National Academies Press.

Nickell, J., & Fischer, J.F. (1999). *Crime science: Methods of forensic detection.* Lexington, KY: The University Press of Kentucky.

O'Brien, R.M. (2007). A caution regarding rules of thumb for variance inflation factors. *Quality and Quantity*, *41*, 673–690.

Peterson, J. L., Mihajlovic, S., & Gilliland, M. (1984) *Forensic evidence and the police: The effects of scientific evidence on criminal investigations*. Washington, DC: US Government Printing Office.

Peterson, J. L., Ryan, J. P., Houlden, P. J., & Mihajlovic, S. (1987). The uses and effects of forensic science in the adjudication of felony cases. *Journal of Forensic Science*, *32*, 1730–1753.

Peterson, J., Sommers, I., Baskin, D., & Johnson, D. (2010). *The role and impact of forensic evidence in the criminal justice process*. Washington, DC: National Institute of Justice.

Regoeczi, W. C., Jarvis, J., & Riedel, M. (2008). Clearing murders: Is it about time? *Journal of Research in Crime and Delinquency*, *45*(2), 142–162.

Rizzo, T. (2013). Crime Sweep Goes After Members of Loosely Allied Groups. *The Kansas City Star. http://www.kansascity.com/2013/01/30/4039471/kc-police-unleash-a-different.html*

Roman, J. K., Reid, S., Reid, J., Chalfin., A., Adams, W., & Knight, C. (2008). *The DNA field experiment: Cost-effectiveness analysis of the use of DNA in the investigation of high-volume crimes*. Washington, DC: Urban Institute.

Schroeder, D. A., & White, M. D. (2009). Exploring the use of DNA evidence in homicide investigations: Implications for detective work and case clearance. *Police Quarterly*, *12*, 319–342.

Smith, W. C. (1976). Overview of crime laboratory management. In R. H. Fox & F. H. Wynbrandt (Eds.), *Crime laboratory management forum 1976* (5-21). Rockville, MD: The Forensic Sciences Foundation Press.

U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives. 2012. *ATF Fact Sheet.* Retrieved from http://www.atf.gov/publications/factsheets/factsheet-nibin.html.

U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives. 2011. *ATF Fact Sheet.* Retrieved from http://www.theiacp.org/Portals/0/pdfs/GVR_C-page-4_NIBIN-Press-Release-2011.pdf

U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives. 2010. *National Directory of NIBIN Users, Summer 2010*. Washington, DC: U.S. Department of Justice.

U.S. Department of Justice, Bureau of Alcohol, Tobacco, Firearms and Explosives. 2009. *Congressional Budget Submission. Fiscal Year 2010.* Washington, DC: U.S. Department of Justice.

U.S. Department of Justice, Bureau of Justice Statistics. (2009). *Census of publicly funded forensic crime laboratories, 2009*. (ICPSR study 34340). Washington, DC: .

U.S. Department of Justice, Office of the Inspector General, Audit Division. (2005). *The Bureau of Alcohol, Tobacco, Firearms and Explosives' National Integrated Ballistic Information Network Program*. Washington, DC: U.S. Department of Justice.

Wellford, C., & Cronin, J. (1999). *An analysis of variables affecting the clearance of homicides: A multistate study*. Washington, DC: Justice Research and Statistics Association.

Yang, Y., Koffman, A., Hocherman, G., & Wein, L. M. (2011). *Using spatial, temporal and evidence-status data to improve ballistic imaging performance.* Stanford, CA: Stanford University, Institute for Computational and Mathematical Engineering.

APPENDIX

Quality Control Issues with Currently Available NIBIN Data

Data files from ATF were received describing hit dyads from 19 NIBIN sites. These files serve as a first step toward unlocking the strategic intelligence contained in hit patterns for NIBIN sites. For example, the innovative social network analysis of violent offenders carried out by Project NoVA in Kansas City benefited greatly from the use of NIBIN data files. In this case, a data-driven local police operation was made possible in part through the use of NIBIN data.[40] Similarly, other sites can benefit from NIBIN data files with information on hit dyads of cases, dates of the offenses, and case numbers. However, as pointed out earlier, these potential uses of NIBIN are rendered impossible for two reasons. First, the data are not made easily available to local agencies. Second, there are serious issues with the quality of the data. Addressing these two issues will make it much easier for local agencies to derive both tactical and strategic value from NIBIN data.

Data Access Issues

The first impediment to using site specific NIBIN hit files is that access to these files is limited. NIBIN sites cannot access NIBIN data in an electronic format from their terminal. NIBIN terminals do not have a USB slot or other data port so the data cannot be saved or downloaded from a the terminal. NIBIN hit data, such as files detailing a site's hits over a period of time can only be obtained by requesting the files from ATF. During the period of this grant, the point of contact for these data files was a contractor who working for ATF's Office of Science and Technology (OST). Few people associated with NIBIN or ATF were aware of these

[40] The Kansas City NIBIN data files were provided to Project NoVA by a member of our research team with the permission of ATF.

files or knew how to access them. In fact, only one person in the field (a field agent with the Kansas City, MO ATF field office) was encountered who knew about them and had requested a file. In other instances, firearms examiners, lab directors, and police personnel were unaware these files exist. When asked to produce statistics from their NIBIN terminal during site visits, firearms personnel produced data on their terminal screen or as a printed report but the raw data were not easily accessible or available in an analyzable format.

Most NIBIN sites carefully track their hits by maintaining paper records. In most instances, sites print a copy of each hit report, attach a printed copy of the images, and file the resulting packet of information in paper format in file cabinets or three-ring binders. This manual cataloging effort is laudable but does not result in available, analyzable data that can be used for the tactical and strategic purposes outlined earlier in this report. Converting paper files to electronic data files is duplicative and time-consuming and beyond the easy reach of most firearms sections.

NIBIN data should be made more widely available in electronic format to law enforcement agencies. At its simplest, acting on this request means making NIBIN hit files available upon request to local agencies in usable formats for data analysis. The other end of the continuum is for ATF to establish user-friendly software providing local agencies easy access to their data files and allowing them to add other fields (like geocodes) and conduct simplistic analyses. Wherever ATF does choose to fall on this continuum of data availability, providing these useful data to NIBIN sites will pay handsome dividends for sites with the expertise and creativity to leverage the data. Acting on this recommendation takes a step toward unlocking the potential vault of strategic intelligence available in NIBIN hit data.

Data Quality Issues

ATF's Office of Science and Technology (OST) provided data on hit dyads at 19 NIBIN sites. These are the files ATF should share with local law enforcement agencies to promote strategic analysis of NIBIN hits. The data was received as separate Microsoft Excel files for each NIBIN site. Due to the format in which the data are stored, hundreds of hours were spent cleaning and reformatting the files before they were usable for data analysis. An interview with a key informant in Kansas City indicates they encountered similar issues. Later communication with FTI revealed that the files can be produced by OST in a format minimizing many of these issues, but those were not the files received. Given the tactical and strategic value of these data for local agencies, addressing these petty data formatting issues is an important first step in realizing their immense value.

Beyond these formatting issues are a host of additional data integrity issues. These issues do not render the data unusable but do increase the necessary level of effort and caution invested by anyone hoping to analyze the data. Below is a set of specific recommendations ATF should implement to render the data more usable for tactical and strategic purposes by state and local agencies and for performance measurement purposes by ATF.

First, each file should contain only hits confirmed or identified by a specific NIBIN site. Some hit files contain hits not produced or confirmed by the site associated with the file, making it easy to misestimate the number of hits a site generates. For instance, CBI Denver's file contains many hits actually confirmed by other NIBIN sites. Table A1 shows the number of hits in each file as well as the number of "legitimate" hits (hits actually confirmed by that site). Most sites' files are comprised primarily of legitimate hits but two sites (Houston PD and CBI Denver) have a sizable percentage of hits (26.8% and 10.4%, respectively) confirmed by other NIBIN

sites. FTI noted that the Data Concentrator includes all hits generated by any site managed under that Data Concentrator. A Data Concentrator may compile hits for multiple NIBIN sites. In some instances, the hits for certain sites also include hits generated by other sites in that region. In other words, a hit file for New Orleans may include hits generated by nearby NIBIN terminals operated by other law enforcement agencies. FTI noted that a new software version (TRAX 2.4) allows reports to be filtered more easily. This new version is currently being distributed (FTI, personal communication, April 2013) so this minor data issue should not plague future attempts to analyze site-specific NIBIN hit data.

Table A1
NIBIN Hits Actually Identified by 19 Sites

Site	Hits	Legitimate Hits	Valid %
Phoenix, AZ	358	357	99.7
Santa Ana, CA	496	496	100.0
Stockton, CA	446	446	100.0
Denver, CO	487	487	100.0
CBI - Denver	77	69	89.6
Marion Co./Indianapolis, IN	298	298	100.0
New Orleans, LA	884	884	100.0
Baltimore, MD	524	520	99.2
Prince George's Co., MD	48	48	100.0
Kansas City, MO	414	414	100.0
St. Louis Co., MO	440	440	100.0
Onondaga Co., NY	602	602	100.0
New York, NY	1,242	1,241	99.9
OSP – Portland	275	275	100.0
Austin, TX	98	98	100
Houston, TX	794	581	73.2
DFS – Richmond	363	363	100
WSP - Tacoma	206	206	100
Milwaukee, WI	179	179	100
Total	8,231	7,977	96.9

A second issue in these 19 data files is that the hit confirmation date sometimes precedes the hit creation date. We refer to this issue as "date inversion." Hits are first created when a firearms examiner notes that two images appear to constitute a hit. The examiner then carefully

examines the physical evidence. If the examiner determines that both pieces of evidence are consistent with a single firearm, they note this match or hit by marking the evidence as a confirmed hit in NIBIN. It is illogical for a hit to be confirmed before it is created.

Table A2 demonstrates that 28.1% of hits in the 19 hit files have a confirmation date preceding the creation date. This phenomenon is more common in some sites than others. Santa Ana has the lowest occurrence of date inversion at only 2.0%. On the other extreme, the majority of hits produced by Austin PD (83.7%) and Prince George's County, MD (83.3%) have their dates inverted. People knowledgeable about these issues, including experts in IBIS™ technology were consulted. One firearms examiner explained, "At no time should a creation date be after a confirmation date." A list of cases with date inversion issues was provided to one firearms examiner to learn more about why this may be happening. He reported that date inversion occurred at his site when more than two cases were associated as hits. When this happened, NIBIN inserted the first hit confirmation date for later cases associated with the first case. Therefore, some hits appeared as if they were confirmed before they were created. This explanation is plausible but incomplete as it does not explain why most dates in other sites are inverted.

Table A2
Percent of Legitimate Hits with Date Inversion (Confirmation Date Precedes Creation Date) for 19 NIBIN Sites

Site	% Confirmed Prior to Creation
Phoenix, AZ	33.1
Santa Ana, CA	2.0
Stockton, CA	4.1
Denver, CO	26.1
CBI – Denver	63.3
Marion Co./Indianapolis, IN	21.2
New Orleans, LA	25.8
Baltimore, MD	20.0
Prince George's Co., MD	83.3
Kansas City, MO	14.3
St. Louis Co., MO	17.5
Onondaga Co., NY	31.0
New York, NY	38.7
OSP – Portland	74.5
Austin, TX	83.7
Houston, TX	20.5
DFS – Richmond	55.2
WSP – Tacoma	18.7
Milwaukee, WI	13.4
Total	28.1

Recall that elapsed times are one of the key performance metrics in this study for NIBIN sites. To ensure the confirmation dates are still a meaningful indicator of elapsed times, elapsed time was calculated in days between the most recent crime or event and when the hit was created for the 19 NIBIN sites. The elapsed days between the crime and the hit creation date was compared to the elapsed days between the crime and the hit confirmation date for the 19 sites (see Table A3). The descriptive statistics in Table A3 differ slightly, but not substantively. The comparison of these measures indicates slight differences in the two measures of elapsed times (seven days difference between the means and six days difference in the medians).

Table A3
Elapsed Days between Crime and Hit Creation Date or Hit Confirmation Date for 19 NIBIN Sites

	N	Median	Mean	SD	Min	Max
ATF Hit Creation Date	7,934	107.0	344.78	649.59	0	5,987
ATF Hit Confirmation Date	7,141	101.0	337.04	655.40	0	5,987

As a final check on the quality of the dates in the data files provided by ATF, 625 paper NIBIN hit reports from the Houston Police Department (HPD) were manually entered and compared to the ATF data file for HPD. Note that HPD is the site with the most significant date inversion among the 19 examined sites. The 625 paper hit reports from HPD were produced between January 1, 2006 and February 28, 2012. ATF data for 581 NIBIN hits that were confirmed by HPD during the same time span is used.[41] The two sources of data differ slightly in that the ATF data use the date the hit was confirmed while the HPD hit reports provide the date the report was produced. Minor differences may be expected if hit reports ("hit report date" in Tables A4 and A5) lag slightly the hit confirmation dates. Procedurally, a firearms examiner would confirm the hit in NIBIN and then produce the paper hit report. Overall, however, the differences in dates should be minor.

As expected, both Tables A4 and A5 indicate that hit reports are issued after hits are confirmed in the NIBIN system, but the differences are slight. The elapsed times between the hit report and the crime date are on average (median) eight days longer than the elapsed time between the crime and the confirmation date for Houston. This difference is relatively minor when considered in the context of elapsed times presented in Table 18 for different NIBIN sites. Overall, this analysis provides greater confidence that the ATF data for confirmation or creation dates can be used to produce meaningful elapsed time statistics for NIBIN sites.

[41] It is unknown why the number of hits during this time span differs between Houston PD and the ATF data.

Table A4
Elapsed Days Between Most Recent Crime and Hit Confirmation or Hit Report. Houston PD

	N	Median	Mean	SD	Min	Max
Hit Report Date	617	120.0	163.46	186.562	0	1,555
ATF Hit Confirmation Date	575	112.0	147.26	164.662	0	1,539

Table A5
Elapsed Days Between Most Recent Crime and Hit Confirmation or Hit Report. Houston PD

	N	5%	10%	25%	75%	90%	95%
ATF Hit Confirmation Date	575	5	11	38	193	315	416
Hit Report Date	617	8	13	52	195	339	505

There are data access and quality issues with some of the NIBIN data. These issues should be addressed before data are used to create performance metrics for NIBIN sites and before the data are disseminated widely to law enforcement agencies. Two specific issues are identified, namely accurately attributing identified hits to the correct NIBIN site and date inversion. With prudence and insight, these two issues can be addressed by ATF.