Tacoma Police Department's Implementation and Evaluation of Gun Crime Technology: Smart Policing Initiative Action Plan

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I. Grantee snapshot

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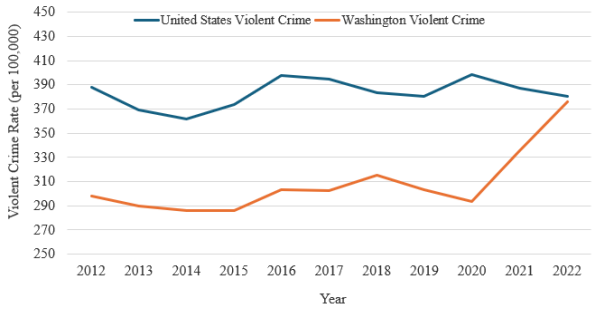
II. Targeted Problem

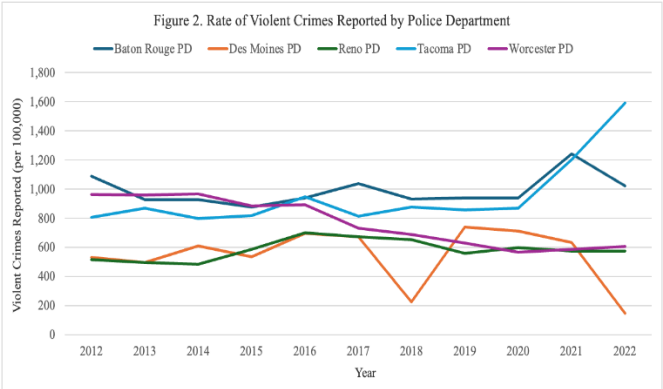
The average U.S. violent crime rate has remained fairly stable from 2012 to 2022, with some years experiencing increases and others experiencing decreases. However, according to National Incident-Based Reporting System data, violent crime rates in Washington state were much lower than the national average from 2012 through 2019, but then increased dramatically starting in 2020. By 2022, the violent crime rate in Washington nearly reaches the national average, as shown in Figure 1. This is a substantial upward trend.[1]

Figure 1. Rate of Violent Crime Offenses by Population



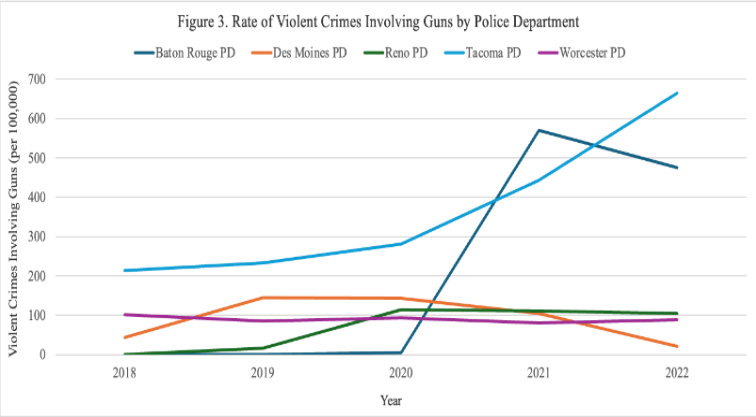
Tacoma, Washington is the 55th largest city in the U.S. inhabited by more than 216,000 people and policed by approximately 330 police officers. Violent crime in Tacoma is on the rise. When compared to other similarly sized cities from various regions, Tacoma has experienced a sharper increase in the rate of reported violent crime per 100,000 residents. Violent crime rates in cities such as Reno, Nevada; Worcester, Massachusetts; and Des Moines, Iowa remain relatively stable or experience slight declines in their rates of reported violent crime over the same period. Though violent crime rates in Baton Rouge, Louisiana also increased in 2020 at a similar level as Tacoma, trends in the cities diverged in 2021, with Baton Rouge experiencing a lower violent crime rate while Tacoma's continued to increase (See Figure 2).

Figure 2. Rate of Violent Crimes Reported by Police Department



[1] All figures use data obtained from the Federal Bureau of Investigations National Incident-Based Reporting System's Crime Data Explorer.

Violent offenses involving the use of guns remain a crucial concern. The rate of violent crimes involving guns in Tacoma increased sharply from 2018 to 2022. In contrast, the rates of violent offenses involving guns remained stable, or slightly declined, in other cities. However, Baton Rouge experienced an upward trend beginning in 2020, followed by a decline in 2021. Collectively, these results indicate that violent crime and violent crimes involving guns are increasing in Tacoma in ways that are not experienced in other similarly-sized communities across the U.S.



Against this backdrop, researchers have identified a "great decline" in homicide case clearance rates specifically, which has been attributed to challenges associated with clearing homicides involving guns specifically (Cook & Mancik, 2024). Clearance rates for gun assaults that do not result in death are even lower (Cook et al., 2019), a crucial concern given that nonfatal shootings far outnumber gun homicides (Hipple, 2022). Given these concerns, implementing effective strategies aimed at identifying, investigating, clearing, and ultimately reducing gun violence is imperative.

This Smart Policing Initiative (SPI) project seeks to improve the Tacoma Police Department's (TPD) capacity to investigate gun crime by implementing and evaluating three separate technologies. First, funding will be used to implement and evaluate the utility of ShotSpotter, an acoustic gunshot detection system, to identify gunshots and to provide precise gunshot locations. The goal of this technology is to provide immediate identification of gunshots and their exact locations, which is intended to reduce response times and allow for improved investigations, including collecting shell casings and witness statements. Second, the grant will fund the implementation and evaluation of RECOVER Latent Fingerprint Technology (Recover LFT), which has the capacity to analyze fingerprints collected from shell casings, to increase TPD's ability to identify suspects in shootings where casings are recovered. Third, the grant will fund the replacement of a FARO Focus 3D Laser Scanner (crime scene scanner) used to capture complete, accurate images of on-scene evidence and generate 360-degree views of crime scenes, with the intention of improving evidence collection and documentation.

In sum, the goal of this SPI project is to implement and evaluate the potential for technology to improve response times to incidents involving gunfire, to increase the evidence collected from shootings, to use that evidence to link separate shootings and identify potential suspects, and to improve TPDs investigations of violent crimes involving firearms. Enhancing the TPD's organizational capacity to respond to shots fired and to collect evidence could ultimately provide meaningful information to secure charges and convictions. Dr. Jessica Huff is the research partner on

this project, and she will work closely with TPD to conduct a process evaluation documenting the implementation of the new technology to ensure fidelity and guide sustainability efforts. She will also conduct an impact evaluation to determine whether the new technology achieves its intended goals. These results will help build an evidence base about the utility of these tools that can serve as guidance for other police agencies facing similar challenges.

In addition to this SPI project, the TPD has partnered with the University of Texas at San Antonio (UTSA) to develop the TPD Violent Crime Reduction Plan, 2022-2025. The plan utilizes near-term, mid-term, and long-term strategies to address the precipitous violent crime increase in the City of Tacoma that occurred in 2021-2022. The first phase of the violent crime reduction strategy is to reduce violence and the number of victims, specifically murder, non-negligent manslaughter, aggravated assault, and robbery. The plan begins with a near-term focus on substantially increasing police visibility at addresses where violent crime is concentrated and prioritizing street-level deterrence in these areas. The second phase incorporates a mid-term strategy of adding problem-oriented policing to the areas identified as hot spots to create a place-based, problem-oriented policing approach. In the final phase of the plan, the TPD will lead a focused deterrence strategy to help break the cycle of violence among the small number of repeat and high-risk offenders who are responsible for committing most of the violent crime in Tacoma. All of these strategies are evidence-based, and all have shown success in other cities. The plan is strongly supported by the Tacoma City Council, the City Manager and the TPD. Dr. Huff will coordinate with UTSA to determine whether the new gun crime identification and investigations technology implemented as part of the SPI project can serve as a force multiplier for the other violence reduction initiatives being implemented in Tacoma.

III. Approach

To address gun crime investigations in Tacoma, this SPI project will evaluate the implementation and impact of three technologies:

1. ShotSpotter acoustic gunshot detection
2. Recover LFT
3. A crime scene scanner

The implementation of these technologies is expected to increase TPD's capacity to respond to and investigate gun crime in three ways. First, ShotSpotter will facilitate the identification of exact gunshot locations, enabling rapid police response and increasing opportunities for offender apprehension and evidence collection. ShotSpotter will be deployed using a data driven approach to identify where the technology could have the most impact and where it can be feasibly installed. ShotSpotter will cover approximately two-square miles in south Tacoma that has been identified as a high gun crime area using Tacoma call-for-service data about homicides, shootings, assaults with a weapon, and drive by shootings from 1/1/2022-8/14/2023. A collaborative effort between TPD and Sound Thinking will be used to select the final ShotSpotter location based on TPD data. Second, Recover LFT will allow TPD to collect fingerprints from ballistic evidence collected at crime scenes that facilitate suspect identification. Third, the crime scene scanner will provide an accurate representation of crime scenes and all available evidence. This will allow TPD to document all potential investigative leads. Both Recover LFT and the crime scene scanner will be used in all eligible gun offenses, not just those occurring in the ShotSpotter target area. As such, this project seeks to use information gathered from technology to enhance TPDs ability to investigate gun crime, with the hopes of apprehending offenders and securing convictions. Through integrating all of these technologies into a strategic effort to address gun violence, the results of this study can be used to provide guidance to other agencies seeking to implement effective responses to gun crime in their communities.

a. Using technology to improve gun crime response and investigations

Gun crime poses a substantial concern for many U.S. communities. Federal Bureau of Investigation data shows that firearms have been involved in the majority of homicides and robberies in the U.S. for the past several years (Federal Bureau of Investigation, 2023). Given the severity of gun crime incidents, these offenses raise substantial concerns for community safety and necessitate effective responses from police. However, identifying and investigating gun crimes presents several challenges for police departments. Research suggests that not all violent crime resulting in injury is reported to the police (Hibdon et al., 2021). Gun crime is no exception, with research suggesting that only 63%-67% of all gun related victimizations were reported to police in large cities between 1996 and 2021 (Rezey et al., 2023). Further, some studies have identified citizen hesitation to provide witness statements or other information to help police investigate gun violence (Brunson & Wade, 2019). Gunshot victims themselves are sometimes unwilling to provide police officers information that could help investigate their case (White et al., 2021). As such, police are likely unaware of all shootings that occur within their jurisdictions due to reporting issues, and even when police are aware of a shooting, they might need to rely on evidence beyond victim and witness statements to identify suspects.

Recent technological advancements and forensic science improvements have been promoted to help police better identify and investigate gun crime. The current project is designed to assess the process and impact of implementing three new police technologies designed to aid the identification and investigation of gun crime: 1) ShotSpotter, an acoustic gunshot detection system, 2) Recover LFT, a technology meant to identify fingerprints from spent shell casings, and 3) a digital crime scene scanner. Prior research related to each of these technologies is discussed below.

ShotSpotter is an acoustic gunshot detection system that is designed to verify and rapidly notify police officers and dispatchers of the times and precise locations of firearm discharges. To do so, the technology uses acoustic sensors strategically placed in an array to detect sound waves produced by a bullet fired from a gun. The technology provides accurate gunshot locations by triangulating the activation time of each sensor. When the sensors are activated, the sound that is captured is sent to an acoustic expert at ShotSpotter headquarters to confirm that the noise was a gunshot (as opposed to car backfiring or other noises that could erroneously activate the sensor). If the expert confirms the activation as a gunshot, the event is sent to a police agency dispatch center with the precise location of the gunfire, the number of shots, and the type of weapon used (SoundThinking, 2024). As such, the goal of this technology is to provide rapid information to police agencies about where gunshots are occurring to increase awareness of shootings, reduce officer response time, and enable officers to identify suspects, witnesses, and collect other evidence (e.g., bullets, casings) from the scene.

In terms of gunshot identification, multiple studies suggest that gunshot detection technology increases the number of shooting incidents processed through dispatch, relative to citizen-reported gunshots (Katz et al., 2021; LaVigne et al., 2019; Ratcliffe et al., 2019). A study of ShotSpotter paired with closed-circuit television (CCTV) in Philadelphia suggested that this technology resulted in a 259% increase in gunshot incidents reported to the department (Ratcliffe et al., 2019). A multicity evaluation of ShotSpotter in Denver, Milwaukee, and Richmond further found that gunshot detection technology results in faster response times (LaVigne et al., 2019), as did a study in Massachusetts (Choi, 2019). In Dallas, gunshot detection technology was associated with a roughly one minute reduction in officer response time (Mazerolle et al., 1998).

The impact of gunshot detection technology on evidence collection has revealed mixed findings across cities. Studies conducted in Phoenix and Kansas City suggest that this technology can increase evidence collection (Katz et al., 2021; Piza et al., 2023). In Kansas City, for example, gunshot detection systems were associated with significant increases in ballistic evidence collection and gun recoveries in treatment areas (Piza et al., 2023). However, other studies have not identified the same benefits. In Philadelphia, there was no increase in the number of shootings that could be confirmed using witnesses, casings, or identifiable bullet holes in treatment areas (Ratcliffe et al., 2019). A study in Massachusetts identified similarly insignificant changes in evidence collection or arrests when officers responded to ShotSpotter activations (Choi, 2019). These findings, along with those in St. Louis and Dallas suggesting that gunshot detection systems substantially increase officer workloads (Mares & Blackburn, 2021; Mazerolle et al., 1998) indicate that agencies need to be strategic about the use of these systems to ensure they are achieving maximum benefits without diverting resources from other tasks.

Less research has examined the impact of gunshot detection systems on violent crime. A recent study in Kansas City did not identify significant reductions in gun violence in ShotSpotter locations compared to similar areas without the technology (Piza et al., 2023). Those authors conclude that police agencies that value evidence collection should consider implementing ShotSpotter, but those

seeking to reduce crime should prioritize other efforts. A Problem-Oriented Policing Guide focused on gunshot detection technology reviewed several studies and most did not identify crime reduction benefits (Mares, 2022). The combination of high costs associated with ShotSpotter and inconsistent evidence suggesting that the technology can reduce crime has resulted in some cities terminating their contracts with ShotSpotter, including Chicago (Piza, 2024). However, researchers involved in these evaluations have cautioned that ShotSpotter can culminate in other benefits – such as evidence collection – which could justify continued use and ongoing evaluations of the contribution of the technology to violence reduction.

In addition to ShotSpotter, the use of new forensic tools could aid investigations by providing additional evidence to identify suspects, such as fingerprints. One prior study found that agencies that maintain an Automated Fingerprint Identification System (AFIS) have significantly higher clearance rates for both persons and property crimes than agencies that do not (Lee, 2020), indicating that fingerprint evidence could improve investigative outcomes. However, some researchers argue that crimes involving guns are less likely to result in the recovery of fingerprint evidence because perpetrators tend to shoot and then flee the scene (Wang et al., 2017). The only pieces of evidence that a shooter might have touched which could result in the collection of a fingerprint involve the gun itself and the bullets that were loaded into that gun.

One of the traditional challenges associated with identifying fingerprints and other types of physical evidence related to gun crime is the extreme heat bullets and casings are exposed to when fired. Further, many of these offenses occur outdoors, which could result in ballistics evidence being exposed to rain, snow, and wind which could destroy or remove fingerprint evidence. However, advancements in forensic technology are being developed to overcome these challenges. Recover LFT is a new fingerprint technology that is intended to recover fingerprints from firearms, casings, and other evidence using a chemical vapor fuming process. A study of the chemical used in Recover LFT has found that fingerprints can be obtained from a wide variety of metals for up to three months after the fingerprints were left, as well as from metals exposed to high levels of heat, water, and even those exposed to detergent (Bleay et al., 2019). Although this technology has the potential to enhance the capacity to identify fingerprints from ballistics evidence for investigating gun crimes, there have been no evaluations of the utility of this technology in a police setting thus far. As such, it is unknown whether Recover LFT will result in fingerprints being collected from casings and increase the odds of suspect identification. The process and impact evaluations of this technology conducted through the current SPI project will address this gap in the research and can be used to build an evidence base about the utility of Recover LFT.

Other efforts to increase evidence preservation and documentation include the use of digital crime scene scanners. These tools are meant to preserve crime scene evidence, allow for reconstruction of scenes, provide measurements, and aid investigators through providing accurate images of crime scenes (Pope, 2017). These crime scene scanners create three-dimensional videos allowing investigators to reconstruct crime scenes to ensure that evidence can be documented, analyzed, and processed later as needed. 3D scanners are argued to be particularly important in situations where physical evidence at a crime scene could be lost or altered (Komar et al., 2012). As such, these scans could provide valuable evidence for gun crimes that occur on the street or in other public places where evidence could be compromised due to weather or human interference. Despite the promise of this technology, research has yet to examine how often these scanners are used in a policing context, or whether the use of these scans facilitates case clearances. The current SPI project seeks to better understand the deployment and utility of 3D digital crime scene scanners for improving gun crime investigations.

In sum, a wide range of technologies and forensic evidence procedures have been promoted to improve police ability to investigate gun violence. However, relatively limited research has examined the impact of these tools on evidence collection, suspect identification, and arrests. While gunshot detection systems have been associated with promising results in terms of response time and evidence collection in some cases, these findings are not consistent across all prior studies. Further, almost no research has examined the impact of fingerprint evidence collected from gun crimes or 3D scans of crime scenes on investigative outcomes. Given the expense of these technologies, the current SPI study seeks to examine how these systems can be implemented to maximize organizational efficiencies and to determine whether the costs associated with these tools are justifiable for police agencies seeking to improve gun crime responses in their communities.

Like many police agencies, the TPD is proactively implementing several strategies in efforts to improve organizational efficiency and facilitate crime reduction. The current SPI project involving process and impact evaluations of multiple gun crime investigation technologies is being conducted concurrently with the rollout of a separate Tacoma Violent Crime Reduction Plan. Though this SPI project is solely focused on the use of technology to improve gun crime investigations and the Violent Crime Reduction Plan is solely focused on the implementation of evidence-based violence reduction strategies, it is possible that the deployment of both research projects could lead to interrelated effects on investigations and crime outcomes in Tacoma. As such, this combination of separate studies could shed further light on the utility of gun crime investigation technology as one element of a larger organizational effort to reduce violence. Given that the Tacoma Violent Crime Reduction plan first focuses on specific crime hot spots and then specific individuals who are targeted using a focused deterrence approach, it is possible that there will be some overlap in the effects of this SPI project and the Violence Reduction Plan. For example, if ShotSpotter is implemented in the same locations that are targeted as hot spots for the Violent Crime Reduction Plan, it will be challenging to determine whether any changes the number of shootings experienced in those areas are due to ShotSpotter, the hot spots strategy, or both. In efforts to isolate the impact of SPI specifically, Dr. Huff will evaluate responses to ShotSpotter activations compared to officer proactive contacts and reactive responses to calls-for-service. This will allow her to establish whether evidence collection, suspect identifications, and arrests are more likely to occur in response to ShotSpotter activations compared to other types of police contacts. Each of these outcomes is an anticipated benefit of ShotSpotter for improving gun crime investigations. Further, because the Violent Crime Reduction Plan routinely moves hot spots in response to real-time data analysis, it is likely that some ShotSpotter areas that overlap with the hot spots at one point in time will no longer overlap during other time periods. As such, it will be possible to examine difference-in-differences models to capture whether any crime changes in a ShotSpotter study area were also associated with selection as a hot spot in a given time period.

b. Project milestones and deliverables

Accomplishing the goals of this SPI project entails meeting specific milestones (detailed information provided in Section IX). These milestones can be broken down into a few major phases:

1. The startup phase
2. Process evaluation
3. Impact evaluation
4. Routine reporting

In the startup phase, TPD and the research partner will work together to finalize all necessary contracts and IRB approvals needed to proceed with the project. TPD will work with Tacoma City Council to procure all new technology purchased as part of this project. Dr. Huff will work with TPD to identify feasible treatment and comparison areas to use for the evaluation of ShotSpotter. TPD and Dr. Huff will work with the SPI TTA team to develop a digital trust and community engagement plan.

Next, to complete the process evaluation, Dr. Huff will collect all official policies, organizational documents, and informational bulletins related to the implementation and use of the new technologies. She will use this information to develop a logic model detailing how these technologies fit into TPDs larger strategic efforts for responding to gun crime in Tacoma. The findings will additionally be included in routine reports and presentations for TPD command staff, Tacoma City Council, and to the BJA SPI team.

The impact evaluation phase will depend on the collection and analysis of several TPD administrative data sources. Dr. Huff will work with TPD crime analysis and Forensic Services Section personnel to gather all needed data. To reduce administrative burden on TPD, she will work with crime analysts to determine whether data being shared with the UTSA team can also be used for the current study. Dr. Huff will conduct ongoing evaluations of these data to provide timely information about the impact of these technologies on violent crime and investigative processes. The findings will be disseminated through routine reports, updates, and presentations to TPD, Tacoma City Council, and the BJA SPI team.

Finally, this three-year evaluation involves ongoing dissemination of findings to ensure the project is being implemented as planned and to address concerns as they arise. TPD and Dr. Huff will maintain regular communication about the status of the project. They will additionally work with the BJA SPI team as needed. Dr. Huff will provide bi-annual update reports to TPD and the BJA SPI team. She will present these reports to TPD leadership, Tacoma City Council members, and other stakeholders during bi-annual site visits as requested. She will also provide yearly interim reports detailing findings from the ongoing process and impact evaluations. All of the study results will be codified into a final report, including a brief executive summary. This final report will be written for a practitioner and policymaker audience to ensure the results can be disseminated to other police agencies seeking to improve their responses to gun crime.

IV. Community engagement

The TPD will develop a Digital Trust Plan and Community Engagement Plan prior to the implementation of the technology. The BJA has recognized the importance of developing Digital Trust Plans for police agencies as they implemented technological change. The BJA awarded $500,000 to the National Policing Institute to develop a Digital Trust & Innovation Center police agencies can refer to as they implement new technologies intended to reduce crime. The National Policing Institute project is ongoing, but the SPI research team will connect with the National Police Institute to obtain guidance for developing their Digital Trust and Community Engagement Plan related to the implementation of ShotSpotter, Recover LFT, and the new crime scene scanner as part of this SPI project.

The TPD Digital Trust Plan and Community Engagement Plans will include detailed information about how TPD will engage with the community to develop an understanding that the technologies will be utilized in ways that will be demonstrably effective and free from bias. The TPD plan will share information about the goals of the technology to ensure transparency and community trust. Additionally, the TPD will ensure the plan includes conversations with the community to address how the technology will be utilized in ways that safeguards data security and privacy. The plan is meant to ensure that the impact of the technology on the community remains a priority to the TPD, and to provide the community an opportunity to engage with TPD in the deployment and implementation process for these technologies.

TPD and the research partner will work with the TPD Community Policing Division, the city of Tacoma Neighborhood and Community Services Department, Sound Thinking, and other internal and external stakeholders to ensure the community has an opportunity to learn more about the SPI project, ask questions, and provide feedback. Sound Thinking has specifically agreed to help educate community members about the technology. News releases will be prepared to inform community members about the implementation of new technologies, as well as to provide updates about the impact of the technology on gun crime identification, investigations, and reductions in Tacoma. TPD will also leverage social media posts (e.g., Facebook, Instagram), an educational component during community meetings where Shot Spotter will be installed, and information distributed to residents, crime watch groups and organizations through their distribution list to inform the community about the SPI project. All information related to the project will also be posted on the TPD website and other sites.

Ensuring the community is involved in the planning phase is particularly important given some concerns that ShotSpotter is disproportionately deployed to minority neighborhoods (Mehrotra & Scott, 2024). As part of the Community Engagement Plan, efforts will be made to ensure community members understand that the purpose of this technology is for TPD to effectively identify and respond to gun crime. As a result, ShotSpotter sensors will be deployed to the highest crime areas in the city. Community members will be assured that the technology is not meant to be a form of surveillance, but to facilitate increased police protection in communities that are most impacted by gun violence.

V. Evaluation plan

As the research partner, Dr. Jessica Huff will maintain regular contact with TPD leadership, Tacoma city officials, other Tacoma community groups identified as important partners, and the SPI TTA team throughout the evaluation of this project. Dr. Huff will work closely with TPD leadership and city officials to ensure all relevant community stakeholders have an opportunity to participate in the project and have their concerns addressed. She will be responsible for collecting and analyzing all relevant data to facilitate both the process and impact evaluations of the new TPD gun crime detection and investigation technologies. She is responsible for providing written updates detailing evaluation progress and will additionally travel to Tacoma to provide biannual presentations to TPD command staff and city officials about the status of the evaluation.

The evaluation itself will consist of two separate components: 1) a process evaluation designed to document the process of implementing these technologies and their use within TPD, and 2) an impact evaluation determining whether these technologies are associated with improved shooting identification, investigations, and reduced violent crime. The evaluation plan for each component is discussed below.

a. Process evaluation

The first component of this project involves a process evaluation designed to document the implementation and use of new technologies into TPD. Process evaluations provide critical information about programmatic efforts to incorporate technology into existing organizational structures. This portion of the project will also involve identifying barriers to full implementation, strategies for overcoming those challenges, and providing recommendations for TPD to improve implementation fidelity and sustainability. To facilitate completion of this project, the research partner will conduct a content analysis of the following official documents collected from TPD:

- All policies related to the implementation and use of ShotSpotter, Recover LFT, and the crime scene scanner
- All informational bulletins about the implementation and use of these technologies disseminated to TPD personnel
- All training materials related to the use of these technologies for TPD Forensic Services Section personnel

This content analysis will be used to develop a logic model describing the intended inputs, activities, and outputs associated with each technology.

In addition to examining these official documents, Dr. Huff will work with TPD crime analysts to gather records documenting the number of ShotSpotter activations and the TPD Forensic Services Section to collect all use information for Recover LFT and the new crime scene scanner. This will allow her to determine how often each technology is used in practice, a key measure of implementation fidelity.

To assess the use of ShotSpotter, she will work with TPD to collect all ShotSpotter activation records captured in their computer-aided dispatch/records management system (CAD/RMS) data. To assess the use of Recover LFT, she will work with the TPD Forensic Services Section to determine how many fingerprints have been submitted for processing using Recover LFT and how many fingerprints have

been successfully identified. She will also collect information related to when evidence was submitted for processing and when results were disseminated to investigators (i.e., processing time), if available. She will similarly work with the TPD Forensic Services Section to determine how many times the crime scene scanner was used to document a crime scene over the course of the study period. Although the TPD has been using crime scene scanners for several years, research has yet to establish whether this technology improves evidence collection and increases intelligence to aid investigations. Prior to examining the impact of this technology, it is important to understand how it is used and whether it increases the efficiency of crime scene investigations. To do so, the policies guiding the deployment and use of the scanners, data capturing the time it takes to scan a crime scene, and information about how evidence captured through a crime scene scanner is incorporated into the broader investigative process within the TPD will be collected.

This process evaluation will specifically identify the resources allocated to using each new technology, whether there is room to enhance the efficiency of the technology, and whether the information gained provides meaningful benefits that outweigh the costs. Process evaluations like these are crucial for understanding how police investigations are conducted and for guiding the implementation of similar technologies in other police agencies. Through identifying how often each tool is used, the process evaluation will also enable future impact evaluations. Namely, by first understanding the fidelity of treatment implementation, it is possible to determine whether the use of these technologies can lead to intended outcomes.

b. Impact evaluation

The impact evaluation will be used to assess whether each of the three new gun crime investigation technologies implemented as part of this project can achieve the intended objectives. The process evaluation will be used to determine whether the technologies have been implemented with fidelity and to guide the selection of an appropriate impact evaluation strategy.

The research team will send a data request to TPD at the end of each month to collect all violent crime offenses. The team will request all arrests, calls for service, and evidence records every six months. The research team will use the following template to request data from TPD, with the specific dates filled in to correspond the time period for each data request.

For the period of **MONTH DAY YEAR** - **MONTH DAY YEAR**:

- All violent crime offenses
    - Violent crimes include murder, robbery of any type, and non-family aggravated assaults
    - Here is a list of the critical fields:
        - CaseNo, AgencyID, OccurredOn, Location, Disposition, IBR_OffenseCode, OffenseCode, Offense, Offense Status, XCoord, YCoord, Reporting Block, District, Sector, Dispatch Time, Arrival Time
- All arrests
    - With a unique ID to identify multiple offenders arrested during the same incident
    - Type of arrest (warrant based vs. on scene; custodial vs. summons)
    - Arrest offense(s)
- All calls for service
    - With call number
    - Type and/or priority of call

- All ballistic evidence and firearms collected and processed
    - Ballistic and firearm evidence includes casings, shells, bullet fragments, and recovered firearms
    - Each record should include a unique ID to identify the incident and/or arrest associated with the evidence
    - Outcome associated with the evidence, including entry into NIBIN, identification of a NIBIN lead, entry into eTrace, processing using Recover LFT, suspect identification, arrest, case clearance, and any other outcomes identified in collaboration between the TPD Forensic Services Section and the research partner

This template is consistent with data requests TPD routinely receives from UTSA in efforts to reduce administrative burdens on agency personnel.

Three separate impact evaluations will be conducted to assess each of the new technologies deployed by TPD, as described in the subsections below.

1. *ShotSpotter*

To assess the impact of ShotSpotter, TPD administrative data will be collected and analyzed to guide the deployment of ShotSpotter sensors and to facilitate a quasi-experimental evaluation of its' impact. Available TPD gun crime and violent crime data will be used to generate a list of areas experiencing high levels of gunshots in Tacoma. Using a combination of the TPD crime data and community structure data gathered from the U.S. Census, k-nearest neighbor matching will be used to identify pairs of similarly situated high gun crime areas. One area in each pair will then be randomly assigned to receive ShotSpotter and the other area will be randomly assigned to a control condition. This will allow an assessment of whether any changes in response time, substantiated gunshots, evidence collection, and arrests between the ShotSpotter locations and similarly situated control areas are attributable to ShotSpotter. This approach is consistent with prior evaluations of ShotSpotter (Ratcliffe et al., 2019). Further, to examine the downstream impact of ShotSpotter, the number of incidents identified by ShotSpotter that result in NIBIN entries and NIBIN leads will also be compared between ShotSpotter and matched control areas.

Given that ShotSpotter is often deployed to the highest crime areas in a jurisdiction, identifying suitable comparisons for these micro-locations often poses a challenge in these types of evaluations. A combination of analytical strategies will be used to assess the impact of ShotSpotter, depending on available data and the ShotSpotter implementation strategy used.

First, the research partner will conduct simple descriptive and bivariate analyses. In treatment areas, data from community reports of gunshots fired will be compared to data acquired by ShotSpotter to evaluate the frequency of unreported gunshots detected by ShotSpotter, the frequency of false positives detected by ShotSpotter, and whether gunshots identified by ShotSpotter are more likely to be substantiated by physical or witness evidence than gunshots reported by civilians. These comparisons are crucial for examining whether ShotSpotter is efficiently and effectively allocating police resources, as opposed to erroneously dispatching officers and limiting their ability to respond to other calls for service. Then, bivariate pre- and post-implementation comparisons will be examined. For example, t-tests will be used to compare the number of shootings, response time, number of arrests, and evidence collection from before ShotSpotter was implemented to after the technology was deployed in treatment areas. These basic analyses are ranked Level 2 of 5 on the Maryland Scientific Methods Scale because they can establish temporal order, but do not eliminate

concerns about other factors that could drive differences between time periods (Farrington et al., 2002).

Second, the research partner will conduct an interrupted time series analysis as a quasi-experimental evaluation of impact. Interrupted time series models are appropriate when there are clearly defined pre- and post-intervention periods and when data related to the outcomes of interested are collected at multiple time points before and after an intervention is deployed. The researcher will collect the exact date ShotSpotter is deployed to determine when the intervention was implemented. The routine collection of administrative data described above will further allow the research partner to assess changes in shootings, response time, arrests, and evidence collection from pre- to post-ShotSpotter implementation. Interrupted time series models are commonly used to evaluate the impact of changing police practices on outcomes, including an evaluation of changes made to the Stockton Police Department Firearms Unit (Maguire et al., 2016).

Third, the research partner will use difference-in-differences models to determine whether changes experienced in treatment areas from pre- to post-ShotSpotter implementation significantly differ from changes experienced in comparable control areas. A similar quasi-experimental evaluation using a difference-in-differences approach was used to evaluate ShotSpotter in St. Louis (Mares & Blackburn, 2021). Further, to address the challenges of identifying similar treatment and control areas when examining outcomes like gun crime, the research partner will use synthetic control matching to artificially create comparable control areas with similar rates of gun crime, violence, and community composition to the ShotSpotter treatment area. The use of synthetic control approaches can address extreme imbalance between treated and non-treated areas in policing research. A synthetic control approach was used in an evaluation of ShotSpotter in Kansas City (Piza et al., 2023). This portion of the evaluation falls at Level 4 on the Maryland Scientific Methods scale because it is possible to compare measures of impact from pre- to post-intervention between treatment and comparison areas, while controlling for other factors (e.g., demographic composition, calls-for-service) that could influence observed differences between groups (Farrington et al., 2002).

In sum, the impact evaluation of ShotSpotter will rely on a combination of simple descriptive and bivariate statistics, in addition to quasi-experimental approaches that attempt to capture differences in outcomes from pre- to post-ShotSpotter implementation, as well as differences in outcomes between ShotSpotter areas and similar untreated areas over the same time period. All of these methods have been used in prior research evaluating similar interventions. The research partner acknowledges that the final modeling strategy selected will depend to some degree on the implementation of ShotSpotter, which could inhibit the selection of comparable control areas. As such, the research partner will use multiple strategies in efforts to isolate the impact of ShotSpotter on gun crime, police responses to shootings, and outcomes of shooting incidents in ShotSpotter locations.

2. *Recover LFT*

Recover LFT will also be evaluated to determine the accuracy of the technology in identifying fingerprints and the effectiveness of the technology for identifying suspects. To examine whether the adoption of Recover has increased TPDs ability to collect fingerprint evidence in gun crime cases, historical data about the number of fingerprints processed during gun crimes in the past five years will serve as a comparison. The post-Recover fingerprint identification data collected during the process evaluation will first be used to examine whether investigators were more likely to identify fingerprints after Recover LFT is implemented.

Descriptive and bivariate statistics will be used to examine the impact of Recover LFT. The research partner will first describe the number of fingerprints collected from ballistic evidence pre- and post-Recover LFT implementation, if possible. In the event fingerprint data is not available prior to the deployment of Recover LFT, the research partner will visually display the number of ballistic pieces of evidence processed through Recover LFT and the number of fingerprints successfully identified using the technology. If historical data is available, the research partner will conduct simple bivariate statistics to determine whether the number of fingerprints recovered from ballistics evidence significantly increased after the adoption of Recover LFT. The research partner will also examine whether cases involving Recover LFT are more likely to be cleared than those that did not involve this technology.

Depending on data availability, an interrupted time-series analysis will also be used to determine whether the introduction of Recover LFT significantly increased the number of fingerprints generated from gun crimes and the number of fingerprints that resulted in suspect identification from pre- to post-Recover. This portion of the evaluation will determine whether Recover LFT adds value through increasing potential leads an investigator can pursue and potentially generating

evidence that could be used to identify suspects and ultimately secure charges and convictions, as compared to evidence gained prior to the use of this technology. As mentioned above, interrupted time series approaches are quasi-experimental and depend on sufficient data to be analyzed at multiple points of time. As such, the ability to conduct this analysis will depend on when Recover LFT is implemented and good record keeping within the TPD Forensic Services Section to facilitate the evaluation.

It is important to note that very few gun crime incidents resulted in evidence being processed to collect potential fingerprints prior to the adoption of the Recover LFT technology. For example, while casings from homicides might be tested for additional evidence, casings collected from shootings that did not involve victims were rarely processed. A descriptive examination of the number of fingerprints collected after the implementation of Recover LFT will provide a needed assessment of the potential for this technology to increase the amount of evidence that can be obtained in gun crimes. Importantly, a descriptive assessment of whether the types of gun cases that are generating fingerprint evidence after the deployment of Recover LFT will provide insight about whether this technology can lead to additional intelligence that would not have been received previously. For example, if Recover LFT is used to collect fingerprints from casings in victimless shootings that can be used to identify suspects and conduct arrests, that would be an important benefit of this technology the department did not have previously. As such, the number of fingerprints collected, suspects identified, and arrests made in cases involving Recover LFT will be important outcome measures.

3. *Crime scene scanner*

Finally, the impact of the new FARO Focus 3D laser scanner will also be assessed. Like the assessment of Recover LFT, the research team will work with the TPD Forensic Services Section to identify historical data related to the use of the crime scene scanners, and whether cases that involved crime scene scans were more likely to be cleared than cases without this documentation. By comparing case outcomes for incidents that culminated in a crime scene being scanned to similar incidents that did not, this study seeks to provide an exploratory assessment of the utility of crime scene scanners. Given the lack of research examining the impact of crime scene scanners, a simple comparative analysis will be beneficial to the field. As such, this portion of the study will be largely descriptive in nature, relying on summary statistics and data visualizations to display trends in crime scene scanner use, evidence documentation, and whether this evidence is forwarded to prosecutors over the course of the study period. Deputy Chief Junger has contacted the City Prosecutor to determine whether we can obtain data on crime scene scanner use in the court context to further evaluate the impact of this technology.

Collectively, this evaluation encompasses several different technologies with the shared goal of increasing the TPD's capacity to respond to and investigate gun violence in Tacoma. Through assessing whether ShotSpotter can improve immediate police responses to gunshots and evaluating whether technologies like Recover LFT and 3D scanners can generate better evidence to facilitate long term suspect identification and convictions, this evaluation provides meaningful research evidence about the impact of interventions strategically aimed to address shootings, which could serve as a force multiplier for other evidence-based crime reduction interventions being implemented by the TPD.

VI. Sustainability

The process evaluation funded through this award will be used to document policy changes, programmatic efforts, and identify barriers to successful implementation and use of these technologies. This portion of the evaluation is crucial for ensuring sustainability after the grant period ends, particularly given that successful implementation of these technologies depends on effectively using personnel and technological resources to support program goals. Given the complexity of these types of strategies, the research partner will work with TPD to identify ways to integrate the new program into existing structures using policy and practical changes to prevent program drift. ShotSpotter, Recover LFT, and the new FARO 3D scanner will continue to be used upon completion of the grant. The findings of this SPI project can be used to guide sustainability in the following ways:

1. Document key processes surrounding the use and integration of ShotSpotter, Recover LFT, and the crime scene scanner into broader TPD strategies.
2. Provide recommendations for tracking the use, inputs, and outputs associated with these technologies. This will be accomplished by creating metrics that can be used by TPD to continually monitor implementation fidelity after completion of the project.

TPD personnel will be central to ensuring the sustainability of the newly implemented technologies through maintaining and revising policies and practices as needed. TPD leadership have provided strong support for using evidence-based practices to address crime in Tacoma. Deputy Chief Paul Junger will be the primary leadership personnel overseeing implementation of the SPI project for TPD. Deputy Chief Junger has a Bachelor of Science in Criminal Justice and a Masters in Homeland Security and Defense from the Naval Postgraduate School. He is an experienced law enforcement officer and leader with over 32 years of experience. Deputy Chief Junger has overseen planning for large scale projects including Super Bowls, NBA All-Star Games, and presidential visits. He also has experience administering federal Department of Transportation National Highway Traffic Safety Administration comprehensive traffic grants in Dallas, Texas. Deputy Chief Junger also has experience implementing strategies and complex plans to reduce violent crime. He served as the Violent Crime Evaluator in May 2021 under Dallas Police Chief Eddie Garcia, a position created by Chief Garcia to assist with implementing the UTSA's violent crime reduction plan in Dallas, Texas.

The TPD Forensic Services Section will be responsible for managing and sustaining the technology implemented through this SPI project. The TPD Forensic Services Section is a civilian crime scene and latent print analysis unit. The Forensic Services Section is accredited by the ANSI National Accreditation Board (ANAB) under international standard ISO/IEC 17020:2012 (certificate number FI-0035). Their capabilities and competencies include analyzing and comparing latent impressions, responding to crime scenes, documenting crime scenes with photography and videography, collecting evidence, processing evidence for latent prints both at the crime scene and in a laboratory setting, mapping crime scenes with a 3D laser scanner to create diagrams, and providing expert testimony in court. The section has been headed by Forensics Manager Paul DePoister since March of 2020. He has a Bachelor of Science in Medical Technology from the University of Washington and 21 years of experience working in the Forensic Service Section. Mr. DePoister has two certifications with the International Association for Identification as a Certified Latent Print Examiner and as a Senior Crime Scene Analyst. Continued TPD partnership with technology providers will be used to ensure the technology is appropriately maintained.

As the research partner, Dr. Jessica Huff will maintain active relationships with the TPD and other researchers working with the TPD to address violence. The process evaluation used in this study will document the roles and responsibilities of each member of the TPD Forensic Services Section in the implementation, maintenance, use, and monitoring of these technologies to codify policies and practices into manuals. This will ensure the continual operation and use of these technologies, even in the event of personnel changes within the Section. The findings of this evaluation will be used guide strategic efforts to incorporate the use of these technologies into other organizational initiatives, such as the ongoing Tacoma Violent Crime Reduction Plan. This will be an important contribution of the current project given prior research suggesting that innovative strategies need to be integrated into the "institutional fabric" of an organization to be sustainable and to continue to achieve intended objectives (Hollywood et al., 2019). Further, prior research suggests that the following elements are crucial to successfully implementing strategic crime control initiatives: 1) community-wide problem analysis; 2) targeted, evidence-based responses; 3) collaborative partnerships; 4) strategic planning; and 5) accountability (Katz & Huff, 2020). The purpose of this project is to build the evidence-base surrounding the impact of technology on gun crime using a collaborative approach. Through strategic planning to develop policies and practices related to the use of this technology, the research partner will also work with TPD to identify policy mechanisms that can be used to establish accountability structures for using these technologies within TPD.

VII. Training and Technical Assistance

TPD and the Research Partner will work with CNA and BJA to identify opportunities for training and technical assistance to facilitate successful completion of the project. The team will specifically connect with subject matter experts familiar with the technology to be evaluated, including Dennis Mares. We will also network with other SPI sites who have implemented ShotSpotter and other similar technologies to discuss lessons they learned through their projects and identify opportunities to improve our own approach.

VIII. Logic Model

Figure 1. Logic Model for Police Department's Response to Gun Crime Investigation Technology Evaluation

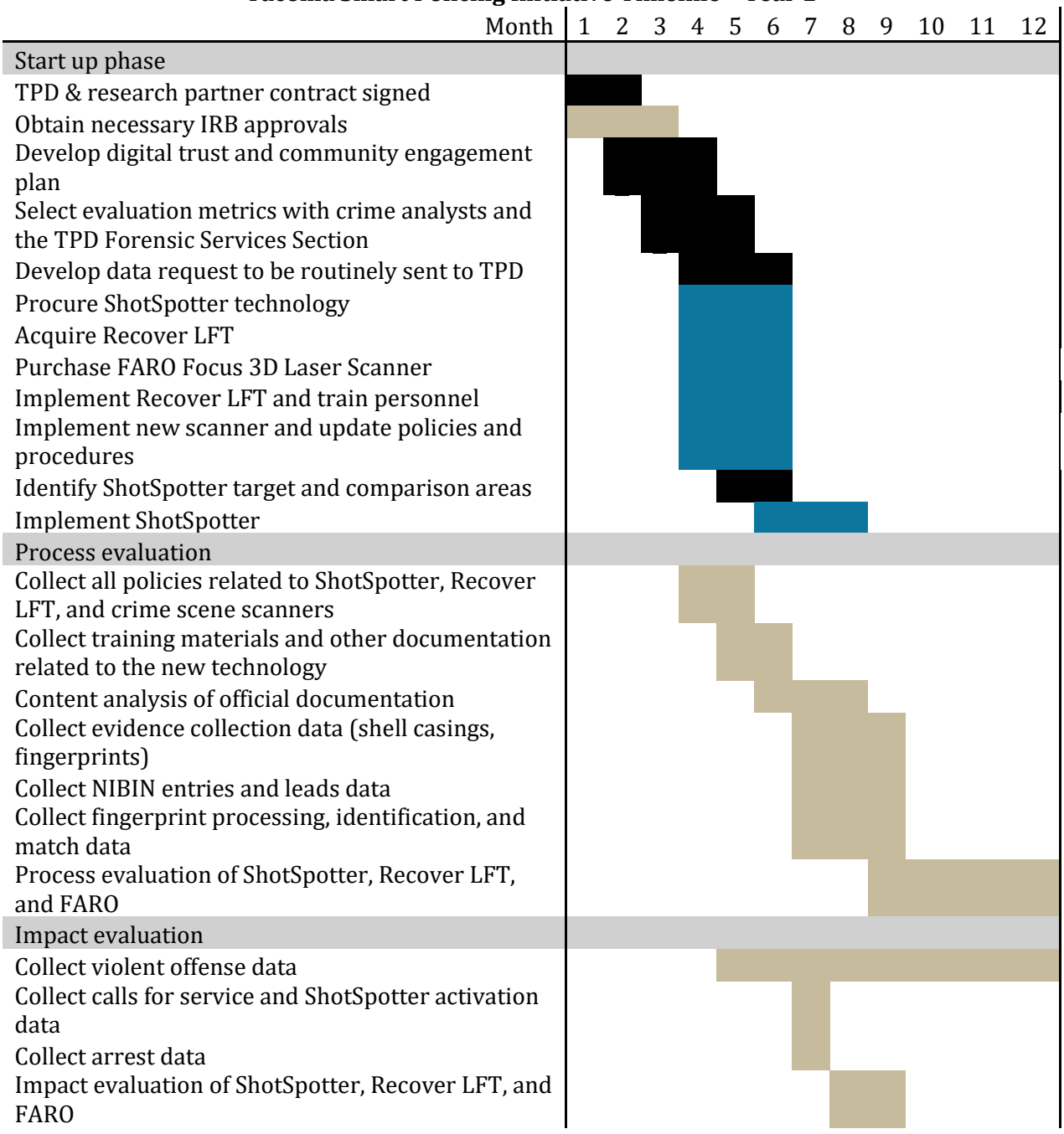
Inputs	Activities	Outputs	Short-term Outcomes	Long-term Outcomes
Bureau of Justice Assistance (BJA) funding to support: • ShotSpotter procurement • Recover LFT (latent fingerprint technology) procurement • Purchase of a new FARO Focus Premium Laser Scanner (digital crime scene scanner) • Research partner to evaluate implementation and impact of new technologies Staff including TPD crime analysts and forensic evidence technicians BJA funding to support training and technical assistance (TTA) from CNA	BJA: • Program and contract administration TPD & research partner: • Purchase, install, and monitor ShotSpotter • Purchase, install, and implement Recover LFT • Purchase and implement new digital crime scene scanner • Process evaluation of new and updated technology implementation • Evaluate overall impacts of new and updated technologies CNA: • Convene national and regional meetings • Monitor implementation and evaluation progress through routine reviews and meetings as needed • Provide TTA as requested	TPD & research partner: • Quarterly reports and presentations of technology implementation, use, and impact on gun crime investigations • Process and impact evaluations of ShotSpotter, Recover LFT, and new digital crime scene scanner on responses to and investigations of gun grime • Final evaluation report CNA: • Promote findings through webinars, newsletters, and the website • SPI reports, articles, and other deliverables	• Process evaluation to document technology implementation along with policies and processes used to support the use of new technologies • Evidence-based understanding of the effectiveness of technology for identifying, responding to, and processing evidence associated with gun crime • Dissemination of findings through quarterly reports and presentations for TPD and the city of Tacoma	• Sustained use of gunshot detection and evidence collection and processing technology in TPD • Reports and publications highlighting best practices for implementing and sustaining gun crime investigation efforts • Reports and publications highlighting the impact of gun crime investigation technology • Improved production and use of evidence-based practices to guide implementation efforts in other communities

Assumptions	External Factors
• ShotSpotter implementation will increase identification, efficiency, and responses to gunshots. • Implementation of Recover LFT and the digital crime scene scanner will increase evidence identification and efficient processing for gun crime.	• Resource challenges among TPD personnel, especially crime analysts and forensic evidence technicians responsible for numerous tasks • Coordination between TPD, the city, technology providers, and the university • Potential for community opposition

IX. Timeline of Activities

The below timelines are approximate and the SPI team recognizes that delays could occur due to contact negotiations, technological issues, resource constraints, and other unforeseen circumstances. The SPI team will maintain regular communication to ensure the project progresses in a timely fashion and to attempt to quickly overcome hurdles as they arise.

Tacoma Smart Policing Initiative Timeline – Year 1



Routine reporting	
Bi-annual update reports Bi-annual update presentations delivered during site visits	
Year 1 interim report	

Tacoma PD
Research partner
Tacoma PD & Research partner

Tacoma Smart Policing Initiative Timeline - Year 2

Month	1	2	3	4	5	6	7	8	9	10	11	12
Process evaluation												
Collect all policies related to ShotSpotter, Recover LFT, and crime scene scanners												
Collect training materials and other documentation related to the new technology												
Content analysis of official documentation												
Collect evidence collection data (shell casings, fingerprints)												
Collect NIBIN entries and leads data												
Collect fingerprint processing, identification, and match data												
Process evaluation of ShotSpotter, Recover LFT, and FARO												
Impact evaluation												
Collect violent offense data												
Collect calls for service and ShotSpotter activation data												
Collect arrest data												
Impact evaluation of ShotSpotter, Recover LFT, and FARO												
Routine reporting												
Bi-annual update reports												
Bi-annual update presentations delivered during site visits												
Year 2 interim report												

Tacoma PD
Research partner
Tacoma PD & Research partner

Tacoma Smart Policing Initiative Timeline - Year 3

Month	1	2	3	4	5	6	7	8	9	10	11	12

Process evaluation	
Collect all policies related to ShotSpotter, Recover LFT, and crime scene scanners	
Collect training materials and other documentation related to the new technology	
Content analysis of official documentation	
Collect evidence collection data (shell casings, fingerprints)	
Collect NIBIN entries and leads data	
Collect fingerprint processing, identification, and match data	
Process evaluation of ShotSpotter, Recover LFT, and FARO	
Impact evaluation	
Collect violent offense data	
Collect calls for service and ShotSpotter activation data	
Collect arrest data	
Impact evaluation of ShotSpotter, Recover LFT, and FARO	
Routine reporting	
Bi-annual update reports	
Bi-annual update presentations delivered during site visits	
Year 3 interim report	
Final report	

X. Supplemental material

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b. Evidence of research partnership, letters of commitment, and CV's for key personnel

The City of Tacoma and University of Nebraska Omaha are in the process of finalizing a contract for this study. The finalized contract will be attached once received. Letters of commitment from other agencies who were not part of the initial proposal will be attached, as needed. CV's for key personnel will be uploaded separately.