Real-Time Crime Centers in Chicago

Evaluation of the Chicago Police Department's Strategic Decision Support Centers

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Preface

The Bureau of Justice Assistance's Strategies for Policing Innovation program supports agencies developing and testing solutions to chronic crime problems. One of this program's grants to the Chicago Police Department (CPD) was directed, in part, toward assessing the CPD's new Strategic Decision Support Centers (SDSCs). The SDSCs are real-time crime centers (RTCCs), which are rooms that bring together staff and a variety of technologies to support policing activities. This support includes both near–real-time support to field operations and analytic support to commanders' strategic decisionmaking, with the latter being somewhat novel for RTCCs. The SDSCs are also novel in that they are implemented at the district level in Chicago; RTCC's typically support entire jurisdictions centrally.

In this report, we evaluate the processes, organizational structures, and technologies employed in the SDSCs. We then assess the extent to which the introduction of SDSCs was associated with reductions in crime levels in the districts. We conclude with recommendations to enhance SDSCs in Chicago further, with the recommendations being of interest for RTCCs in general. This study and its results should be of interest to law enforcement agencies interested in RTCCs and in novel, data-driven approaches to reducing crime.

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Summary

Strategic Decision Support Centers (SDSCs) are the Chicago Police Department's (CPD's) district-level real-time crime centers (RTCCs), launched in January 2017 and expanded in 2018. They serve as command and control centers for staff to gain awareness of what is happening in their districts and decide on responses. Their objectives are to improve districts' abilities to reduce crime, hold offenders accountable, improve officer safety, and reduce service times.

SDSCs are implemented as small conference rooms with spaces for meetings and have three staff members, including one dedicated supervisor (a sworn officer who is a lieutenant or sergeant) and one dedicated civilian crime analyst. Software tools include a public safety mapping tool that shows the locations of events of interest (calls for service, crime incidents, current locations of police vehicles); a display for video feeds from Chicago's surveillance cameras; shot detection; predictive policing software for identifying places at higher risk and, separately, for identifying persons at higher risk of a crime; and supporting equipment, including three wall monitors. The SDSCs also leverage the data stored in Chicago's data warehouse and existing geospatial information system tools. Figure S.1 shows a picture of an SDSC.

In addition to the room, the CPD provided smartphones to the districts' officers that are loaded with an app providing key information to them (warrants, be on the lookout for, stolen vehicles, etc.). The CPD also increased the number of surveillance cameras in each district (about ten additional cameras with each SDSC installation).

Room buildouts cost about $300,000; Chicago's public safety mapping and video display software cost $1.5 million to set up and costs $300,000 annually. The geospatial predictive policing software costs about $300,000 annually. Shot detection, which includes fielded sensors, costs $65,000 per square mile covered. From a labor perspective, the civilian crime analysts in each SDSC are new hires; other staffing reflects reassignments of existing personnel.

RTCCs typically serve as monitoring centers for surveillance cameras and sensors. However, Chicago SDSCs also have more functions and capabilities. We observed SDSCs doing the following:

1. **Supporting day-to-day decisionmaking**. This includes preparing for (and hosting) daily briefings and other briefings as described below. Analyses include tracking crime, event, and operation statistics; looking for patterns and hot spots; and other analyses in support of crime reduction and investigations. SDSCs capture decisions made during the briefings and create action items to implement them, both for those in and outside the room.

Figure S.1
Photo of a Strategic Decision Support Center

SOURCE: Photo provided by the CPD.

2. **Answering requests for information**. This includes preparing analyses for formal requests (submitted requests or walk-ins). SDSC staff assist those requesting information with access, interpretation, and follow-up.
3. **Monitoring camera, sensor, and radio feeds**. SDSC staff monitor these feeds, identifying developing incidents. They coordinate responses to real-time triggers, such as calls for service, ShotSpotter hits, or suspicious activity on camera.
4. **Supporting operations in the field**. Staff answer requests for real-time support, such as by using cameras and license plate readers to monitor a scene or responding to officers' information requests for data pulls.
5. **Supporting cross-district and cross-agency cooperation**. SDSC staff support neighboring districts, cross-CPD bureaus, and external agencies both strategically and in real time (e.g., assisting a joint task force).
6. **Supporting the district personnel's training and learning**. This includes the local context (district and neighborhoods), current events, technology, and analysis processes.

Unlike typical briefings, in which participants passively receive information, SDSC briefings follow canonical decision-cycle activities, such as John Boyd's classic Observe, Orient, Decide, Act (OODA) loop (Brehmer, 2005), and typically include the following:

1. **Review recent events (Observe)**. SDSC briefings cover the current status and net changes of several metrics and/or key performance indicators (e.g., shots fired, gang

activity, thefts, and burglaries). They also review major events, incidents, and planned activities since the last meeting, covering differences between what was planned and what was realized.

2. **Develop an understanding of events (Orient)**. This step makes sense of the provided information and includes creating and sharing organizational knowledge: what is or has happened, what it means, and what it might imply in the future. The briefings then include an initial discussion during which participants identify and agree on priorities for watches, areas, and specific missions.
3. **Make decisions (Decide)**. This step includes decisions addressing what is the problem, what are the possible solutions, what can or should be done, and by whom. It provides for the coordination of district resources for the immediate future and over longer-term planning horizons.
4. **Set action items (Act)**. Finally, action items are assigned to those in the room and those reporting to personnel in the room. This step includes specifying operational directives and supporting information for personnel attending the briefing to share within their area of authority (e.g., priorities, missions) and using the rooms' communication channels.

We observed SDSCs helping support decisionmaking within districts over four horizons, as shown in Figure S.2. Prior to SDSCs, staff described doing formal reviews and planning mostly in response to COMPSTAT sessions, which involved reviewing incidents that were months old (COMPSTAT is a performance management system for police departments).

Our evaluation found that SDSCs are a promising tool for supporting crime reduction. We estimated changes in the incidences of ten major crimes, across four time horizons, after districts added SDSCs. Figure S.3 shows the percentage changes in these crimes that districts could expect after adding an SDSC. We observed no expected increases in crime after adding SDSCs, for any crime type or any evaluation model.

The RAND team made the following recommendations to the CPD for sustaining and enhancing SDSCs, some of which the department has already begun to implement as of the time of publication.

Figure S.2
SDSC Support to Districts' Decisionmaking

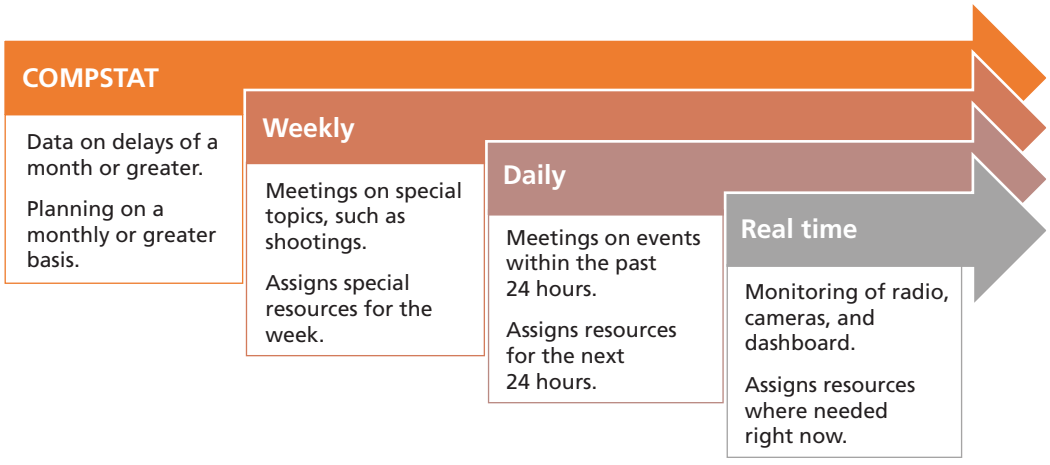
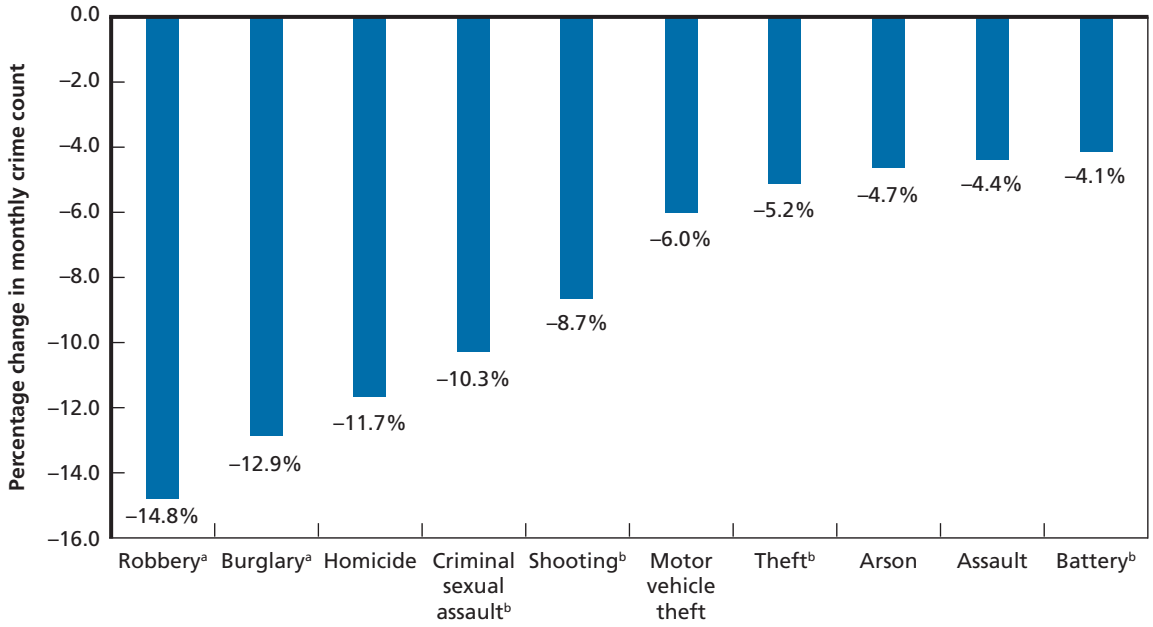


Figure S.3
Expected Changes to Districts' Monthly Crime Counts After Adding an SDSC



[a] For these crimes, the expected reduction in crime was statistically significant in all models.
[b] For these crimes, there was at least one model in which the expected reduction in crime was statistically significant.

Sustain the effort and improve processes and training over time. The CPD has made progress toward sustainment through policy, informal information exchanges, meetings, and newsletters. However, processes, policy, and procedures (including budgeting) are not yet established enough to guarantee ongoing and improving operations as leaders change over time. The CPD needs to further improve organizational learning at SDSCs, including by documenting lessons learned, processes, and best practices, as well as by developing training and onboarding, including for transitioning leaders. Similarly, the recruiting and retention of SDSC staff at all levels needs to be bolstered to increase expertise. SDSCs also need to adopt continuous improvement and change management measures to support the improvement of operations over time. Governing policies and special orders need to be updated to better reflect requirements, established practices, and what SDSC personnel do. Planning and budgeting for SDSCs need to become routine parts of the CPD's main planning and budgeting cycles.

Expand the scope of SDSC operations, which are currently focused on reactive response to crime in patrol operations. First, there is a need to expand SDSC support for crime investigations. We observed some cooperation with detectives, prosecutors, and partner units and agencies going on in SDSCs, but this cooperation needs to be formalized and expanded, CPD-wide. Note that the Bureau of Justice Assistance's guidebook to homicide investigation best practices (*Homicide Process Mapping*; Carter, 2013) discusses investigative teams drawing on multiple types of expertise, including crime and intelligence analysis.

Second, there is a need to expand the districts' responses to crime issues. We recommend wider adoption of and training on problem-oriented policing, including key references for solutions, such as the Center for Problem-Oriented Policing's online repository (Center for Problem-Oriented Policing, undated). We specifically recommend practices used by District 7

during our evaluation, which had reductions in shootings of more than 40 percent. These practices involved gaining trust with residents and having positive community interactions with them, but to get information to reduce or solve crimes, not just for checking boxes. All officers in District 7 were expected to engage in these practices, not just designated community policing officers.

Integrate technologies so that staff see displays of what is important to them. Currently, key information is split across multiple tools. We suggest integrating all sensor and crime forecasting data into the main public safety mapping display in SDSC rooms. These data include shot detection, crime hot spot forecasting, license plate reader detections, and relevant dispatch information. Otherwise, key information can be overlooked because it requires going into separate systems. For the SDSC's app for officers in the field, we recommend creating a "what's important now" screen displaying the most pressing information, rather than having different types of information on separate screens only.

Besides technology integration, there were a few additional technology issues:

- Camera operations can be improved to marquee operations in which staff frequently switch camera feeds, switching away if nothing of interest is on screen and searching for feeds with suspicious activity on them. Camera placements and capabilities should be improved over time.
- The SDSC's Crime and Violence Reduction Model, which flags people who are at a high risk of being involved with violence (either as an offender or victim), should be migrated toward tools and methods that (1) are based on recommending specific services and interventions and (2) are integrated with service providers, including treatment providers, outside of the CPD.

The CPD has informed us that they have developed, based in part on recommendations from this report, a new SDSC Oversight Panel, which includes participation from all bureaus and representatives from the University of Chicago Crime Lab. The panel coordinates the implementation and management of the SDSC initiative to ensure that goals and objectives are achieved. The CPD has also developed a series of Department Directives to define the SDSC initiative's key focus areas and to articulate roles and responsibilities. These directives include Day-to-Day Operations, overseen by the Chief of Patrol; Strategy Review, Compliance Monitoring, and Coordination, overseen by the Deputy Chief of Crime Control Strategies; Infrastructure and Technology, overseen by the Chief of Technical Services; and Training, overseen by the Chief of Organizational Development. The CPD's new processes and policies are intended to ensure that, per this report's recommendations, effective SDSC operations are normalized and are subject to regular review and improvement. The CPD is also continuing to develop the supporting technical systems; it is now testing a version of its decision support system (Genetec Citigraf) that runs on Android for smartphone use.

Acknowledgments

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We would especially like to thank all the staff at SDSCs, at CPD headquarters, and in the field who supported our visits, interviews, and requests for data calls. Specifically, we would like to thank the commanders and staff of the 7th and 25th Districts, who accommodated our extended interviews and observations of daily briefings and other meetings.

Abbreviations

BJA	Bureau of Justice Assistance
CCTV	closed-circuit television
CPD	Chicago Police Department
CVRM	Crime and Victimization Risk Model
FBI	Federal Bureau of Investigation
IIT	Illinois Institute of Technology
OODA	Observe, Orient, Decide, Act
POD	Police Observation Device
PTV	party to violence
RTCC	real-time crime center
SDSC	Strategic Decision Support Center
SOP	standard operating procedure
SSL	Strategic Subject List

CHAPTER ONE

Introduction

The Bureau of Justice Assistance's (BJA's) Strategies for Policing Innovation program "is designed to assist agencies with identifying innovative and evidence-based solutions to effectively and efficiently tackle chronic crime problems in their jurisdictions" (CNA, undated). One of this program's grants to the Chicago Police Department (CPD) was directed, in part, toward assessing the CPD's new Strategic Decision Support Centers (SDSCs). The SDSCs are real-time crime centers (RTCCs), which integrate staff and a variety of technologies to support policing activities. These activities include (as the name suggests) near–real-time response to crimes and other major incidents as well as conducting analyses to identify crime problems and coordinating responses to those problems. The SDSCs are novel in that they are implemented at the district level in Chicago, rather than having one center for the entire city.

The RAND Corporation serves as the technical assistance and evaluation partner for this assessment. In this report, we evaluate the processes, organizational structures, and technologies employed in the SDSCs. We then assess the extent to which the introduction of SDSCs was associated with reductions in crime levels in the districts. We conclude with a summary of the SDSCs' functioning and performance to date and present recommendations to enhance SDSCs further.

Background

Real-Time Crime Centers to Date

In addition to the CPD, several agencies have implemented RTCCs. These RTCCs, however, have typically been at the jurisdiction level; Chicago setting up centers at the district level appears to have little precedent. That said, given the size of Chicago's districts (with well over 100,000 residents per district, on average), the district SDSCs are in character with what a medium-size agency might establish.

RTCCs we examined elsewhere principally support monitoring cameras and other sensors to detect crime in progress (and safety issues, such as for event security), and provide an array of tracking and information look-up services to support first responders and subsequent investigations once a crime occurs. Table 1.1 lists examples of agencies with RTCCs and their reported emphases.

A literature search did not identify any formal evaluations of RTCCs. Existing scholarly references instead tended to focus more on reporting about RTCCs (D'Amico, 2006; Sweet and Cass, 2007) and/or their use of predictive policing software (Vlahos, 2012; Jouvenal, 2016). There have also been evaluations of specific technologies that were present in RTCCs,

Table 1.1
Examples of Real-Time Crime Centers

Agency	RTCC Emphasis
Albuquerque, N.M., Police Department	**Supporting high-risk call responses.** This RTCC's standard operating procedures (SOPs) focus on providing key information for officers on "high-risk calls for service" in addition to providing general situational awareness across the department (Albuquerque Police Department, 2016). The RTCC includes (1) a "bridge team" that provides database and other information to officers on high-threat calls, using a specific protocol to reduce information overload; (2) a video network team that monitors and cues a network of cameras in response to requests (and can push snapshots and video to the field); and (3) a crime analysis team. **Supporting identifying persons at high risk.** The department has also added the "Analysis Led Recidivism Team" project (Shepard, 2017), which uses crime analysts to identify persons who could pose a danger to the community, based on past histories and crime scene evidence, as well as persons who are arrested frequently and/or are failing to appear at court hearings. Persons on this list are flagged for observation, arrest (if possible), and to have evidence about them brought up at pretrial hearings. The effort brings together the Albuquerque police, sheriffs, district attorney, Federal Bureau of Investigation (FBI), and probation and parole agents.
Austin, Tex., Police Department	**Monitoring cameras.** This RTCC focuses on monitoring cameras, with camera focuses based on historic call loads. The RTCC also provides video of past events (if available) in support of investigations and provides site history information to officers on call (Gordon, 2017). The total network of cameras, including other government agency and private cameras, grew to 1,000 as of early 2016 (Prall, 2016).
Charlotte-Mecklenburg, N.C., Police Department	**Supporting major crime and incident responses.** This RTCC's SOPs, featured on the BJA's Crime Analysis Toolkit web resource (Charlotte-Mecklenburg Police Department, 2015), emphasize supporting the response to, and initial investigation of, crimes and other major events. Resources brought to bear in support of event response include a staff of on-call detectives and analysts, a network of closed-circuit television (CCTV) cameras, automated license plate readers, gunshot detection systems, and several investigative databases. The SOP also supports monitoring cameras outside of major responses in support of crime prevention and event security.
East Orange, N.J., Police Department	**Monitoring a camera and sensor surveillance grid.** East Orange was an early pioneer of what would become RTCCs. Its Community Safety Information Grid brought together cameras, license plate readers, automated police vehicle locator data, a gunshot detection system, call-for-service data, predictive analysis tools, a "dashboard" displaying key crime statistics, and operators in a central center as well as tools for officers to receive information and watch surveillance cameras from within their cars. This approach was cited as contributing to a reported more than 75 percent drop in crime in the city (John L Studios, 2010).
Fresno, Calif., Police Department	**Monitoring cameras.** This RTCC provides a location to monitor surveillance cameras (as of 2015, 180 police cameras and "thousands" of other government agency and private cameras; Fresno Bee, 2015). This RTCC was also featured for using the controversial Intrado Beware software, which used proprietary algorithms to give the properties listed for 911 calls, as well as the people potentially in them, green, yellow, or red (highest risk) threat ratings (Jouvenal, 2016).
Memphis, Tenn., Police Department	**Supporting crime analysis.** This RTCC is recognized for using its Blue Crush software to identify crime patterns and use them to allocate resources to hot spots (Figg, 2014). It also serves as a hub for cameras and incoming calls for service and reports, expediting the speed with which analysts can provide suspect and other information to officers in the field. In addition, the center has software for identifying potential linked crimes and suspects in an area immediately around a crime (Memphis Police Department, undated).
Modesto, Calif., Police Department	**Monitoring cameras.** This RTCC provides a hub to monitor and forward information from a network of surveillance cameras, with the video cameras seen as a "force multiplier" to detect criminal activity potentially in progress and search for suspects and other evidentiary video immediately following a crime (Alfaro, 2018).
Newark, N.J., Police Department	**Supporting the regional sharing of law enforcement information.** The Corr-Stat RTCC focuses on supporting law enforcement information exchange across 80 cities (and the New Jersey Regional Operations Intelligence Center) in northeastern New Jersey. It uses Information Sharing Environment–supported technologies, including the Project Interoperability tools and National Information Exchange Model standards, to permit searching and sharing information about crimes, including suspicious activities, crime patterns and trends, and potentially involved persons and assets, across jurisdictional lines. It received funding from the BJA's Strategies for Policing Innovation initiative (Hickey, 2015).

Table 1.1—Continued

Agency	RTCC Emphasis
New Orleans, La., Police Department	**Supporting emergency response.** This RTCC, operated by the New Orleans Office of Homeland Security, supports all first responder services in addition to policing. It emphasizes providing situational awareness during emergencies and major public events, as well as providing real-time and investigative information to officers responding to crimes. Technologies include more than 340 cameras and an ability to integrate with private cameras via the SafeCam NOLA initiative (City of New Orleans Office of Homeland Security and Emergency Preparedness, undated).
Ogden City, Utah, Police Department	**Monitoring cameras and sensors; supporting crime analyses and responses to crime.** This RTCC reports using crime analyses to identify future crime risks and patterns and to influence resource allocation and investigative decisions as a result. The RTCC has access to over 1,500 cameras to follow up on incidents, license plate reader data, law enforcement historical data, public social media data, tips, and map displays of events and data of interest. The RTCC provides this information (in response to immediate response and investigations) to the Ogden Police Department, neighboring agencies, and federal law enforcement (the FBI and the Bureau of Alcohol, Tobacco, Firearms and Explosives) (Utah League of Cities and Towns, 2012; Ogden City Utah, 2015).
Philadelphia, Pa., Police Department	**Monitoring cameras and sensors; supporting responses to crime; processing crime tips; supporting deconfliction.** This RTCC supports monitoring of close to 2000 camera feeds (mostly public transit cameras) as well as license plate readers. It also processes several thousand tips from the community (mostly narcotics tips) and supports searching of over a dozen crime databases simultaneously. In addition, the RTCC arranges for operational deconfliction of investigations (Reyes, 2013).
Sacramento, Calif., Police Department	**Monitoring cameras and sensors**. This RTCC serves as a hub to monitor a variety of surveillance tools, including license plate readers, alarms, radio traffic, and more than 100 cameras. Reported applications focus on monitoring cameras and sensors to detect suspicious activity in progress, monitoring large events for public safety, and providing immediate support following crimes. The estimated startup cost was $430,000 (Chabria and Bizjak, 2016).
St. Louis, Mo., Metropolitan Police Department	**Monitoring cameras and sensors; supporting responses to crime.** This RTCC emphasizes using surveillance cameras, license plate readers, call for service data, law enforcement databases, and crime analysis to monitor, deter (largely through visible cameras), and analyze crimes. It provides rapid reaction investigative support for crimes, supporting on-scene responders and detectives (St. Louis Metropolitan Police Department, undated).
Westchester County, N.Y., Police Department	**Monitoring cameras; supporting responses to crime.** This center serves as a hub for a network of cameras used to find crimes and follow up on reported crimes; an example application is increasing the number of vehicle theft arrests. It also includes a large data warehouse of police data, corrections and probation data, open-source records data, license plate readers, and tracking and facial recognition software. It is staffed by six county detectives and a civilian crime analyst, along with part-time liaisons from New York City and Mount Vernon, New York. It also supports an online chat room to share information across law enforcement agencies in the region (Eberhart, 2018).
Wilmington, Del., Police Department	**Coordinating units in real time.** This RTCC provides for the common viewing (on a map display) of events of interest, vehicle locations, recent crime patterns and trends, and assignments for patrols, missions, and immediate incident responses. The latter can be drawn on interactive whiteboards and shared with officers in the field. It also supports tools for providing information to officers in the field and gives officers a tool to file tips and reports and get additional information in response to the details in those tips and reports. The initial startup budget was $750,000 (WITN Channel 22, 2016; Horn, 2016).

including CCTV in Philadelphia (Ratcliffe and Groff, 2019) and gunshot detection in Philadelphia (Ratcliffe et al., 2019).

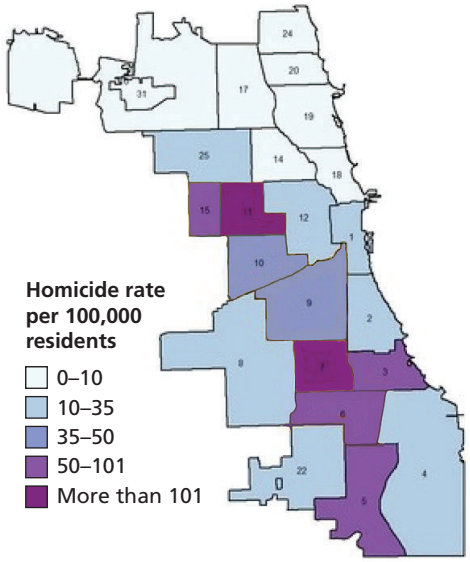
Setting the Stage for SDSCs: An Overview of Chicago and the 2016 Spike in Violence

Chicago is one of the United States' largest cities, with a population of 2.7 million people within its 234 square miles. The CPD is also one of the nation's largest, with over 13,000 sworn officers covering 22 districts. This means that each CPD district, on average, provides policing for about 125,000 people over 11 square miles. Populations and district sizes vary substantially across the city. Levels of violence in Chicago also vary substantially. Figure 1.1 shows homicide rates in 2016 per 100,000 residents, by district. As shown, rates varied by more than a factor of ten, from 0 to 10 per 100,000 to more than 100 per 100,000.

In 2016, Chicago faced a dramatic surge in violence, with homicides rising almost 60 percent over what they had been in 2015 and in comparison with recent years (roughly). Researchers at the University of Chicago's Crime Lab examined the crime surge, identifying factors that were *not* responsible for the spike in violence (Kapustin et al., 2017). These factors included weather changes, social service spending, school spending, high school graduation rates, and arrests (which did not decline during this period, with the partial exception of narcotics arrests, which continued an ongoing linear trend of more than 400 fewer arrests each year since 2010).

To look at factors that might have contributed to the spike, we examine a sequence of events in Chicago and elsewhere. The 2014 police-involved shooting of Michael Brown in Ferguson, Mo., and subsequent civil unrest began a new period in which law enforcement agencies have come under heavy scrutiny for the lethal use of force and broader problems with community trust and legitimacy. The 2015 death of Freddie Gray while in custody, followed by further civil unrest in Baltimore, Md., intensified these conflicts. By the fall of 2015, media outlets were reporting on Chicago Mayor Rahm Emanuel's claims that Chicago police were becoming "fetal" (i.e., de-policing) as "they have pulled back from the ability to interdict . . .

Figure 1.1
Homicide Rates in 2016, by District



SOURCE: University of Chicago Crime Lab data.

they don't want to be a news story themselves, they don't want their career ended, and it's having an impact" (Byrne, 2015) and that "stay fetal" was becoming a popular slogan among police (Wallace-Wells, 2017), with "Stay Fetal" T-shirts being available for sale (Bauer, 2016).

Chicago experienced its own police community relations crisis in November 2015 with the release of the Laquan McDonald shooting video. Heavy protests followed in Chicago through February 2016. During that time, investigative stops declined from more than 50,000 per month in November 2016 to less than 10,000 per month, a trend which continued for all of 2016. The Chicago Fraternal Order of Police claimed this drop was due to a combination of low morale in general and increased paperwork required after a stop (Konkol, 2016), with a new two-page report form that required documenting reasonable suspicion and/or probable cause for the stop as well for a protective pat-down and search, if performed (CPD, 2017). Even more substantively, clearance rates for nonlethal shootings dropped below 1.5 percent and homicide clearance rates dropped below 17 percent during the first three months of 2016. By the end of 2016, clearance rates had risen to 26 percent for homicides and 5 percent for nonlethal shootings, but these numbers were still well below 2014's numbers of 44 percent and 10 percent, respectively (Arthur and Asher, 2016).

Figure 1.2 shows this sequence of events, overlaid with the number of homicides per month in Chicago.

This timeline suggests three, likely interlinked, potential drivers for the spike in violence:

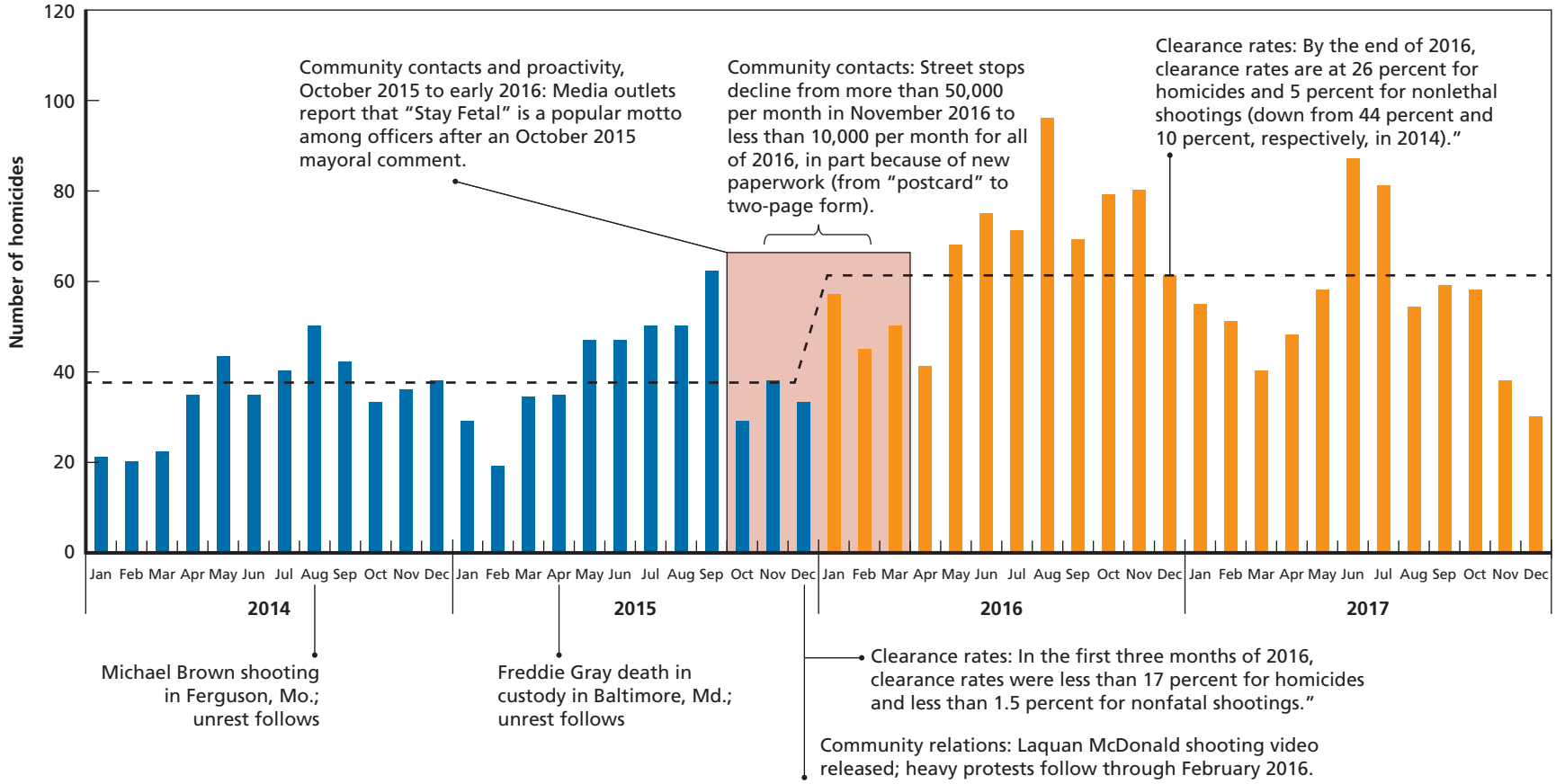
- The Laquan McDonald video release, which took place in an already charged environment, appears to have caused an acute police-community relations crisis. Such a crisis can cause a falloff in legitimacy, which is a key driver in why people follow the law (Tyler, 2006). It can also reduce the reporting of criminal threats and key information to the police (potentially symbolized by the declines in clearance rates) and can result in people "taking the law into their own hands" or committing acts of violence more readily instead of going to the police. As researchers looking at the nationwide increase in homicides in 2015 noted, "Lack of trust and confidence in the police militates against crime prevention as a co-production of police and community and may promote violence as a form of self-help" (Rosenfeld and Wallman, 2019).
- The large decline in solving shootings might have led to a falloff in deterrence of would-be shooters, because research shows that the likelihood of getting caught is a primary factor in choosing to commit crimes (Nagin, 2013). For the first quarter of 2016, nonlethal shootings were largely undeterred in Chicago, with a greater than 98 percent chance of the crime going unsolved.
- Finally, the timeline suggests a general decline in police-community contacts and proactivity because of declining morale and other factors, which would decrease the department's ability to carry out proactive actions to reduce crime.

Strategic Decision Support Centers

History

In the context of this violence and community-relations crisis, the project that led to the creation of SDSCs began. This project dates to a request from the then new superintendent of

Figure 1.2
Community Events and Monthly Homicide Counts in Chicago, 2014–2017



SOURCE: Data provided by the CPD.
NOTES: Blue bars are monthly homicide counts in Chicago from 2014 to 2015; the orange bars show monthly homicide counts from 2016 to 2017. The shaded box highlights the six months in which the key community relations events occurred. The dashed line compares the average monthly counts from 2014 to 2015 with the monthly counts from 2016 to 2017. Note that Chicago homicide counts typically show substantial seasonality, with monthly homicide lows in winter and highs in summer.

the CPD to the BJA National Public Safety Partnership to assist with developing a new crime reduction strategy to address the crime surge. The BJA helped establish a consulting team, including both CPD staff and external subject-matter experts, and supported that team with a small training and technical assistance grant. The team had the following insights:

- The CPD needed "(1) to better integrate technology into CPD's policies and practices by building out a crimefighting infrastructure, and (2) to specifically address gun-related crime" (Bureau of Justice Assistance National Training and Technical Assistance Center, 2018).
- Chicago had a great deal of technology already, including thousands of street surveillance cameras (or Police Observation Devices [PODs]), predictive policing tools, and a data warehouse (known as CLEAR [Citizen and Law Enforcement Analysis and Reporting]) tracking a very large amount of information about offenders, incidents, and other law enforcement–relevant information.
- Given the extreme size and variation of Chicago's districts and the CPD's subsidiary units, strategies and innovations needed to happen on a district-by-district basis.

From these insights, the team identified the need for and developed a business case to employ the CPD's technologies to better support crime reduction at the district level. More broadly, the team developed a theory of change for how a new strategy and supporting technologies would lead to a reduction in crime. Logistically, this theory of change centered on inserting technologies into district-level centers that were set up in repurposed offices. From a process perspective, there was a focus on SDSCs providing better information and awareness to district personnel, improving their decisionmaking as a result. From an organizational perspective, SDSCs added dedicated staff, including professional civilian crime analysts trained to support both district-level decisionmaking and real-time operations in the field. The SDSC stand-up effort also included encouraging district commanders to do community outreach (Main, 2018).

The CPD asked the University of Chicago Crime Lab for support in developing and implementing SDSCs and assessing the impact of the SDSC model, as well as in providing the initial civilian crime analysts to staff the SDSCs until the CPD could hire its own professional crime analysts. After the CPD hired its own professional crime analysts, the Crime Lab team transitioned to a support role focused primarily on providing training to the CPD analysts and measuring the impact of the SDSCs.

The CPD made decisions about where to deploy SDSCs primarily according to the level of violence within each district, with districts with greater levels of violence receiving SDSCs first. The initial schedule of SDSC deployments was as follows:

- January 7, 2017: District 7
- February 17, 2017: District 11
- March 15, 2017: Districts 6, 9, 10, and 15.

As shown in Figure 1.1, these districts had the highest rates of violence in Chicago, with 7 and 11 having the highest. The CPD expanded the program in 2018 to districts with medium-to-high levels of violence:

- January 1, 2018: Districts 3, 4, 5, and 25

- March 1, 2018: Districts 2, 8, and 12.

The CPD has decided to expand SDSCs to all districts in Chicago, although districts with low levels of violence are scheduled to receive "SDSC-Lites" that have lower levels of technology than full SDSCs, with the ShotSpotter gunshot detection system being the technology most frequently omitted.

What SDSCs Are, Logistically

> These centers include predictive crime software that helps district leadership make deployment decisions, additional cameras, gunshot detection systems, and mobile phones to officers in the field who receive real-time notifications and intelligence data at their fingertips. (Chicago Police Department Office of Reform Management, undated)

Logistically, SDSCs are small conference rooms that are outfitted with a variety of technologies, described below. Included in the rooms, typically, are three wall monitors, three workstations, and a conference table. They are typically staffed with two to four people per shift. Staff includes both sworn officers and civilian analysts, with analysts typically working during day shifts. Each SDSC is supervised by a sworn officer with the rank of sergeant or lieutenant. The room provides working space for briefings and collaboration efforts beyond the individual work of the SDSC staff. Figure 1.3 is a photo of an SDSC and shows a typical layout.

Figure 1.3
Photo of a Strategic Decision Support Center

SOURCE: Photo provided by the CPD.

SDSC Objectives and Duties as Described in CPD Policy

As described in CPD Special Order S03-02-01 (CPD, 2019), SDSCs have the objectives of helping district command staff and personnel

- reduce crime in districts (the primary objective)
- decrease incident response times
- increase clearance rates for crimes
- improve officer safety.

Duties of the SDSC include the following:

- Act as the district's center of intelligence (more precisely, the center of situational awareness), collecting, analyzing, and gathering information to support the district's personnel at all levels, including by
  - preparing and hosting a daily briefing for district personnel and personnel in other agencies; this briefing should include analyses of recent crimes and other events of interest, as well as results of prior missions
  - providing real-time information, analysis, and support to police operations, which includes supporting responses to violent crimes, crime prevention efforts, and actions to reduce response times.
- Support the development of crime reduction strategies and day-to-day missions (assigning resources to carry out specific policing tasks).
- Support collaboration within the district and with partners outside the district, such as other districts and interagency task teams.

Technologies in the SDSC

SDSC rooms are equipped with the following core technologies.

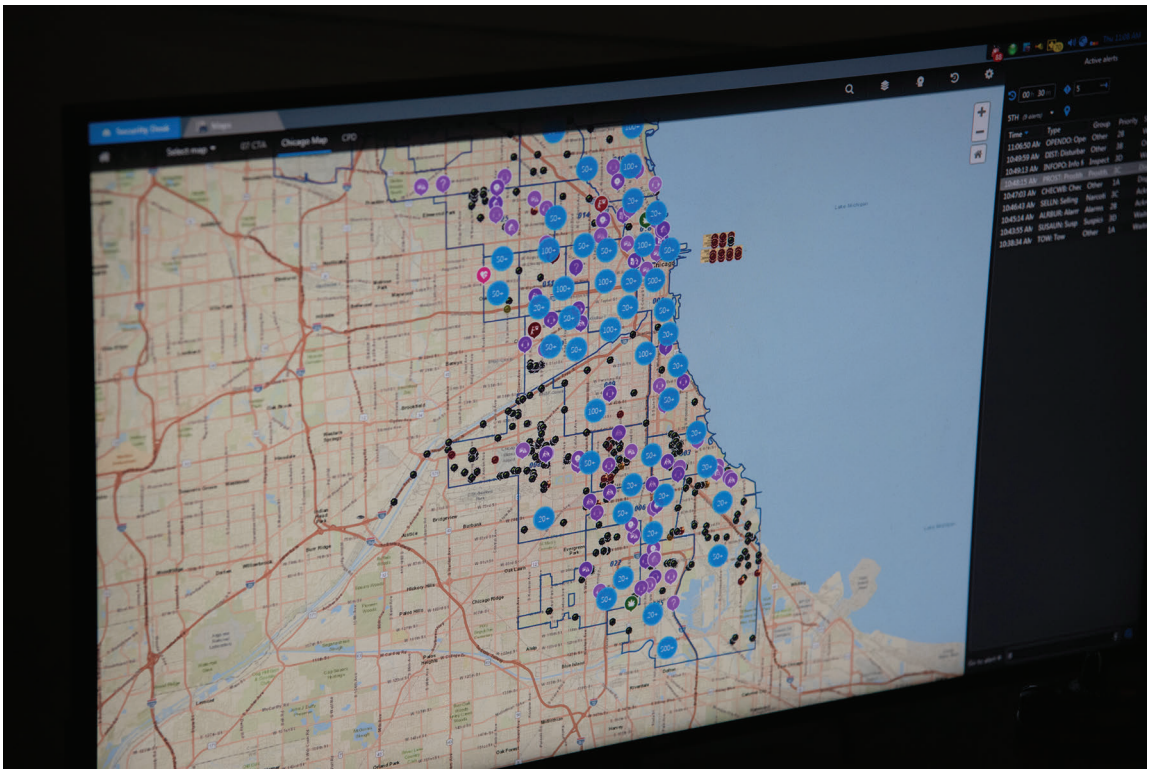
Public Safety Decision Support System

The CPD's public safety decision support system (Genetec Citigraf) has two major displays employed by the SDSCs: (1) a situational awareness map and supporting records display and (2) a camera feed display. (The camera feed display is discussed below.) The main display shows a map of events of interest, such as calls for service or automated license plate reader hits, and the location of police units. It also supports a drill-down capability to bring up details of interest about those events, such as details on persons or buildings involved, using data from the CPD's databases. Figure 1.4 shows a partial screenshot, displaying a map of incidents of interest within a specified area, as well as a tabular list of the same events.

Police Observation Device Cameras and Displays

The CPD started building a network of remote-controlled video surveillance cameras, known as PODs, in 2003 (CPD, undated a). As of early 2019, there were close to 35,000 cameras in the network, including the CPD's PODs; cameras owned by other agencies, such as schools; the Chicago Transit Authority; and, increasingly, privately owned security cameras, with more frequently being added (Williams, 2018; Pletz, 2019). The Genetec Citigraf software's camera display permits showing up to 16 camera feeds at one time, with four typically shown (Figure 1.5).

Figure 1.4
Incident Map Display in SDSCs



SOURCE: Photo provided by the CPD.

ShotSpotter

ShotSpotter employs a series of acoustic sensors to detect and triangulate the location of gunshots in near–real time, then forwards those alerts to police networks (ShotSpotter, undated a). In the SDSCs, gunshot alerts are displayed on a ShotSpotter mapping display tool that is separate from Citigraf's mapping display. Figure 1.6 shows a sample ShotSpotter display screen.

Geospatial Predictive Policing Software

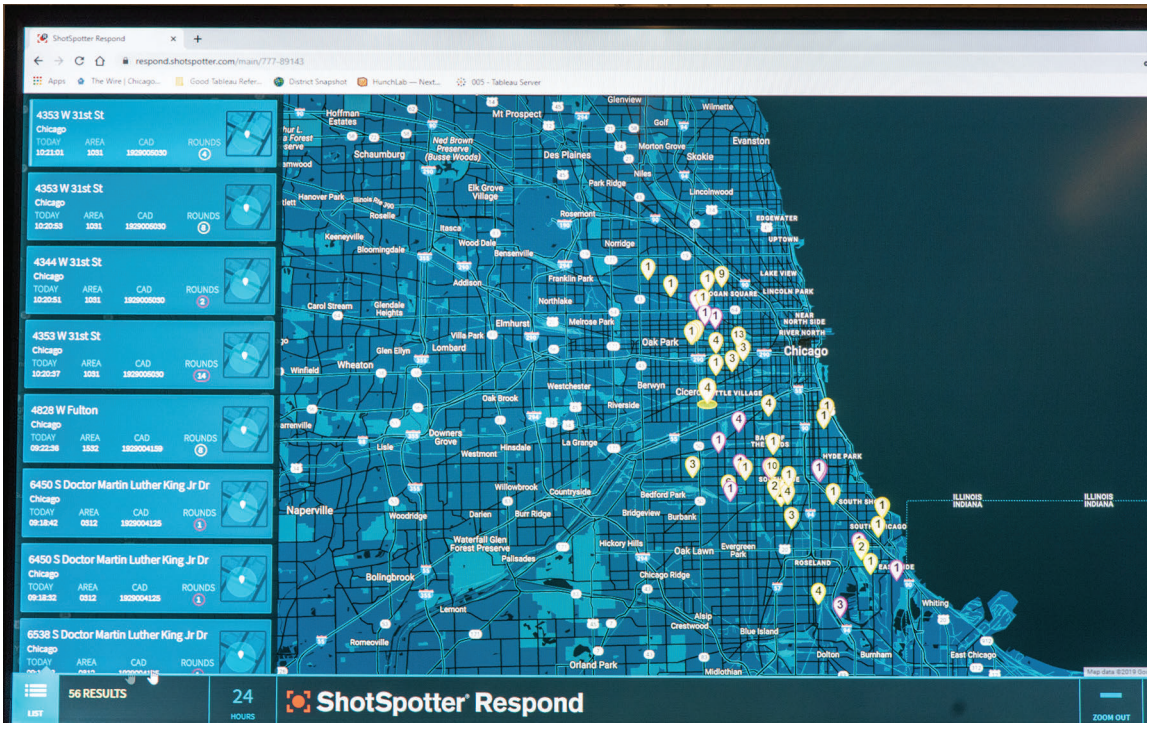
The SDSC's geospatial predictive policing software, which during our evaluation was called HunchLab (created by Azavea, recently sold to ShotSpotter, and now called ShotSpotter Missions), identifies locations (typically 250 square meters) that have an elevated risk for a specific type of crime in a given shift. The software also supports printing maps for patrol officers in the field. These customized maps show squares for patrol officers to focus on during their shift, as well as timing on how long an officer spends in a given box (ShotSpotter, undated b). Figure 1.7 shows a sample predictive policing display.

The predictive algorithm identifies locations to focus on using a combination of inputs, including historical crime data, broken out by time of day and day of week; weather; the presence of features typically associated with more or less crime (bars, bus stops, etc.); and whether a crime recently occurred there (implying that the perpetrators might strike the same area) (Azavea, 2015).

Figure 1.5
Police Observation Device Display

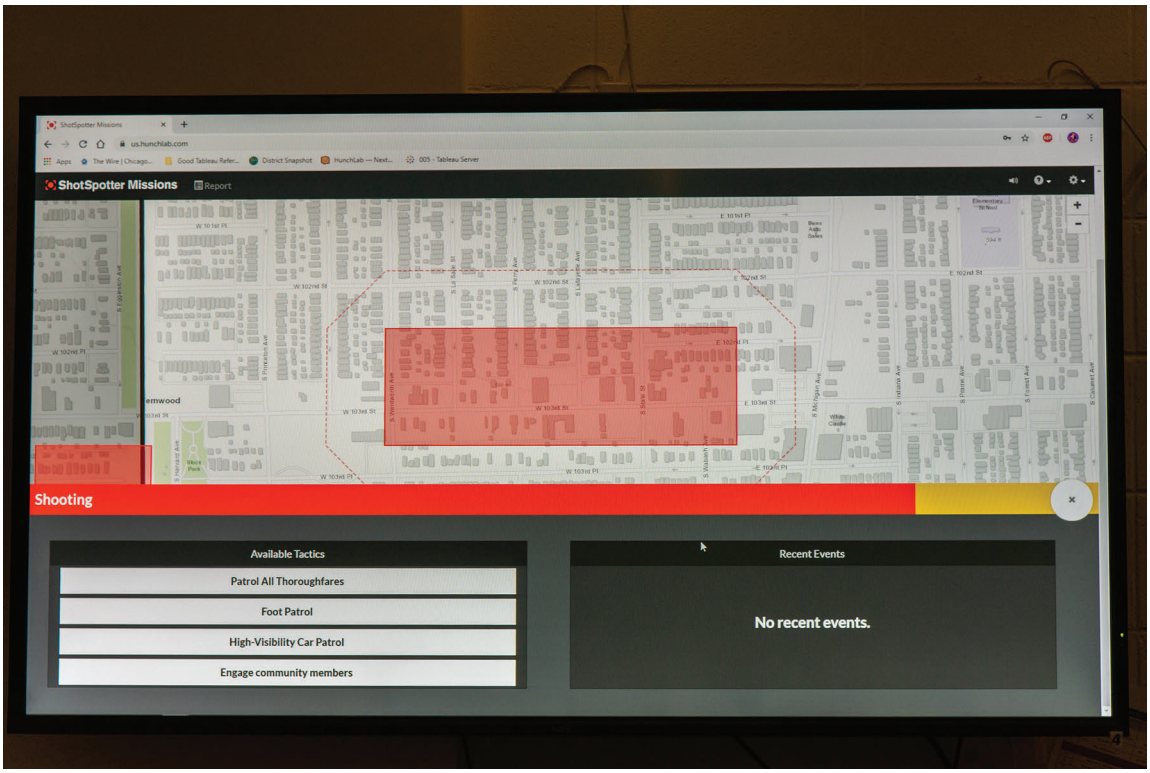
SOURCE: Photo provided by the CPD.

Figure 1.6
ShotSpotter Display



SOURCE: Photo provided by the CPD.

Figure 1.7
ShotSpotter Missions Display



SOURCE: Photo provided by the CPD.

Link Chart Analysis Tool

The CPD has developed a social network analysis tool that displays, for a given subject, the first- and second-degree co-arrest links around them. This tool also permits drill-downs on selected subjects, bringing up criminal history information about them.

Crime and Victimization Risk Model Tool

The Crime and Victimization Risk Model (CVRM) is a revision of the earlier Strategic Subject List (SSL) tool that assessed the risk that a person would be a party to gun violence (either as a victim or perpetrator). The earlier tool estimated risk using only the number of co-arrest links that subjects had to homicide victims, with results disseminated as a static spreadsheet. This tool leveraged earlier research that persons who are associated with homicide victims are at a high risk of becoming a victim themselves (Green, Horel, and Papachristos, 2017). The evaluation of this version of the SSL, along with interventions for those deemed to be at high risk, found that the interventions were not defined sufficiently to be able to make a significant impact on violence (Saunders, Hunt, and Hollywood, 2016).

The CVRM was designed to be a decision-support tool to inform district-level decisionmaking rather than producing a static list of people to prioritize for action. The CVRM produces a risk classification for all persons with an arrest record in Chicago in the past four years (over 300,000 people), with only a few thousand assigned to the "very high" and "high" risk categories. The algorithm's inputs include numbers of past shooting victimizations, age at latest arrest, aggravated burglary and assault victimizations, linear trend in arrests, unauthor-

ized use of a weapon arrests (primarily gun charges), and arrests for violent offenses (CPD, undated b). These inputs are weighted so that very recent incidents count up to twice as much as older incidents. Co-arrest links are used indirectly; the algorithm employs a second phase in which individuals with co-arrest links have their risk levels adjusted so that they are similar to each other, with more co-arrest links resulting in greater similarities (Illinois Institute of Technology [IIT], 2019). We observed that the CVRM was primarily employed as a static model, with updated risk scores made available to the CPD by IIT every few months (we discuss the implications of this use in the process evaluation chapter).

We were initially tasked with evaluating the CVRM separately. There is also substantial public interest in the CVRM, as shown by prior coverage about the SSL. A full-scale evaluation of the SSL did not occur because (1) the team was never provided with the necessary data by IIT, and (2) the CPD ended up not using the CVRM's risk predictions operationally. Given sponsor and public interest, however, we provide an extended evaluation of the CVRM's potential and operational suitability in the "Technology Evaluation" section in Chapter Two.

SDSC Mobile Application

SDSC personnel designed an SDSC app to be used by officers in the field on CPD-issued smartphones. Figure 1.8 shows the home screen of the app. As shown in Figure 1.9, the app provides officers with links to key types of information, with each type of information displayed on a separate page. Officers also have a screen ("Contact SDSC") to forward information to their district's SDSC. SDSC staff can also provide officers with district intelligence through the app.

Costs of SDSCs

SDSC room buildouts cost about $300,000. Chicago's public safety mapping and video display software costs $1.5 million to set up and $300,000 annually. The geospatial predictive policing software costs about $300,000 annually. Shot detection, which includes fielded sensors, costs $65,000 per square mile covered. From a labor perspective, the civilian crime analysts in each SDSC are new hires; other staffing reflects reassignments of existing personnel.

Evaluation Methods

We employed a mixed-methods approach to evaluating the processes and technologies employed by the SDSCs as well as the outcomes in terms of crime reductions associated with opening and operating SDSCs at the district level. These methods leverage the research described in the previous section.

Process Evaluation

Our evaluation of the SDSCs' processes and supporting technologies draws on a combination of structured interviews with SDSC personnel, site visits to the CPD and its district SDSCs, reviews of CPD policy, guidance, newsletters, instructional material, and other literature about the SDSCs. We also conducted limited ethnographic research at the SDSCs in two districts (7 and 25), listening to parts of their daily briefings over several months and having extended dialogues with staff members. We listened to District 7's daily briefings about once per week for two and a half months and District 25's briefings about twice per week for four months.

Figure 1.8
SDSC App Screenshot

SOURCE: Chicago Police Department, SDSC Mobile Application User Guide, p. 2, Not available to the general public.

When assessing the SDSCs' processes, we compared their processes to known best practices and assessment frameworks related to (1) examining whether and how information technology improvements lead (or fail to lead) to better situational awareness, decisionmaking, and improved operations and outcomes; (2) improving organizational processes for making decisions, as supported by technology; and (3) running decentralized command, control, and communications centers at various levels (e.g., operations centers, "nerve centers"), as well as improving operational decision cycles more broadly. For the first assessment, the evaluation team has experience with assessing how well information technology improvements led to improvements in performance in military operations, including policing-like operations that include local security (Gonzales, Johnson, et al., 2005; Gonzales, Hollywood, et al., 2007). For the second and third assessments, the evaluation team has substantial direct experience with understanding and assessing similar centers and decision-cycle improvement, including in the areas of emergency medicine and surgery (McKay, Engels, et al., 2013; McKay, 2011b), advanced manufacturing (Hameri, McKay, and Wiers, 2013; McKay, 2011a; McKay and Black, 2007), and organizations' abilities to innovate in general (McKay, Erenay, and Wang, 2015). We also drew on our research on improving policing strategies, which includes how to

implement new strategies, such as SDSCs, and how to improve decisionmaking and conduct change management more broadly (Hollywood, Lauland, et al., 2018).

Process assessments began with describing what SDSCs do, in practice. We then assessed whether SDSC processes were aligned with common best practices for

- providing functional capabilities related to information analysis, supporting command decisionmaking, and supporting field operations
- integrating those capabilities into the larger organization (in the case of SDSCs, at district-wide, CPD-wide, and external partnership levels)
- aligning with common success factors for operations (or "nerve") centers, in general
- providing for sustainability and supporting evolution and continued improvement over time.

We next assessed the performance of technologies. Our assessments were based on how well the technologies were able to support SDSC operations, in line with the past research on how information technology can lead to improved performance as described above.

We then assessed how well the SDSCs' technologies, and procedures for operating technologies, aligned with cybersecurity, privacy, and civil rights protections. The protections used are based on a framework developed in two prior RAND studies in which we worked with expert panels to determine needs for law enforcement to use emerging technologies. A significant part of the panel discussions concerned identifying needed protections to use the technologies safely, legally, and equitably (Hollywood, Vermeer, et al., 2018a and 2018b).

Finally, the last stage of the process and technology evaluation was to search for evidence of novel ways of operating in districts, both within district headquarters and out in the field. Core to past assessments on information technology and operations is the hypothesis that high performance on baseline process and technological functions will lead to novel operations, not the technology in isolation from its use. These operations include idealized ways to operate that were not possible previously and ways to operate that had not been imagined previously. It is these new ways of operating, if found, that would be the mechanisms leading to improved outcomes.

Outcomes Evaluation

For outcomes, we assessed changes in crime levels before and after deploying SDSCs. We did not assess outcomes related to other SDSC objectives (increasing clearance rates, improving officer safety, and reducing response times); these would be topics for future study.

We assessed whether opening SDSCs were associated with significant changes in crime levels using a conservative difference-in-difference modeling approach. Chapter Three contains the details of the outcomes evaluation methodology.

CHAPTER TWO

Process Evaluation

Overview of SDSCs in Practice

The SDSCs are a hybrid of two innovations: technology innovation and a process innovation that provides information and communication hubs that enable efficient and effective planning and decisionmaking. The technologies and processes are codependent because the technologies, especially the incident map and surveillance camera display, are also enablers that facilitate improved information flow at the district level. Although the goal to provide districts with better access to CPD technologies helped drive the development of SDSCs, the process and organizational changes, enabled by technology, might provide greater core value in the long run.

SDSC Activities

In Chapter One, we described the SDSCs' operational duties as specified in CPD policy. By making site visits, conducting interviews, and listening to SDSC daily briefings, we prepared the following checklist of what SDSCs did in practice:

1. Support day-to-day decisionmaking
    a. Prepare and host daily briefings and other briefings as required. This is perhaps the biggest single activity of SDSCs; what happens during this briefing is detailed in a separate list below.
    b. Analyze historical data and synthesize analyses that (1) inform decisions, (2) are disseminated outside the district, such as for the CPD-wide COMPSTAT and area-wide shooting reviews (COMPSTAT is a performance management system for police departments), and (3) trigger follow-on analyses.
    c. Capture decisions made in the briefings and create action items to implement them, both for those in the room and not in the room.

2. Answer requests for information
    a. Prepare analyses in response to formal requests (submitted requests or walk-in traffic). Also assist those requesting information with accessing the needed information, interpretation, and follow-up.
    b. Provide answers to questions to those visiting the room, using readily available sources within the room, other CPD sources, and non-CPD sources, such as profiles on shooting victims.

3. Support operations in the field
   a. Monitor cameras and other information feeds, identifying developing incidents.
   b. Answer requests for real-time support from patrol officers by using cameras and license plate readers to monitor a scene or respond to officers' information requests.
   c. Respond to real-time triggers, such as incoming calls for service, ShotSpotter hits, or suspicious activity on camera, coordinating a response.

4. Support cross-district and cross-agency cooperation
   a. Support neighboring and external agencies in either a historical or real-time fashion (e.g., assist a joint task force).

5. Support district personnel's training and learning about the local context (district), current events, technology, and analysis processes.

SDSC Briefings

SDSC briefings follow classic decision-cycle activities, such as John Boyd's Observe, Orient, Decide, Act (OODA) loop.

1. Review recent events (observe)
   a. Review changes in several metrics and/or key performance indicators (e.g., shots fired, gang activity, thefts, and burglaries).
   b. Review major events and incidents since the last meeting.
   c. Review planned activities since the last meeting and discuss what was planned versus what was realized.

2. Develop an understanding of events (orient)
   a. Create and share organizational knowledge, including what is or has happened, what it means, what it might imply for the future, and what should be done in response.
   b. Discuss, identify, and converge on priorities and focuses for each watch, individual missions, and district areas.

3. Make decisions (decide)
   a. Engage in problem-solving and decisionmaking, including by specifying what are the problems, what are the possible solutions, and what can or should be done and by whom.
   b. Provide coordination and orchestration of district resources for the immediate future and longer-term planning horizons.

4. Set action items (act)
   a. Assign action items to those in the SDSC room and those reporting to personnel in the room: what to follow up on, what to analyze.
   b. Identify operational directives and supporting information for personnel attending the briefing to share within their area of authority (e.g., priorities, missions).
   c. Identify operational directives and supporting information for SDSC personnel to share using the room's communication channels.

SDSC Operations Evaluation: Assessing SDSCs as Command, Control, and Communication Hubs

The equivalent of an SDSC can be found in many other settings. They have been called RTCCs, hot rooms, nerve centers, operational centers, command and control centers, communication hubs, and a variety of other terms. Figure 2.1 shows a simple view of a command, control, and communications hub; the language reflects SDSCs, but diagrams of hubs in other fields would structurally be very similar.

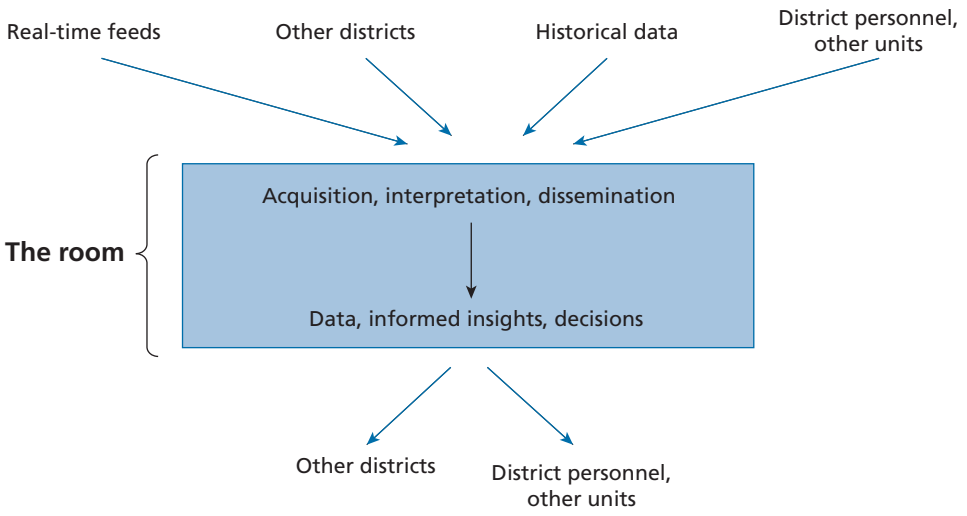
There are degrees of functionality in what these hubs do, ranging from basic information providers that deliver data, informed insights, and decisions in a rather discrete fashion as a standalone unit or entity acting as a service to a model in which the room is fully and seamlessly integrated into the fabric of the organization. Although the details are different in each case, they all share several characteristics that affect the effectiveness and efficiency of such a room.

As described in Chapter One, there has been a great deal of research on rooms that serve as hubs for command, control, and communications across a variety of fields. This includes research on analysis of information flows in and out of the rooms, analysis of the decision-making processes in the room, and development of information systems for operational rooms, with a special focus on how the personnel in the room make decisions and process the information—specifically, in rapidly changing situations that require human judgment. This background informs and guides the analysis in this report. In brief, for hubs such as SDSCs, one can assess

- the level of functional capabilities provided by the SDSC
- the level to which SDSCs are integrated into districtwide and CPD-wide operations
- the extent to which SDSCs' elements and operations reflect common success factors
- the sustainability of SDSC operations and the capability for SDSCs to evolve and improve over time.

Each of these is discussed in turn in the following sections.

Figure 2.1
Simple View of Command, Control, and Communications Hub



Assessing the Functional Capabilities of SDSCs

A center's level of capability can be assessed using a *maturity model* view, with a maturity model customized for SDSCs presented below. Here, a maturity model is a framework describing core capabilities, in order from basic to intermediate to advanced, that an organization should acquire to become proficient in an area of expertise; Rosenstock, Johnston, and Anderson, 2000, provides a survey of management-related maturity models. The six levels in Table 2.1 align with incremental increases in added value, accomplished by developing the skills and expertise of the room personnel. These are roughly commensurate to the six main levels of Bloom's canonical taxonomy of learning updated by Anderson and Krathwohl, 2001, and presented as an ascending hierarchy of learning and application: Remember, Understand, Apply, Analyze, Evaluate, and Create.[1] It is possible that a center will have different levels of value and contribution based on the day or set of events unfolding. The purpose of the maturity model concept is to have a baseline understanding of what the room usually is; ignoring off days or special, extraordinary levels of performance.

The first three layers focus on the center's ability to be an efficient and effective data and information transport service: providing the right information in the right way to the right

Table 2.1
Maturity Model for SDSCs

Level	Description
Level 1 (Commensurate to a basic implementation of Anderson and Krathwohl's [A&K's] Levels 1–3: Remember, Understand, and Apply).	The center performs the bare necessities, meaning the essentials of data acquisition and dissemination, including of current and past raw data or information derived from data using automated or imbedded tools and requiring no further analysis or interpretation by room personnel. The center has the ability to satisfy pull requests from key stakeholders and satisfy any requirements for pushing out data and information when and where stipulated. The room basically takes information flows and sources as a given.
Level 2 (Commensurate to an intermediate implementation of A&K's Levels 1–3)	The center participates in the decisions about data sources and data acquisition, helping guide the when, where, how, and what of data feeds into the organization's data warehouse, live systems, or equivalent.
Level 3 (Commensurate to an advanced implementation of A&K's Levels 1–3)	The center participates in the requirements and specification of any automated or imbedded tools that turn the data into information (basic analyses, aggregate reports). The room personnel request certain statistical processing of data, grouping of associated data, or specific formatting of the data.
Level 4 (Commensurate to A&K's Level 4: Analyze)	The center analyzes historical data, explaining why things happened, what was related to what, and what caused what.
Level 5 (Commensurate to A&K's Level 5: Evaluate)	The center evaluates historical data and looks to the future (including by using predictive analytics) to assess what might occur, when it might occur, and where it might occur.
Level 6 (Commensurate to A&K's Level 6: Create)	The center provides strategic and real-time analyses as incidents happen, potentially using the insights and knowledge associated with Levels 4 and 5, to create new options and decisions for policing strategies. At this level, the SDSC is providing value well beyond the simple dissemination of real-time information.

[1] Technically, our Level 1 constitutes a basic implementation of Anderson and Krathwohl's first three levels (Remember—which can be summarized and applied to SDSCs as collecting and processing incoming data; Understand—interpret the data; and Apply—generate useful results and/or products from the data). Our Levels 2 and 3 then correspond to incrementally more sophisticated implementations of Anderson and Krathwohl's first three levels, with SDSC staff having sufficient know-how to direct the data flow and tools they use to generate useful results. Our Levels 4 through 6 correspond more directly with Anderson and Krathwohl's fourth, fifth, and sixth levels (Analyze, Evaluate, and Create).

people at the right time. This service can be in support of routine decisionmaking by individuals, meetings of decisionmakers, or in real-time support of field activities. These are the core capabilities of any communication hub and are considered the minimum objectives and goals.

The center's personnel must be trained and supported in these tasks: The personnel need to know what data are available, where to find it, and how to put it together in an appropriate format to disseminate—quickly and accurately. With respect to decisionmaking or how the information is used, centers at Levels 1–3 are passive, and decisions are made by the data and information consumers. Levels 1–3 require personnel with good technical skills on the tools used to acquire and disseminate the information.

Levels 4 and above occur as the center technically and functionally matures and the personnel participate in the interpretation of data and information, potentially providing insights into the actual decisionmaking, analyzing the data at a deeper level based on the center's specific context, and actively participating in the decisionmaking based on the center's information-processing. The personnel requirements at these higher levels focus on problem-solving, contextual or situational awareness, and advanced analytical training.

Levels 4–6 require the center personnel to know what the data mean, what the data imply, the strengths and weaknesses of any implication, the assumptions and conditions underlying the data acquisition, and so forth. The more breadth and depth there is in the center, the better the center will be at the higher levels. These levels are typically where the human shines. Pure information technology can often handle the first three levels. The current state of data analytics can provide tools to help with the higher levels, but not in a fully automated way. Human judgment and critical thinking are needed, especially in rapidly changing situations in which disjointed information and situational knowledge are dynamically pulled together to arrive at a decision or insight.

The levels in the maturity model successively build on each other. There can be exceptions, but effective and efficient performance at higher levels typically require effective and efficient performance at the lower levels (e.g., good decisionmaking depends on good analysis, which depends on good data). The levels also consider the whole room and the general ability and capabilities of the room personnel, not the existence of a single individual who is the exception to the norm.

We reviewed SDSC task duties and responsibilities (as identified by Bureau of Patrol Special Order 18-08) and compared them with the six maturity levels. The review used the Level 1–6 framework for functional capability for context. At each SDSC,

> sworn Department members and Criminal Intelligence Analysts **gather and analyze** intelligence in order to **recommend** crime prevention and reduction **strategies** to the District Commander. Combining intelligence gathered by officers with data analytics, these centers provide **hyper-local**, **real-time situational awareness** for police officers to ensure **rapid response and effective policing, and enhance officer safety** (CPD, 2018, p. 1, emphasis added).

These sentences in Bureau of Patrol Special Order 18-08 suggest that the potential of such a room was well understood by the CPD and matches functional capability Level 6, as it should. The words we have highlighted align with capability maturity model Levels 4, 5, and 6.

Task-to–Capability Level Analysis

The evaluation team then reviewed specific task duties and responsibilities (shown in the following list), looking for alignment with the six levels.

- SDSC supervisor (Part A)
  - Gather and present data at daily meeting(s), disseminate briefing (**Level 1**)
  - Prepare forecasts, recommend missions, review missions (**Level 5**)
  - Review, share, and organize follow-ups (**Level 5**)
  - Serve as contact point (**Level 1**)
  - Disseminate information about community or special activities (**Level 1**)
  - Formulate requests for outside resources (does not map to a level directly, but is a logical support function)
  - Conduct presentations about the room (does not map directly, but is a logical task)
  - Disseminate information to watch operations lieutenant (**Level 1**)
  - Collaborate to develop and share best practices (does not map directly, but is a logical task)
  - Disseminate success stories (does not map directly, but is a logical task)
  - Organize crime intelligence meeting (**Level 1**)
  - Provide staff with access to applications (**Level 1**)
  - Provide direction and leadership to ensure staff are able to do their tasks.

- Police officer (Part B)
  - There are nine tasks or duties listed and all align with **Level 1**.

- Crime analyst (Part C)
  - Perform data analytics, formulate strategies, recommend missions (**Level 4** and **Level 5**)
  - Analyze trends, create actionable intelligence (**Level 4** and **Level 5**)
  - Track data, compare with goals (**Level 4** and **Level 5**)
  - Provide training to others (does not map directly, but is a logical task)
  - Review and share statistics and information to others needing them (does not map directly, but is a logical task).

Although the stated duty and responsibility descriptions are not wrong, we found that the lists do not capture many of the key duties, skills, and expertise needed to deliver on the objectives stated in the directive's overview. As a key example, few of the official tasks aligned with Levels 2, 3, and 6. We also saw a great deal of self-guided ownership within the rooms that extended tasks completed beyond those described in the special order. The directive might be viewed as a minimal expectation, and it is likely that rooms will evolve and take the actual duties and activities to a far higher level, depending on the personnel.

There might also be implicit and generally understood duties which have not been documented, but the absence of tasks directly related to the six levels opens up the possibility of an incomplete understanding of what the personnel do, what training is required, and how the rooms should be supported as they mature from Level 1 to Level 6. For example, the police officer duties and responsibilities stated in Part B of the directive are limited to the types of passive tasks associated with Level 1 and do not include any expectation or recognition of proactive, engaged participation in the decisionmaking, analysis, or in potential continuous

improvement activities for the room and the room processes. Many of the success stories from the SDSCs highlight proactive decisionmaking by the sworn officers. Because all rooms have probably evolved beyond this initial description, the detailed description might be considered for review and updating to better reflect what is going on in the rooms.

Human Factors to Functional Capability Analysis

Beyond just looking at the capability level of prescribed duties, it is necessary to assess whether room staff possess the collective cognitive skills, experiences, and capabilities needed to execute those duties effectively. A room at functional capability Level 1 is basically mechanical and administrative. The types of activities suggested by Levels 2–6 can be viewed from a *cognitive science* perspective: the cognitive skills required to problem solve, make recommendations, and provide insights. There are two perspectives: efficiency and effectiveness.

- Efficiency focuses on how the work is done and what the room personnel do. For rooms to evolve and get better, the rooms' personnel need to use some of their time and resources to identify shortfalls in the tools and processes used by the team.
- Effectiveness focuses on the quality of the information, insights, and recommendations and the effect the room's output has on the decisions and actions of the district personnel. That is, does the room have a positive effect on the district: who, what, where, when, why, and how? The effect of the room might be on the efficiency of the district (e.g., use of resources) or on the effectiveness of the district (e.g., reducing violent crime).

With respect to the general utility such a room provides an organization beyond Level 1, one value of the room is to foresee future difficulties and discount them. The types of difficulties can be types of waste (e.g., resources, effort, delays, common mistakes that force multiple attempts) that affect goals and objectives and the types of issues that will jeopardize the successful attainment of the goals and objectives (e.g., the wrong decision at the wrong time).

To deliver this value proactively, room staff need to know what information will be needed, when, and by whom. Room staff need to anticipate what will be needed and be prepared to deliver the information as efficiently as possible, in advance of the actual need or request. In a reactive real-time situation, room staff need to be able to access and deliver the necessary information with minimal delay. Room staff become proactive by anticipating some of the common requirements and having recipes and, perhaps, "macros" at their fingertips. This is problem-solving at Levels 2 and 3 in the maturity model, improving the room processes.

Such inward-looking problem-solving often takes advanced knowledge of the tools and an in-depth knowledge of the types of questions and requests that will arrive (different scenarios, combinations of requests, etc.). The problem-solving addresses topics such as what information exists, what can exist, how it can be combined, how the pieces relate to each other, and how the room's time can be better spent. Improving the tools and processes will reduce the time to service a stakeholder's request and free up resource time for other tasks and activities. To do this problem-solving, room staff need time to devote to the problem-solving and the freedom and ability to challenge the status quo—i.e., why something is done the way it is done. Although there should be continuous opportunities to discuss improvement and move the ideas forward, there should be regular reviews that challenge and probe existing processes and assumptions. A separate budget or capability should exist at the room level to support

continuous improvement and some centralized capability to support regular reviews of best practices by internal and external experts.

In our observations and discussions, we found evidence of such inward-looking problem-solving, with much of it being ad hoc and independently driven rather than through regularly scheduled reviews and continuous improvement discussions. We discuss this topic further in the section on assessing the sustainability of SDSCs.

Outward-looking problem-solving requires extensive knowledge of the community, crime patterns, the current situation with respect to law enforcement options, and strategies for how to dissect the situation, follow clues, assess options, and reach reasonable solutions. It is with this knowledge that the personnel in the room can make recommendations about missions and resource deployments during planning and provide high-value insights and recommendations during real-time incident support.

Again, we saw evidence of such outward-looking problem-solving and prerequisite expertise within the community, and again much of it was individually driven, with levels and types varying by district. However, we observed one substantial limitation: Solutions put forward to address crime problems tended to be somewhat generic and heavily focused on baseline patrol operations. The most common responses to identified crime problems were increases in patrol activity into problem areas, perhaps coupled with extra camera viewing time (e.g., virtual patrol). SDSCs could benefit by considering a larger range of problem-oriented policing solutions.

When personnel start working at an SDSC, there are several topics that need to be learned, as follows:

- specific technology (e.g., PODs, HunchLab/ShotSpotter Mission)
- infrastructure support technology (e.g., Caboodle)
- secondary tools (e.g., Word, Excel, PowerPoint)
- use of the tools in their situational context—when to use, how to use in real-time, review modes
- room protocols and processes—meetings, briefings, specific tasks.

This technical list addresses the basic skills needed at Level 1. At this level, the highest levels of performance will occur when the personnel have excellent memories (e.g., remembering where the cameras are, what directions they face), a personal interest in learning the new technologies, and intrinsic motivation to learn the tools quickly and at a high level of competence. The personnel should also take pride in their work and aim for high-quality work with few (if any) errors. Attention to detail is paramount in these types of tasks, as are a good work ethic, teamwork skills, and communication skills. Ideally, personnel selection should take these individual traits into account.

Personnel will likely have a mix of prior knowledge and experience at the time they join a room. Ideally, each individual should be assessed, and individual training programs should be developed, to ensure that each topic is learned at the appropriate, desired level. This process might include a one-to-two-day visit in a room before receiving the official training. By seeing the tools and processes in context, the individuals can ask relevant questions during training and, depending on the individual, be more efficient and effective during the training.

Moving beyond Level 1 requires additional skills and expertise. Levels 2–6 are nonpassive and require the majority of personnel in a room to be engaged in problem-solving (what they

do, how they do it, and how their "product" is used by others). The nature of the tasks implies that preferred individuals would have

- a propensity for puzzle-solving
- the ability to understand a problem and recognize when the numbers do not add up
- the ability to figure out why something is happening (and not just accept that it is happening)
- the ability to recognize and reduce waste and inefficiency
- the ability to think critically
- the willingness and ability to analyze assumptions
- an external "customer" view and the desire for their consumers to be better and to use the room's products in the best way possible
- the ability to think beyond the room itself.

As with inward and outward problem-solving, we saw evidence of all such needed attributes in SDSC staff. We did not assess the CPD's hiring processes for the SDSCs, nor did we assess the hiring and training processes for the civilian analysts. Civilian analysts appeared to have relevant experience, such as prior military intelligence analysis experience. We reviewed some training and onboarding materials; these materials as well as broader organizational learning strengths and weaknesses are discussed below in the sustainability assessment.

Assessing the Integration of SDSCs into District-Level and CPD-Wide Operations

In addition to the capabilities of the SDSCs, one can also assess the maturity of how integrated the SDSCs are into district-level operations and the operations of the CPD as a whole.

To provide clarity, we will refer to *stages* when speaking about organizational integration and restrict the term *level* to when we are discussing functional capability. The stages of integration are as follows:

- **Stage 1: No Integration**. This stage is where the communications hub is seen as a pure service unit without any informal linkages or contact points. The hub can be decentralized or in a different physical location. The protocols are usually clean and there is little contextual value added. The hub receives requests for information in a pull fashion or pushes the information out. From our visits and interviews, all SDSC rooms were past Stage 1.
- **Stage 2: Partial Integration**. This stage has the communications hub partially integrated into the organization. Partial integration includes several aspects. For example, this would include some, but not the majority, of the relevant and potential personnel flows. This would include some support for other units but perhaps more of a hands-off role, rather than in-person, everyday support. This would include some personnel reaching out and learning more about the hub, but most of the organization's personnel would not invest the time or energy to learn from or to assist the hub's personnel. Similarly, the hub's personnel might have some outreach within the organization, but it would be somewhat limited.
- **Stage 3: Full Integration**. This stage is a reasonably full integration of the hub within the fabric of the organization. Almost all of the relevant and potential personnel flows can be seen regularly and frequently. The hub's personnel would do joint activities with

other personnel when possible, engaging in sharing and supporting. The hub's personnel would be regularly invited, assumed to be involved with the aspects of the organization that feed the room, and would consume the organization's outputs.

In the context of the SDSCs, a fully integrated situation would be different in each case, but it is possible that the SDSC personnel would help the watch operations lieutenant prepare material and perhaps even help present the material at each roll call. Patrol officers might even stop by on a regular basis, not just to say hello and ask what is happening but also to give feedback and make suggestions. The fullest potential of a communications hub is realized when it is fully integrated into the organization. This integration is one of the benefits of a decentralized strategy, such as the CPD's. It is easier to have the communications hub reach its potential when personnel see personnel and have the opportunity for frequent and meaningful contact.

Because of our evaluation's funding and scope, it has not been possible to prepare a detailed assessment on each room or a robust aggregate assessment for the group as a whole. However, it is possible to provide the team's impression of what we have seen and experienced during the analysis with respect to the stages. We have seen evidence of some rooms operating at Stage 3 in our extended observations (e.g., Districts 7 and 25), and there might be others working at a highly integrated level within the district, as well. We have also seen evidence of rooms operating at Stage 2 and others at a point that we would describe as between Stages 1 and 2. We suspect that an overall assessment for the CPD SDSCs would be at this latter level (somewhere between Stages 1 and 2). We suggest that, if the CPD does a stage assessment, rooms should not be ranked or directly compared: The progression should be relative to the room itself, since it was established.

Assessing SDSCs Against Common Success Factors

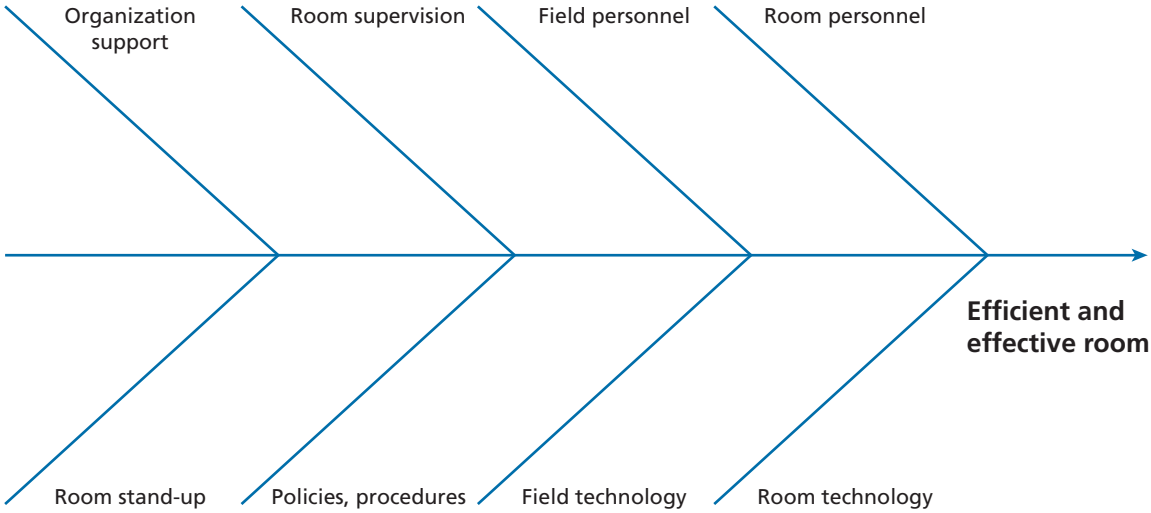
The outputs from any hub must be trusted and valued and must have credibility. Although there are many factors that can affect the trust, value, and credibility—the ultimate factors that affect the performance of a room—there are some common elements. Our past research implies that there are eight common success factors for hub operations. These are shown in the cause-and-effect (Ishikawa) diagram in Figure 2.2.

Each of the eight factors can be expanded into subsidiary criteria that assess the extent to which a hub aligns with each of the success factors. Next, we present the subsidiary criteria and our brief assessment of how well the SDSCs collectively met these criteria.

Room Personnel

- Personnel who understand and know how to use the technology they are assigned to interact with
- Personnel who understand all of the tools in the room to a reasonable level—i.e., understand strengths, weaknesses, and how the tools complement or relate to each other
- Personnel who understand the field operations they are supporting, in real time and post-analysis (e.g., patrol officers, detectives)
- Personnel who understand the specific situation they are supporting (e.g., the specifics of their district)
- Personnel who can interact and communicate with field and supervisory personnel.

Figure 2.2
Common Success Factors for Hubs



In general, we observed that personnel who could carry out the above functions were generally present, although there were variations in skill levels across the SDSCs. There were also, out of necessity, learning curves to training new staff. Skill-building was somewhat hampered in the beginning, in that the SDSCs did not have formal documented processes or training curricula.

Room Technology

- Technology to acquire, organize, and collate data into information that can be used for the decisions the room personnel need to make
  - Partially present; SDSC staff leveraged the CPD's and City of Chicago's extensive databases. However, we observed many manual processes still being performed, and there are opportunities for further research to identify additional automations.

- Technology that integrates various data sources about what has happened, what is happening, and what might happen that is relevant to the room's decisionmaking requirements
  - Partially present, because certain key pieces of information were captured on separate screens. Genetec Citigraf provided an overall view of current events and a camera interface, shot alerts were shown on ShotSpotter, predicted hotspots were shown on HunchLab displays, and information about shooting victims and perpetrators and their social networks were shown on the CVRM networking display tool.

- Technology that supports real-time and post-analysis functionality
  - Real-time technology support was present but had an incomplete scope. Tools present included the interactive map, ShotSpotter, and camera display, with effective overwatch support limited to those places with cameras and acoustic sensors. Post-event analysis tools were also present, with results delivered to the field via the app, briefings, and roll calls.

- Technology that is robust and is available when needed
  - Availability was limited by camera placement and resolution level. We heard some concerns about the reliability of older cameras.

- Technology that has appropriate space to be used.
  - In general, this appeared to be the case, although there were limitations on the number of people and tasks that could be accommodated in the small SDSC rooms (which are repurposed offices and small conference rooms) at once.

Field Personnel

- Personnel who know how the room can help them
- Personnel who know how they can help the room
- Personnel who use the room and help the room.

For these three points, personnel varied by SDSC. Some SDSCs reported established processes and cultures for using the room and its findings; in others, we did not hear about such provisions.

- Ability to receive timely, appropriate, and accurate data from the room
- Ability to provide timely, appropriate, and accurate data to the room.

These two abilities were generally present and enhanced through the SDSC app, although they varied by the extent to which personnel engaged with the room and whether technological sensors (especially cameras) could be brought to bear on specific events.

Field Technology

- Sufficient technology to provide the information needed by the room to meet its objectives
  - Generally present, but camera and sensor coverage issues, combined with display integration issues, limited technology support.

- Operationally robust technology that can provide consistent access and quality information feeds
  - Partially present; in addition to camera and sensor coverage issues, there were some issues of older cameras not having sufficient resolution.

- Technology located where needed and is permanent and mobile, as required
  - Partially present; one of the more common complaints was that districts did not have enough cameras and some of the cameras they did have were not positioned optimally.

- Provides the room with the appropriate level of information awareness to know what is happening and where in order to match the room's expectations and objectives.
  - Generally present, except for the limitations listed in this section.

Room Supervision

- Personnel who understand the strengths and weaknesses of the technology used in the room: what it can do, what it cannot do, and what is needed to make the best use of the technology
- Personnel who understand field operations and activities
- Personnel who understand the specific nuances of the situation (e.g., the specifics of their district)
- Personnel who are available during the highest room traffic (e.g., day watch)
- Personnel who have excellent supervisory and communication skills in pressure situations
- Personnel who can network, self-reflect, and work with peers for improvement
- Personnel who can multitask with excellent time management
- Personnel who have data organization skills (tracking, information retrieval)
- Personnel who have exceptional situational awareness of what has happened, what is happening, and what might happen.

Supervisors who had the above nine skills were generally present, although skill levels varied by room. Supervisor strengths were somewhat limited by the lack of standardized instruction materials and training. We noted mismatches in cases for which experience at the lieutenant level was needed for stressed centers but was not present. Opportunities to collaborate with, and learn from, other supervisors and experts were present (we attended an all-hands SDSC meeting, there was a newsletter presenting success stories, and there are biweekly analyst and supervisor meetings) but were limited in scope.

Policies and Procedures

- Clear processes for routine tasks: what to do, when to do it, who does it, what knowledge is necessary, what tools are necessary, what training is necessary, and how to evaluate the quality of the task
  - Partially present; there is a high-level SOP and a manual for various technologies. Knowledge of how to do routine tasks is implicit—i.e., commonly done but, for the most part, not formalized or documented.

- Policies and procedures that encourage and facilitate continuous improvement and growth
  - Present on an informal and ad hoc basis.

- Policies and procedures that recognize the need for human judgement in certain situations when faced with exceptions and provide for controlled deviation, with appropriate oversight and governance
  - We are unaware of these.

- Policies and procedures that encourage and support the acquisition of organizational knowledge (best practices, issues, risk management)
  - Partially present, with routine meetings for SDSC staff, frequent informal exchanges, occasional all-hands meetings, a new policy, and a newsletter.

- Policies and procedures that address the change of management and personnel (e.g., what happens when there is a new commander, captain, or lieutenant)
  – Not formally present.

- Policies and procedures that guide change management—i.e., when and how to introduce new methods and processes
  – Not formally present.

Organization Support

- Provides the room with what it needs to deliver the room's objectives
  – Partially present; some staff (crime analysts) received training from the University of Chicago's Crime Lab, and as noted, there was some ongoing collaboration, dissemination (newsletter), and training (all-hands meetings). We are not aware of studies that assess specific districts' needs.

- Provides the organization with authority and value awareness across the organization
  – Partially present; conveyed via updated overall policy, newsletter, and ad hoc information exchanges, and sometimes via COMPSTAT.

- Provides the room with the appropriate supervisors and personnel
  – Partially present; true in most cases, but it is possible that hot or priority rooms might require more-senior and more-experienced personnel and additional personnel during high activity periods.

- Provides appropriate levels of recognition and incentives for cognitive skill acquisition (e.g., recognizing and helping with various levels of skill and expertise in the tools, how to use them, resulting decisions and actions)
  – Not formally present.

- Provides the room supervision and personnel with the appropriate resources for training, networking, peer mentoring, peer collaboration, and continuous improvement
  – Present on an ad hoc basis, with some formal support via biweekly meetings, all-hands meetings, and newsletters.

Room Stand-Up

- Appropriate training of room supervisor
- Appropriate training of room personnel
- Appropriate training of field personnel who will interact with the room
- Appropriate training of organization's supervision and management team.

With the exception of Crime Lab–trained crime analysts, training for the above personnel was largely ad hoc.

- Smooth installation of technology (e.g., on time, smooth integration and hook-up)

  - Not discussed during our interviews, but we did not hear about installation problems.

- Phased introduction with respect to a portion of the room's scope (e.g., a demonstration and learning area, not all areas at once)
  - SDSCs were phased by district, with staff from SDSCs that were being established conducting site visits to prior SDSCs, but SDSCs were not phased by implementation within a district.

Assessing the Sustainability of SDSCs

Throughout the evaluation process, one concern came up repeatedly: the long-term sustainability of the rooms and their performance. This is a concern that haunts all innovations: There is the establishment, the learning curve, the honeymoon period of bliss and initial amazement at the results (if the innovation is successful), declared satisfaction, and then the inevitable segue into routine or, worse, fade-out. There are two key aspects to what happens next in the story of any innovation: (1) how are the initial results sustained and (2) how does the innovation grow, evolve, and improve over time.

There is no single formula to ensure that innovations are sustained or will reach their long-term potential. However, using our prior research, we can identify common reasons why innovations such as the SDSC rooms do not sustain results, and we can identify similar reasons why they do not evolve and improve. In addition, we can identify common processes, procedures, and activities that can potentially help an SDSC room sustain its performance and evolve over time, as well as mitigate and control unwanted variations.

The following list presents what we consider to be five of the most common, innovation-crushing problems, based predominantly on McKay's prior research on organizational innovation (for example, McKay, Erenay, and Wang, 2015). Any one of these items will cause problems with sustainability and lead to the potential benefits falling short of expectations.

1. **The expectations and results from the early operations are not understood and the expected levels of sustained results are not valid.** There can be results in the beginning that are akin to low-hanging fruit or even fruit falling into the basket by itself. These results must be discounted when projecting future performance. There are also diminishing returns, which imply that, in long-running situations, the incremental effort required for a similar improvement is not linear; for example, an initial 50 percent improvement in an outcomes metric will be hard, if not impossible, to repeat, and realistic goals must be set. Thus, it is possible to think that the performance is not sustained when, in fact, it is—i.e., a false negative.
2. **The funding and resources are not sufficient to support a sustained or evolving situation.** Sustainment requires ongoing training, education, improvement of technology, and methods to ensure that the solution matches the problem, which is also likely evolving or improving.
3. **The organizational knowledge and learning is static.** Given the same problem, the existing solutions and tools (human and technological) will work, but as the problem changes, the thinking and problem-solving will not be adequate. If an individual has ten years of experience but is still at the level of skill and ability obtained during the first year, they have effectively repeated one year ten times without growth or improvement.

4. **The organizational support and drive from "above" is reduced.** The reduction of interest in or lack of understanding of the past, current, and potential value of the innovation by superiors will incapacitate most innovations. The project's champion moves on, or another shiny object distracts from the innovation. This can also occur when a new superior takes over with such attitudes and practices as "this is the way I do things," "I want to leave my mark," and change for the sake of change. If the new superior does not understand the intent, history, and value of the innovation, it is likely that the innovation will not receive the care and nourishment it requires.
5. **The innovation and its sustainment and evolution are not integrated into the institutional fabric (practices, policies, and procedures).** If sustainment and evolution are handled by ad hoc management practices, it is likely that the innovation will deteriorate and not reach its potential. Specific policies, procedures, and methods need to be developed and added to the institution's game book: People need to know the particulars of day-to-day operations as well as growth and development. For example, is there a specific budget item for continuous improvement in the area's output? Another line item for internal processes? That is, are both efficiency and effectiveness specifically and explicitly addressed in the policies and budgets? Is change management and evolution specifically addressed in the policies, directives, and procedures?

Our SDSC evaluation took place early in the life of the centers. We were not able to look years into the process, when we could discuss actual sustainment and what happened in the intervening years. The following list details how much risk each of the five problems presents to the SDSCs and is limited to what was observed and what those observations might imply for the future. We observed moderate risks for points 1 and 2 and major sustainability risks for points 3, 4, and 5.

1. **The expectations and results from the early operations are not understood and the expected levels of sustained results are not valid.** In 2018, we observed some issues with the expectations and how the rooms were being evaluated and compared. However, we understand that the COMPSTAT process has evolved and that the issues observed in 2018 might have been addressed. We suggest that each room and district should have updated objectives that recognize the early gain phenomena and incremental, relative gains, which are nonlinear. We also suggest that each metric be assessed in terms of what behavior the metric might drive and how the behavior contributes to the overall objectives. As noted, this might not be a risk or issue at this time; the issues observed in 2018 have been addressed.
2. **The funding and resources are not sufficient to support a sustained or evolving situation.** Substantial external grants have contributed to the SDSC existence. Ongoing, sufficient funding should be allocated out of the normal budget for room maintenance and improvements (the what and the how, or effectiveness and efficiency). External funding should not be assumed. We did not have access to budgeting information and future plans. If the rooms are planned to be 100 percent supported by normal funding, this is not a risk.
3. **The organizational knowledge and learning is static.** This is a major risk and concern. There are some activities that currently exist (e.g., the SDSC newsletter, the document repository in the SDSC network area, the biweekly meetings of the analysts and

supervisors). However, these activities are not sufficient for long-term sustainability and growth.

4. **The organizational support and drive from "above" is reduced.** This is a major risk and concern because major aspects of SDSCs are dependent on who specific leaders are. The control structure addresses the functional capability level of the communication hubs. There is still a risk in that the stage of integration is dependent on the district situation.
5. **The innovation and its sustainment and evolution are not integrated into the institutional fabric (practices, policies, and procedures).** Although we are aware of the main directive and related directives on the technology as well as the protocols and "pseudo-SOPs" in the rooms, we consider the lack of common SOPs and directives across all of the SDSCs to be a significant risk. The policies and directives must address issues such as continuous improvement, integration within the district, advanced risk management practices using analytical results, and so forth. We are not aware of specific budget support for room and field technology evolution (e.g., a specific budget for moving up to 10 percent of the PODs each year to better locations, including the PODs funded by aldermen's prerogatives).

Considering these risks, we believe that, if the status quo is maintained and risks are not explicitly addressed, the CPD can expect initial gains followed by turbulence and the rooms entering a static or even declining period in which they provide basic value but show no systematic growth in maturity (with respect to the level and stage frameworks). Recommendations for how to improve the sustainability of the SDSCs are provided in Chapter Four.

Technology Evaluation

Our assessments reflect how well the technologies were able to support SDSC operations, in line with past research on how information technology can lead to improved performance, described previously. Note that our evaluation does not include detailed technical performance analyses.

Public Safety Mapping Display (Genetec Citigraf)

The public safety mapping display was described by SDSC staff as a critical enabler of SDSC operations as their primary geographic information system analytic tool, because it provided real-time situational awareness of crimes, other events of interest, calls for service, and police car positions. However, during our interviews, SDSC staff indicated that they would like to see further integration and interoperability among their analytic tools to reduce hopping from one system to another to obtain answers and to increase flexibility in the types of analyses they attempt. Because Genetec Citigraf recently announced that they will integrate ShotSpotter displays, this shortcoming will likely be addressed directly by the vendor (Genetec, 2017).

SDSC staff indicated that they also use Caboodle (a locally developed application) for geographic information system analyses but have been moving to Tableau because it provides more flexibility to build custom dashboards by linking data of interest.

Cameras and Camera Displays

We had more discussions about the PODs and supporting Citigraf camera display than any other technologies. Personnel consistently described the cameras as a game-changing technology. Applications included

- conducting virtual surveillance missions, looking for suspicious activity in progress
- providing near–real-time surveillance of a reported crime scene, identifying perpetrators, victims, and potential witnesses
- providing overwatch support to units responding to a crime scene, helping officers deploy to scene effectively and safely
- looking for suspects and their vehicles fleeing a crime scene.

The districts and CPD headquarters staff provided several success stories in which they described how cameras led to rapid arrests.

We did identify gaps in the PODs and POD operations. Technologically, staff frequently asked for more cameras, to move cameras whose positioning had become operationally obsolete, and to upgrade older PODs to new, high-resolution systems. Staff noted that the older PODs did not necessarily have enough resolution and optical performance to provide sufficient detail to identify the faces of those involved in a crime, for example.

Operationally, we noted that cameras being used in virtual surveillance (i.e., not supporting response to a specific incident) were often left on the same view for long periods. In contrast, camera operators in other marquee camera surveillance operations, such as Detroit's Project Green Light and Baltimore's Citiwatch, frequently cycle between camera feeds, immediately switching feeds if nothing of interest is on screen.

SDSC personnel also noted that monitoring the POD cameras can be labor intensive. They have been granted access to a system to run automated analytics on video that supports keyword searching for specific types of features and events, but they are often limited by usage quotas and the required bandwidth to transfer video into the analytic system. This type of analytic functionality will be much more useful to the CPD if it were to be integrated directly into the POD viewing system. That way, analysts could set up alerts for certain objects or activity (e.g., guns or violence), and the system would also facilitate searching historical video using appropriate text tags (e.g., "red car on 34th Street on May 2nd").

ShotSpotter

SDSC personnel indicated that by directly monitoring ShotSpotter alerts at the SDSC (rather than at the citywide Office of Emergency Management Center), they are able to quickly get cameras trained on the area to begin gathering video evidence. They are also able to get patrol officers on scene more quickly (two to three minutes earlier), which often means officers encounter suspects and victims more frequently and are able to more easily gather shell casings, which contribute to ballistic forensic evidence. When SDSC personnel are able to monitor video feeds following a ShotSpotter alert, they also reported being able to provide virtual backup to responding officers by informing them of the direction that suspects or victims fled and/or where they might be hiding and what they were wearing.

Also, by analyzing historical ShotSpotter data, some districts discovered historical patterns (e.g., locations of celebratory gunfire on New Year's Eve). This insight was used to send letters to nearby property owners in advance of these types of events. The letters indicated that

gunfire had been detected in the vicinity in the past and that officers would be on the lookout in the future for unauthorized weapon discharges.

As noted, a current drawback is that ShotSpotter alerts are on a separate screen from the main Citigraf mapping display; this could be fixed, as noted.

Geospatial Predictive Policing Software (HunchLab/ShotSpotter Mission)

In our interviews with SDSC staff and observations of SDSC meetings and observations, the predictive policing software saw some use in the daily briefings for planning purposes. However, it was not discussed that frequently. A shortfall is that the software is a standalone tool not connected to Citigraf, meaning that the predictive displays had to be brought up separately and provided predictions of hot spots in isolation from other key situational awareness data—i.e., the tool provided colored map squares of locations at risk but did not provide other information, such as context or guidance on specific operations within those map squares. This isolation meant that HunchLab's predictions were downplayed in comparison with other SDSC operations.

Link Chart Analysis Tool

The Link Chart Analysis Tool is a social network display that shows, for a given victim or perpetrator, links to all persons who have been co-arrested with them as well as second-degree arrest links (persons arrested with persons who have been co-arrested with the victim or perpetrator). The tool also provides a drill-down capability to provide criminal history details about specific persons. We observed screenshots from the tool being presented for all shootings during a shootings review meeting at the CPD area (multidistrict) level. We also received comments from staff that the tool was useful in shooting investigations.

That said, it was not clear how much the social-networking tool was being used in practice in SDSC operations. This tool was not commonly referenced during SDSC daily briefings, which tended to reflect the fact that the official focus of SDSC operations was on patrol operations to reduce crime, not on crime investigations.

CVRM Tool: Party-to-Violence Risk Predictions

As noted in the introduction, we provide a detailed evaluation of the CVRM in this report, because of both the original tasking of this project and high public interest in the CVRM and its predecessor, the SSL.

A Limited Evaluation

Our evaluation of the CVRM risk model is limited for two reasons.

First, the CPD did not identify a specific intervention to take action directly on those whom the model flagged as being in the high-risk bands. The CVRM has historically been linked with custom notifications, as shown on the CPD's Violence Reduction Strategy web page (CPD, undated b). However, the custom notification program operates largely independently from the CVRM, with John Jay College of Criminal Justice staff, district commanders, and others making decisions on whom to notify based on their own intelligence. For example, one commander reported notifying persons whom his personnel thought were most likely to be parties involved in recent shootings (either directly or involved in underlying conflicts between groups). At most, the CVRM risk model was described as one tool that informed commanders' and officers' decisionmaking.

Second, the model's developer, IIT, never provided us with model testing and validation data and documentation. We therefore relied strictly on the limited documentation and publicly released data provided on the CPD's Violence Reduction Strategy website and IIT's CVRM fact sheet (IIT, 2019), as well as some direct contacts with the IIT developers.

The CVRM System May Be Operationally Effective at Identifying Persons at Elevated Risk

Among persons arrested in Chicago over the past four years (through mid-2019) and for whom a CVRM score was calculated, Table 2.2 shows the distribution of persons by risk category and the expected risks of being a party to violence (PTV) over the next 18 months, as reported by IIT. Because IIT did not provide any model testing or validation data, we also provide the number and percentage of persons in each risk category who were a PTV in 2018 as a rough proxy for the model's predictive accuracy.

The proxy for predictive accuracy is largely in line with IIT's predictions (albeit on the lower end of IIT's predictions), given that (1) their predictions were for 18 months, not 12 months, and (2) IIT predicted PTV risk going forward given recent information, not 2018 PTV events. Persons in the top three risk categories (10,751 persons) appear to have been involved with about 25 percent of shootings in 2018. Thus, the CVRM was reasonably effective at identifying a subset of those at a highly elevated risk for being a PTV, and interventions with the roughly 10,000 people in the highest risk categories could potentially preempt about one-quarter of Chicago's shootings, not counting potential second-order effects. This scope should be doable for a city of Chicago's size, especially if agencies and organizations outside the CPD are involved.

The CVRM's PTV Risk Prediction System (Software and Processes), as Currently Implemented, Is Not Operationally Suitable

However, we found the CVRM's current PTV risk prediction system to be operationally unsuitable, for two reasons. First, the full process (administrative and technical) of running the model takes several months, and has taken up to years, to come up with updated data sets. This pace is in contrast with the commonly held perspective that the real-world risks of violence can escalate very quickly, and the CPD must be able to diagnose and respond quickly. As noted in Chapter One, the model's inputs are time sensitive, with the influence of recent inputs declining exponentially over time. This makes the model's results become obsolete very quickly.

Table 2.2
Expected Risk of Being a Party to Violence, by Risk Category

Category	Persons	IIT's Projected PTV Risk (next 18 months)	2018 PTVs
Very High	785	27–35%	111 (14%)
High	1,742	15–27%	166 (9.5%)
Moderate	8,224	5–15%	324 (3.9%)
Low	112,181	1–5%	983 (0.88%)
Very Low	190,537	0–1%	360 (0.19%)
Total	313,469	N/A	1,944 (compared with 2,391 total shooting incidents in 2018)

Furthermore, the model must be run at IIT, and IIT is no longer working on the effort because of the expiration of its grants with the CPD. The risk prediction tool was never transported, much less integrated, into CPD's systems or operations. As of the publication of this report, the CPD and IIT continue to be in communication and are working to rectify this situation.

As noted in Chapter One, the CVRM algorithm works in two phases: A regression equation is used to generate initial risk scores, and then a second, more complicated phase modifies the scores so that persons who were co-arrested are likely to have similar scores. In principle, one could just import the first-phase regression equation directly into CPD systems to predict PTV risk. This would be far simpler to import than the full software code from IIT. We do not have data to assess the difference in performance in identifying people at high risk, but even if that difference is large (IIT informally estimated it would reduce predictive accuracy by about 25 percent), it could make the difference between being able to deploy a tool that provides risk assessments in near–real time and one that does not.

Second, the model does not provide enough information to identify suitable interventions for those at high risk. To start with, given Chicago's low clearance rates for shootings, the CVRM is de facto a *victim prediction system*. As noted in a RAND study of the initial version of the CVRM (then called the SSL; Saunders, Hunt, and Hollywood, 2016), there were several persons who are at high risk but are not posing high threats to the community (i.e., driving violence). Known examples include people who engage in behaviors that put them at high risk (visible street sales, public drug use and/or intoxication) and people who are associated with those who are at high risk but not directly involved. Indeed, preliminary clustering of high-scoring persons on the prior version of the CVRM into three groups found that persons could be roughly divided between those with recent arrests for violence and gun charges, those who were recent victims, and those who were frequently arrested on drug charges. This fact immediately raises questions about bringing in risk-reducing services in addition to focused deterrence–style measures.

The CVRM input data can provide some insight into what services and other interventions a person might need, but really understanding a person's needs would require information outside traditional police records management systems. This information includes human intelligence, social service, educational, and even medical and (especially) mental health records and diagnostics. As a comparable example, George Mason University's Center for Advancing Correctional Excellence has a Risk-Needs-Responsivity Tool that starts by prescribing one of six core needs for correctional clients. These needs include substance abuse treatment, treatment to reduce criminal thinking, self-management training, interpersonal skills training, life-skills training, and no interventions needed. However, the tool requires 17 questions about "individual offenders' risk, needs, and lifestyle factors" (Center for Advancing Correctional Excellence, 2013, p. 2), including sensitive mental health and lifestyle data. Gathering these data will involve building partnerships with service providers while maintaining security and civil rights protections on the data, beyond just simply restructuring the algorithm to go beyond simple risk categorizations.

The CVRM (and Its Earlier Incarnation, the SSL) Was Widely Misunderstood, Contributing to Unnecessary Public Fear

We have, throughout the course of working with the CPD on predictive policing, observed widespread public concerns about the CVRM (and its earlier incarnation, the SSL). Concerns,

often repeated in media articles, in meetings and conferences that included privacy and civil rights advocates, and in discussions with policymakers and funders, include that the model constituted "pre-crime analysis" like that shown in the movie *Minority Report*, and/or that the model constituted computer-assisted discrimination. An article from technology news website The Verge, titled "The Minority Report: Chicago's New Police Computer Predicts Crimes, but Is It Racist?" is just one especially illustrative example (Stroud, 2014).

As noted above, the CVRM (and the SSL) is principally a victim prediction system, not a criminal prediction system. Furthermore, the interventions for the CVRM and SSL were never well defined. Under the initial SSL (Saunders, Hunt, and Hollywood, 2016), districts made widely varying attempts to contact those at high risk, with a great degree of variation in how this was done. We have not identified any specific interventions genuinely associated with the CVRM variants. (As noted, although the CPD's Violence Reduction Strategy associates the CVRM with custom notifications, actual custom notification decisions appeared to use CVRM scores as just one input, at most.) Thus, the level of public fear about the CVRM or SSL greatly exceeded what was actually being done.

We identified initial communications issues and timing that might have played a role in the misperceptions and resulting concerns.

- The CPD initially was not fully transparent about the SSL's inputs, outputs, and exactly what was being done to intervene with the high risk. This left a great deal of room for concerns to grow and spread unchecked.
- The few hundred names on the high-risk list emerging from the SSL (the early CVRM) were sometimes publicly described as the "bad guy list," even though (as noted) being at high risk did not necessarily mean the person was driving violence.
- The CVRM or SSL provides risk scores for everyone arrested in Chicago at some point over the past four to five years, which constitutes hundreds of thousands of people. As noted above, only a few thousand had high-risk labels, with the remaining several hundred thousand largely discounted from further consideration. Public statements that were unclear about this fact resulted in concerns that everyone in Chicago with a recent arrest was being held up for additional scrutiny and punishment.
- All of these developments occurred at a time when predictive policing algorithms were attracting a great deal of public, media, and public policy advocacy attention and concern.

Information Protections Evaluation

As centers that handle a great deal of sensitive law enforcement information, as well as video and sensor data that can be considered surveillance, information protections are vital to ensuring that SDSCs provide for cybersecurity, civil rights, and privacy rights protections.

In this section, we use a framework for security, civil rights, and privacy rights protections for emerging technologies to assess the SDSCs.[2] As shown in Figure 2.3, the framework prescribes a set of interlocking protections covering the full range of data collection and man-

[2] The Priority Criminal Justice Needs Initiative, a project for the National Institute of Justice, has worked with several expert panels on law enforcement's needs for emerging information technologies that collectively developed a framework

Figure 2.3
Information Protections Framework

agement, analysis, and usage in police operations. We assessed how well the SDSCs' operations and systems complied with the elements of this framework, in general terms; the scope of this evaluation did not include performing detailed security or privacy audits.

Data Protections

Data protections relate to what data are collected, how they are collected, and how those data are transmitted and maintained. Key protections in this area, and observed SDSC alignment with them, follow.

First, in general, the security of law enforcement data needs to be protected against loss, corruption, and unauthorized access and use, as described in core data policies, such as the FBI's Criminal Justice Information Services Security Policy (FBI, 2019). We did not conduct a security audit of SDSC systems. However, we did not observe any obvious shortfalls. In our observations, SDSC systems were only accessed and used by SDSC and other authorized CPD personnel. The SDSC app was available only on dedicated CPD smartphones.

Second, law enforcement predicates (i.e., reasonable suspicion) are needed for data collection. For surveillance systems, which for SDSCs include video, ShotSpotter, and license plate readers, there is a need for collection to focus on events and activities with strict criminal, public hazard, and/or homeland security predicates. Using the information in a criminal investigation further requires criminal predicates for collecting that information (28 C.F.R. Part 23); furthermore, there are exclusions on collecting and searching for First Amendment–protected speech. In general, surveillance systems such as video should be used for passive sensing to detect crimes and hazards and to support criminal investigations when strictly needed, not for active, persistent surveillance of the public. The following list includes a discussion of the potential surveillance burden for the SDSCs' surveillance systems.

- **Citigraf maps, incoming calls for service and other incident data.** These reflect data being reported to the CPD for law enforcement purposes.
- **Video.** The cameras are positioned to view public areas or areas of special interest and permission (e.g., in school hallways). CPD staff reported that the camera programs are popular, with the biggest issues from communities being unmet requests for more cameras. That said, concerns about exposure from the sheer number of cameras are emerging (e.g., Pletz, 2019). SDSC staff can only see up to 16 feeds at once, with four usually

for security, civil rights, and privacy rights protections. These included a panel on social media and social network analysis (Hollywood, Vermeer, et al., 2018a) and a panel on video analytics and sensor fusion (Hollywood, Vermeer, et al., 2018b).

shown, and typically staff are only following zero to one, strongly limiting the surveillance burden on the public. We observed camera feeds being left to display "uninteresting" action; moving to more active searching of feeds, in which uninteresting feeds are switched away from quickly, would reduce any surveillance burden.

- **Video analytics.** These emerging technologies offer the potential to greatly increase the number of criminal and hazardous activities that are detected and addressed but also raise the risk of increasing the surveillance burden on the public significantly. For this study, video analytics ended up being a nonissue; CPD executives reported that they have experimented with video analytics technologies, in part using Department of Justice support, but the technologies had not yet progressed to the point where they could provide useful returns.
- **License plate readers.** Use cases identified with SDSC staff included searching for plates from stolen cars and other cars of interest in a crime and searching for potential cars fleeing crime scenes in recent license plate reader collection data. Both have criminal predicates.
- **ShotSpotter.** The systems detect gunshots, which have law enforcement predicates.
- **CVRM.** The system uses arrest and crime incident data from within the CPD's record management systems, which have criminal predicates. (See below for an assessment of how these data were used.)

Analysis Protections

These protections broadly fall into two categories. The first class of protections reflects that crime analyses and other analyses commonly constitute sensitive law enforcement data and need to be protected like other data, as described above. Our assessment of data protections above also applies to crime analysis data.

The second class of protections is equal justice protections, intended to defend against biases and inaccuracies in analysis inputs, algorithms, and analytic processes. Our observations of the SDSCs' analysis protections are as follows:

- **Crime analyses in general.** The crime analyses we observed included general statistical and trend analyses of crime incidents, identification of crime hot spots and problems, and analyses directly in support of criminal investigations. Issues of whether hot spot analyses, and hot spots policing more broadly, are inherently biased are outside of the scope of this study; Weisburd, 2016, provides a review of these issues. We did not observe any obviously biased analyses or analysis products.
- **Geospatial predictive policing software.** HunchLab's (now ShotSpotter Missions) developers assert that they are transparent about how the algorithm works and that the tool uses only place-based data (no data about individuals) and only forecasts places (250-square-meter boxes) as being at an elevated risk for crimes (Cheetham, 2019). We did not do any explicit bias assessments of the geospatial predictive policing algorithms in Chicago because that was outside the scope of the study.
- **CVRM.** As noted, data inputs to assess the risk of a person being a PTV include criminal history, age at last arrest, criminal victimization, and co-arrest links to other persons.

- Because we never received training, test, or validation materials (data files, code, documentation), we were unable to test the CVRM algorithm for explicit racial and other biases.
- As noted above, the CVRM was not associated with any specific interventions during the observation period; from a practice perspective, we were not able to determine a bias burden.
- Age at last arrest could be seen as a biased variable. However, U.S. law considers age discrimination to be bias against those over age 40, and the CVRM's age bias places higher scrutiny on younger persons, not older ones.
- The inputs include two types of variables that are not past data on serious crimes committed: victimization and co-arrest links. An earlier version included narcotics arrests, which have been accused of reflecting over-policing; Lum and Isaac, 2016, provides an example of how using biased narcotics enforcement data can result in biased predictions.
- More fundamentally, given Chicago's low clearance rates for shootings and homicides, the CVRM is largely, de facto, a victim prediction system. Thus, the severity of any bias burdens depend strongly on what interventions are done on persons labeled at risk of victimization, and why (i.e., are interventions tailored to the reasons that a person is at high risk, which does not necessarily mean they are high violent threats themselves). This issue is discussed below.

SDSCs and Usage Protections

Usage protections are designed to ensure that any policing operations using data and analyses, whether conducted by the CPD or other government agencies or organizations, are justified, equitable, and consistent. There are three relevant types of protections for SDSCs.

The first is to have policies and procedures that protect against distorting policing practices. This means avoiding carrying out more enforcement actions just to populate databases and unneeded enforcement actions driven by data and analyses implying greater risk than is present. An example of the latter is interpreting a person who has a high number of casual social media connections as being involved in any of those connections' criminal activity; at an National Institute of Justice panel on social media and social network analysis, one comment was "just because you have 500 Facebook friends doesn't mean you have a real relationship with more than a few of them" (Hollywood, Vermeer, et al., 2018a, p. 11). Our observations of the relevant usage protections for SDSCs are as follows:

- **In general.** We did not observe any discussions during our site visits, meeting observations, or interviews that called for increased enforcement just to collect data.
- **CVRM.** The unneeded enforcement risk appeared relevant only to the CVRM, which uses co-arrest links; there have been claims that the CVRM has unfairly prioritized people who had petty-crime associations but little serious criminal involvement (Kaplan, 2017). The practical impact of this prioritization mostly depends on the nature of the interventions.

The second type of protection is to have policies and procedures to make consistent and equitable decisions based on the actions.

- **In general.** As discussed, commanders' decisions on responding to crime spikes, major crimes, and specific problems were mostly reactive to the problems and cases presented. The typical decisions observed were to see a cluster of Part 1 crimes in an area (or type of location, such as gas stations) and assign more units to those locations. We did not see obvious signs of bias in these decisions, although we did not formally test for them, statistically.
- **CVRM.** In practice, as discussed, the lack of interventions formally associated with the CVRM meant that there were not intervention bias problems. If there had been, a major need would have been for policies and processes to separate the high-threat persons (those driving violence) from the high-risk persons (those at risk of being victimized, based on associations and lifestyle choices, but not driving violence themselves).

The third is to be transparent and open to community involvement when making policy and process decisions about what data-intensive applications will be used, how, and for what purposes.

- **In general.** SDSC staff mentioned having community representatives visit the SDSCs, but there was no mention of direct community engagement regarding how crime problems are being addressed. As SDSCs go forward and evolve, we anticipate it will be useful to have sessions with community representatives and experts to advise the CPD on how to best respond to incoming data.
- **Cameras.** Placement decisions were described as being something of an ad hoc process, using a combination of community requests, Aldermen's neighborhood funding decisions, and which other agency and private camera holders chose to make their cameras available to the CPD. As this program continues to expand rapidly—and because, in the future, it will likely include video analytics systems—there is a need for more formal community engagement to develop norms for how cameras will be placed, how data and analyses will be used in making those decisions, and how the cameras should be used.
- **CVRM.** Descriptions of the most recent versions of the CVRM, as well as a restricted and anonymized dataset, have been made available (CPD, 2019; IIT, 2019).

From SDSC Operations and Technology to Changes in the Field

SDSCs have evolved and matured a great deal in the past two years (since 2017), but they are still evolving with respect to best practices and generating value to the various stakeholders. The team's analysis is based on this recognition; that is, how are they doing considering the time they have been in place and considering the degree of innovation exhibited within the CPD context?

Past research discusses how information technology and command and control improvements, including hubs such as SDSCs, provide an expectation that these improvements should enable new and improved ways of carrying out missions in the field. One major model for how these improvements occur is the *Network Centric Operations Conceptual Framework* (Evidence Based Research, 2003). This framework describes the following hypothesis:

- Improved networking, including both technology and processes, combined with improved data, lead to improved quality of information.
- This leads to improved situational awareness ("mental maps" of what is happening) and understanding.
- This leads to better decisionmaking at all levels, from senior commanders down to local commanders and personnel in the field.
- This leads to improved operations in the field and increased mission effectiveness. Although mission effectiveness initially meant military operations, those operations explicitly included humanitarian response and stability operations (similar to policing operations, just against insurgents attacking civil populations) and certainly applies to policing missions, as well.

In line with this framework, studies have shown how better information, presented in forms that directly support mental awareness and better decisionmaking at all levels of command, led to dramatically improved outcomes. These include a study on urban operations (Gonzales, Johnson, et al., 2005), in which new information, decision processes, and technologies led to nearly unprecedented levels of performance in training exercises. They also include a study of operations in Northern Iraq combating extrajudicial killings and bomb attacks by insurgent groups (Gonzales, Hollywood, et al., 2007). A key part of the successful response studied was the policing-like solution of collecting and acting on tips from the population. Next, we describe our observations of how SDSCs align with this framework.

Improved Networking

By applying the framework (or similar models) to the SDSC evaluation, we first note that the inputs needed to get to improved understanding, decisionmaking, and performance are not limited to technology in these frameworks. A more complete set of inputs is shown in Figure 2.4.

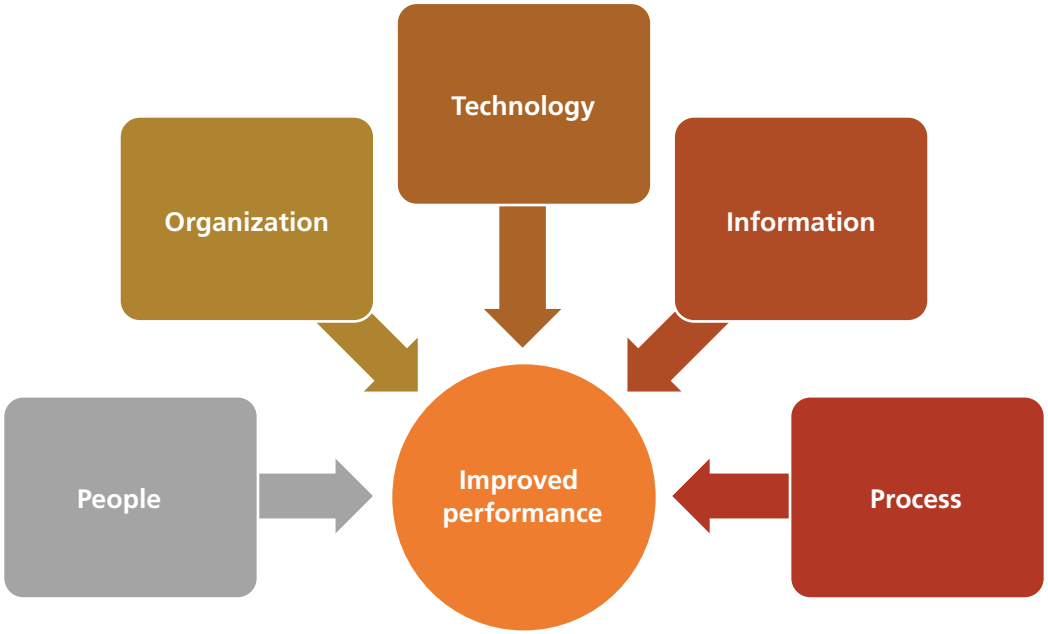
The prior sections have documented the additions and changes made to implement SDSCs, not just to technology but to people, process, the organization, and sources of information. Thus, all the major types of inputs needed to drive operational changes and improvements are in place for SDSCs.

Quality of Information and Situational Awareness

The next steps in the framework are to see networking improvements lead to improved quality of information and, therefore, improved awareness. The above sections have described how SDSC personnel, and personnel communicating with SDSCs, are provided with near–real-time maps of incidents and vehicle locations, shots fired (in covered areas), and camera feeds. SDSCs also provide for interpersonal sharing of information and analysis about ongoing cases and events through a combination of scheduled briefings and meetings as well as ad hoc discussions.

Kahan, Worley, and Stasz, 2000, finds that commanders need three types of information: pipeline (routine, regularly provided updates about the current environment), alarms (alerts that major events have occurred), and question tree (answering ad hoc questions and follow-ups, typically about the major events). Observations of daily briefings in Districts 7 and 25, as well as reports of briefings from other SDSCs, found that the briefings consistently provided these types of information.

Figure 2.4
Core Inputs to Achieve Improved Understanding, Decisionmaking, and Performance



SOURCE: Adapted from Garstka, 2005, slide 23.

Through the app, field presentations, and ongoing communications, personnel in the field were provided with regular updates relevant to patrol and investigative activities.

All told, these outlets for information collectively improve the quality of information available to SDSC and supported personnel. We further observed examples of the quality of information improvements leading to improvements in situational awareness: Personnel at all levels described being better aware of incidents, considerations, and how to respond to them since the addition of SDSCs.

Improved Understanding and Decisionmaking

The next steps in the framework call for signs of improved understanding and decisionmaking. There have been a series of similar frameworks introduced on how organizations can iteratively make decisions using available information, evaluate what happened and use that information as an input for making further decisions, and improve over time. Some of the best known of these *decision cycle* models are Boyd's OODA loop (from the military; see Brehmer, 2005, for a history) and Deming's Plan-Do-Check-Act, or Shewhart, cycle (from industry; see Moen and Norman, 2009, for a history). These models are shown in Figure 2.5.

Policing also has decision cycle models. The best known of these are the SARA model for implementing problem-oriented policing (Scanning, Analysis, Response, and Assessment; Eck and Spelman, 1987) and the predictive policing cycle (Perry et al., 2013). These are shown in Figure 2.6.

In general, the decision cycle models all provide for roughly similar steps of collecting information about the environment, analyzing it, using the data to make decisions, putting those decisions into practice, and assessing the results. Feedback from results should then inform the next round of information and analysis about the environment. It is important to

Figure 2.5
Decision Cycles from Military and Industrial Operations

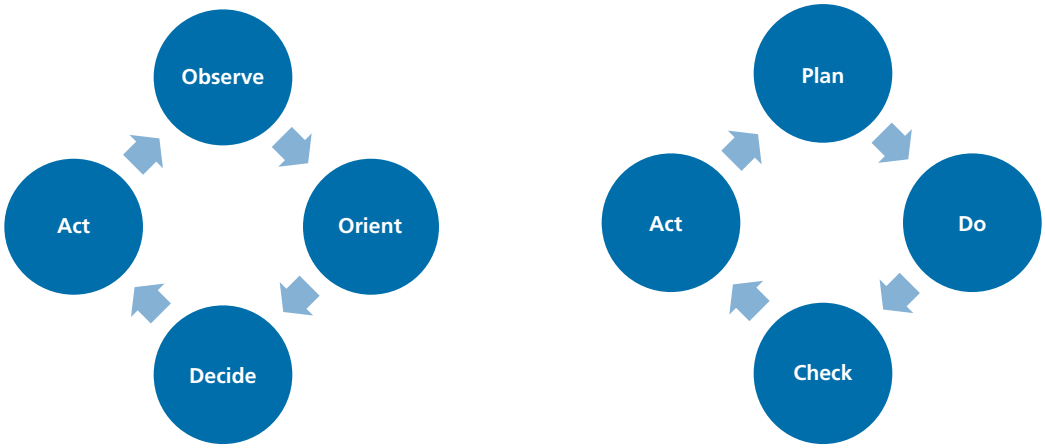


Figure 2.6
Policing Decision Cycles

note that decision cycles can and should occur at different levels and over different time horizons, ranging from near–real-time decision cycles to adjust responses to live events in the field to monthly or even yearly cycles to conduct high-level strategic planning and budgeting.

Prior to the SDSCs, interviewees told us that formal decision cycles to review operations might only occur every few months, typically in preparation for the CPD's COMPSTAT review meetings. With the advent of SDSCs and daily briefings, interviewees reported that regular decision cycles to review operations occurred daily, and they reported using the SDSCs' timely information (as opposed to COMPSTAT data, which could be months out of date). SDSCs were also reported as greatly facilitating the speed and quality of rapid decisions to support operations in the field.

Improved Operations

The final steps of the framework are to see novel, improved actions in the field, followed by improved outcomes. In the context of the CPD, the rooms would be considered effective and

efficient if they directly or indirectly addressed the following objectives stated in the directive overview:

- contribute to the reduction of crime
- improve incident response times
- enhance officer safety
- improve clearance rates.

The next section presents observations of novel operations that were reported as both supporting the above objectives and being enabled by SDSCs. They are presented by which SDSC objective they support. Outcomes (at least for changes in crime counts) are discussed in the following chapter.

Supporting Crime Reduction

We observed actions enabled by the SDSC that are consistent with what is known about effective and promising crime-reduction strategies. Examples included the following:

- Much of the daily briefings process was about identifying areas with crime problems, increasing resources in those areas, and then following up on the deployments. Hot spots policing is a well-studied and effective intervention (see Braga, Papachristos, and Hureau, 2014, for a meta-analysis of past experiments).
- The daily briefings process, as well as various special topic and ad hoc discussions, addressed specific shootings and gang problems. In some cases, these related to realizing the need for, and assigning, various types of focused deterrence interventions. Focused deterrence, in which law enforcement, community, and social service representatives hold interventions in which those involved in violence are confronted with consequences if they engage in violence and are offered services if they desist, is similarly an effective intervention (Braga and Weisburd, 2012, provides a meta-analysis).

The above two types of interventions were performed before the deployment of SDSCs existed in districts. However, decisions about these interventions previously depended either on what commanders knew about through ad hoc means or on using data that could be months out of date (assembled for COMPSTAT reviews). The SDSC-supported assignment decisions were based on recent data assembled in awareness-supporting formats (maps, charts, etc.), making the information used in decisions, and therefore the adjustments to operations, far timelier and more accurate.

SDSC staff provided numerous examples of detecting suspicious activity in progress, as well as seeing wanted persons and vehicles on camera and preventing likely crimes as a result. The CPD's cameras have been around for several decades, but the staff, interface software, and space to monitor them regularly are new.

Incident Response Times

The process of reducing incident response times has two basic factors that work together and are codependent. These are

- when the incident comes to the attention of the dispatchers (or equivalent)

- where the closest units are that can be tasked with the response.

The SDSCs directly contribute to the first factor in the following ways:

- Technology such as ShotSpotter provides immediate awareness of shots fired to the SDSC and to CPD dispatch, avoiding the delays in having a member of the public manually call in reports of shots fired to 911.
- Use of the technology, such as POD monitoring in high crime areas by SDSC personnel as part of their normal daily routine, provides the opportunity for the SDSC personnel to observe and detect an incident in real time; similar to the ShotSpotter alerts, the SDSC-detected incidents can dramatically reduce the response time.
- SDSC staff monitoring of call-for-service and dispatch traffic allowed them to vector units on scene faster than waiting for citywide dispatch.

The SDSCs directly contribute to the second factor in the following way:

- Technology such as HunchLab, as well as straightforward eyeballing of crime locations, hot spot mapping, and crime series detection by the crime analysts, helps the district deploy its personnel to areas where there is a greater probability that they will be needed, placing them closer to potential incidents, which potentially could reduce the response time.

Improving Clearance Rates

SDSCs had multiple novel means to hold offenders accountable that were not possible pre-SDSC. The most striking of these had to do with the use of surveillance cameras as well as ShotSpotter. The following examples were provided by the CPD:

- solving shootings by being able to be on scene much more quickly because of ShotSpotter alerts, as opposed to waiting for calls for service (if the shots were even called in)
- witnessing criminal activity in progress on camera and moving to intercept the perpetrators immediately
- reviewing camera footage to identify perpetrators (these reviews included a combination of direct views of the crime as well as views of people and vehicles fleeing a crime scene)
- using cameras to help find evidence, such as the locations of guns thrown or stashed by perpetrators on camera.

Less striking (but still effective) examples had to do with SDSCs providing support to crime investigations. This support included crime analyses in support of investigations. This support also included simply hosting collaborations and meetings between patrol officers, commanders, detectives, and Cook County prosecutors to both identify likely offenders and coordinate collecting the evidence needed to charge them. In our discussions and interviews, these analyses and collaborations were described as ad hoc, with the levels and types of effort depending on the SDSC and its operational situation.

Officer Safety

The SDSCs were described as contributing to officer safety in the following ways:

- As part of the daily briefings, there is typically an officer safety agenda item, and officer safety is also discussed as part of response planning during the rest of the briefing.
- The higher concentration of personnel in certain areas, informed by the use of the SDSCs' data and crime analyses to identify areas with increased risk, places more resources in the vicinity that can provide backup for on-scene units.
- SDSC staff described using cameras to provide information to officers before and as they arrived on scene regarding risks and threats. They also noted that ShotSpotter helps officers with risk management as they arrive on scene and understand where the shootings occurred. Outside of cameras and sensors, CPD staff described SDSC analysts and staff as providing in-depth information about locations and persons over the radio as officers were en route or staging.

Again, we did not assess officer safety outcomes directly. Note that assessing officer safety outcomes statistically is difficult, because assaults on officers as fractions of total calls and enforcement actions are rare.

CHAPTER THREE

Crime Rate Outcomes Evaluation

Methodology

We employed difference-in-difference models to estimate crime reduction effects resulting from adding an SDSC, calculated as estimated fractional changes in crime counts per month per district. Because these models were for positive (and sometimes small) crime counts, we employed Poisson regression rather than ordinary least squares (i.e., linear) regression.

To account for serial correlation in the crime counts in each district (Bertrand, Duflo, and Mullainathan, 2004), we used bootstrapped standard errors to develop confidence intervals. These are more conservative (i.e., larger) than traditionally estimated confidence intervals, which can be too small as a result of serial correlation (Bertrand, Duflo, and Mullainathan, 2004). Models were fit in the R statistical software system.

We employed the following independent variables:

- dummy variables covering years 2013–2018
- dummy variables for months
- site effect dummy variables covering every district receiving an SDSC at some point over the experiment (Districts 2, 3, 4, 5, 6, 7, 8. 9, 10, 11, 12, 12, and 25)
- one variable of interest for SDSC presence: 1 if the district had an SDSC in that month and year, 0 if not.

We ran models to estimate effects for each of the following major crime types: shootings, homicides, criminal sexual assaults, robberies, aggravated batteries, aggravated assaults, burglaries, felony thefts, motor vehicle thefts, and arsons.

The CPD provided crime data from January 2013 through August 2018. SDSCs were coded as being present in districts on the following schedule:

- January 2017: 7
- February 2017: 11
- March 2017: 6, 9, 10, 15
- January 2018: 3, 4, 5, 25
- March 2018: 2, 8, 12

We ran models that included data from four periods: January 2013 to August 2018 (shown as "All" on the following figures), January 2014 to August 2018, January 2015 to August 2018, and January 2016 to August 2018. This was done to explore the impact of the citywide spike in violence (as evidenced by shootings and homicides) that started in early 2016.

Results

Changes in Outcomes in Monthly Crime Counts When Districts Added an SDSC

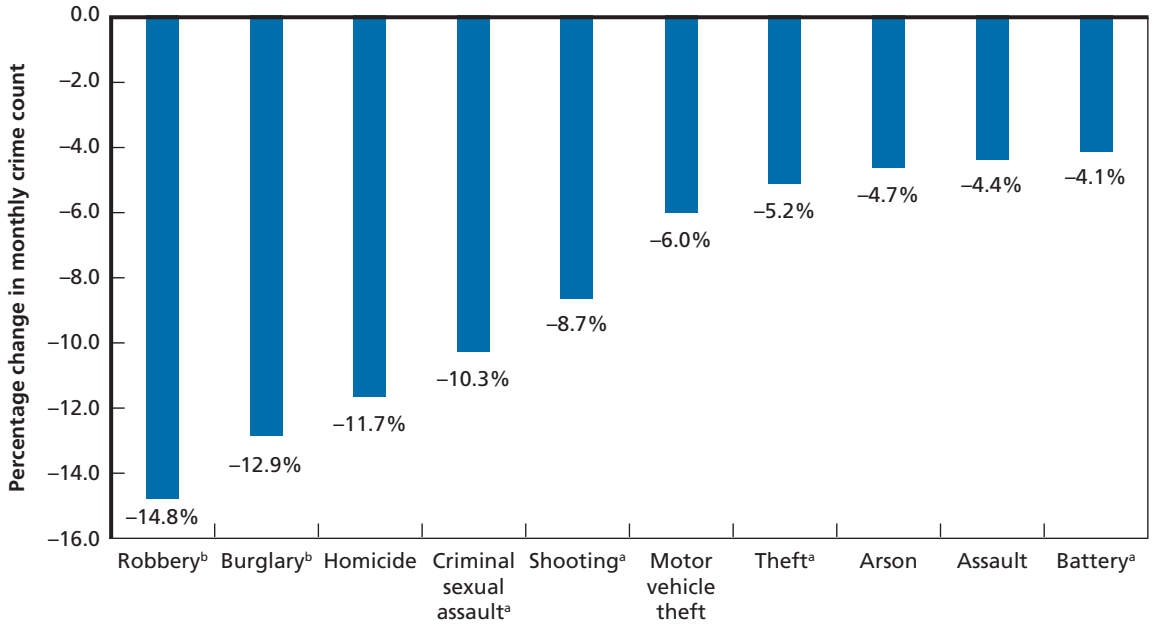
Figure 3.1 shows the expected percentage changes to a district's monthly crime counts that occur when a district adds an SDSC, as estimated across our difference-in-difference models. As shown, all expected changes were reductions in crime.

Figure 3.2 shows the estimated fractional changes (dots) and confidence intervals (bars) in crimes, by type and period.

Of the 40 models (ten crime types by four periods), 15 showed significant reductions in average monthly crime counts after districts added SDSCs. Robberies, burglaries, and aggravated batteries showed significant reductions for most modeled periods. Shootings showed significant reductions from 2016 to 2018 (i.e., for the period that starts when the citywide spike in violence started). Motor vehicle thefts showed significant reductions from 2014 to 2018; felony thefts showed significant reductions over the 2013–2018 period.

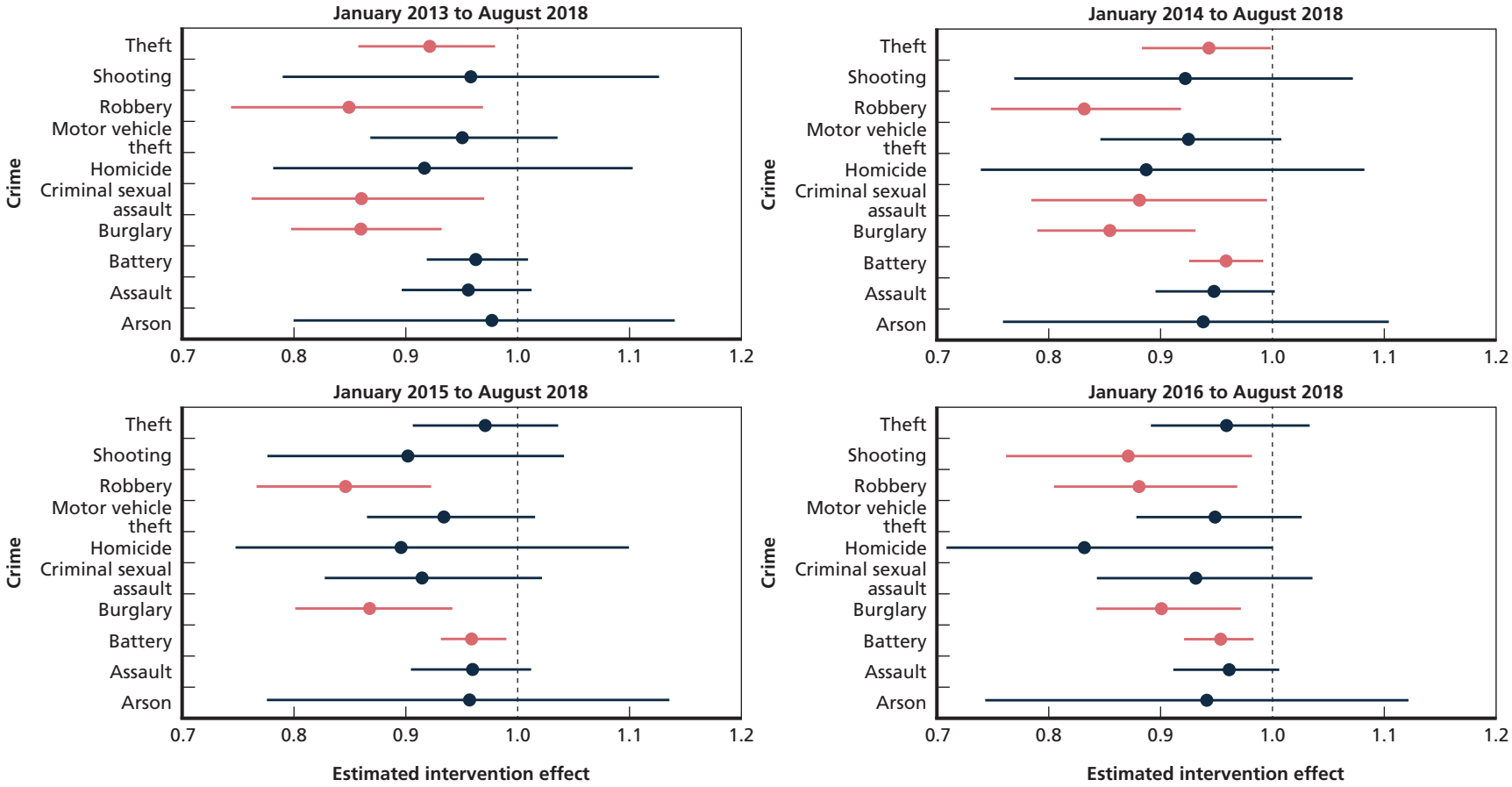
There were no estimated increases in crime counts associated with adding an SDSC for any modeled crime type or period, much less any significant increases. We used a nonparametric sign test to test the hypothesis that adding an SDSC does not lead to a change in monthly crime counts; not surprisingly, with 40 reductions in crime (negative occurrences) and zero increases (positive occurrences), this hypothesis was rejected, with a P-value of 0.0 (Neath, 2018).

Figure 3.1
Expected Changes to Districts' Monthly Crime Counts After Adding an SDSC



[a] For these crimes, there was at least one model in which the expected reduction in crime was statistically significant.
[b] For these crimes, the expected reduction in crime was statistically significant in all models.

Figure 3.2
Estimated Intervention Effects on Monthly Crime Counts



NOTES: 95 percent confidence intervals given by line ranges. Estimated changes that were statistically significant are shown in red, and nonsignificant changes are shown in black. Intervention effects are given as fractions over the original; e.g., an effect of 0.85 means that adding an SDSC was associated with crimes being 85 percent of what they were before the addition.

Outcomes Differences by District

We further estimated fractional changes in crimes for each district, for both the 2016–2018 period and the 2013–2018 period. Figures 3.4, 3.5, and 3.6 show estimated crime changes by crime type.

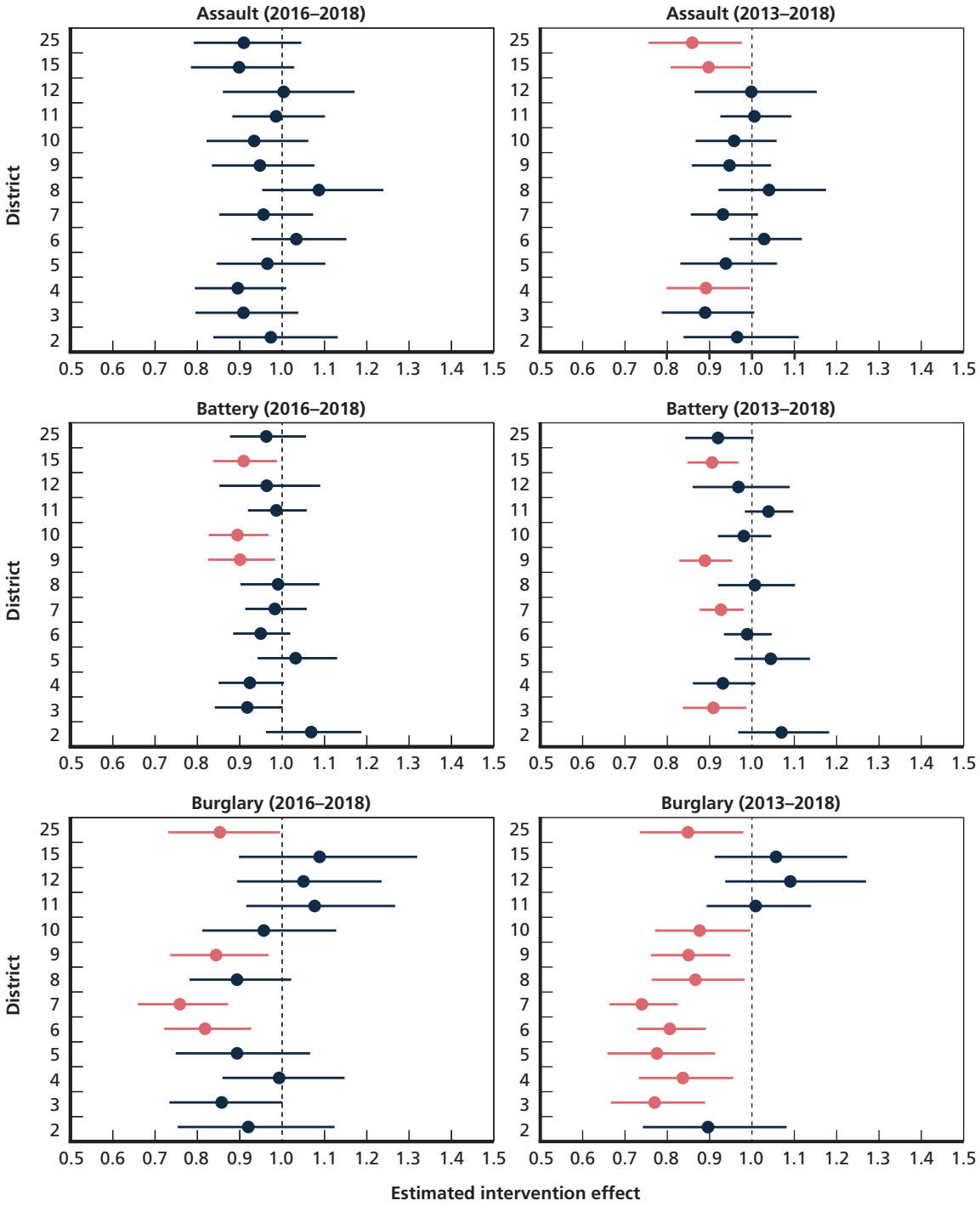
As shown in Figures 3.3–3.5, the estimated crime changes include increases and also more uncertainties (as shown by the confidence intervals). Burglaries and robberies had the greatest numbers of statistically significant decreases in crime. There was one statistically significant increase in crime, in motor vehicle thefts in District 10.

For shootings (which, along with homicides, drove the creation of SDSCs), one district had significant reductions: District 7, which had estimated reductions of more than 40 percent. Other districts had similarly large reductions, but because of large uncertainties as expressed by large confidence intervals, these were not significant.

Figures 3.6, 3.7, and 3.8 show the estimated crime changes by district.

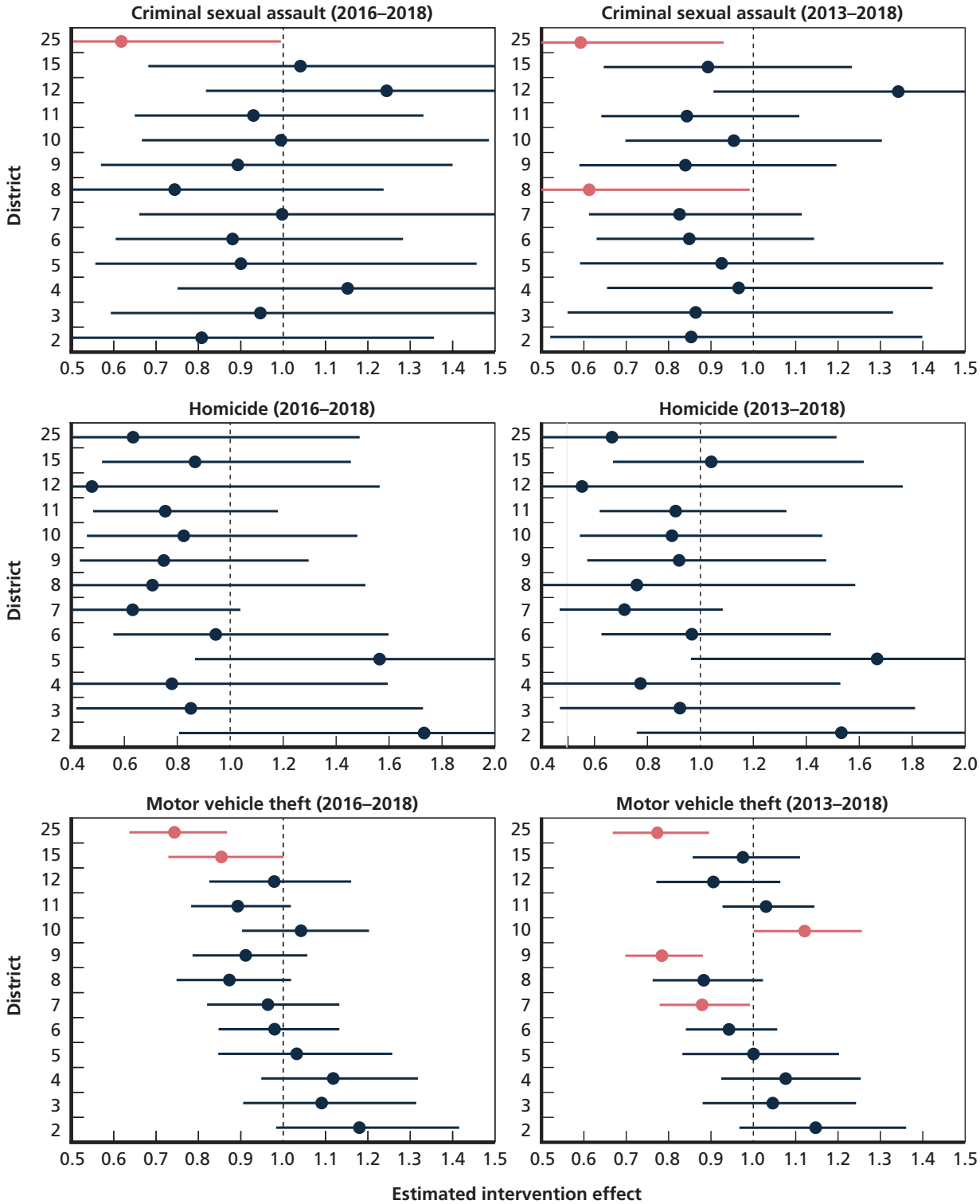
Looking across all crimes, District 7 had the greatest number of crime types that showed significant reductions (six of ten reduced), followed by Districts 9 and 25 (five each reduced) and District 4 (four reduced).

Figure 3.3
Estimated Intervention Effects, by Crime Type (Assault, Battery, Burglary)



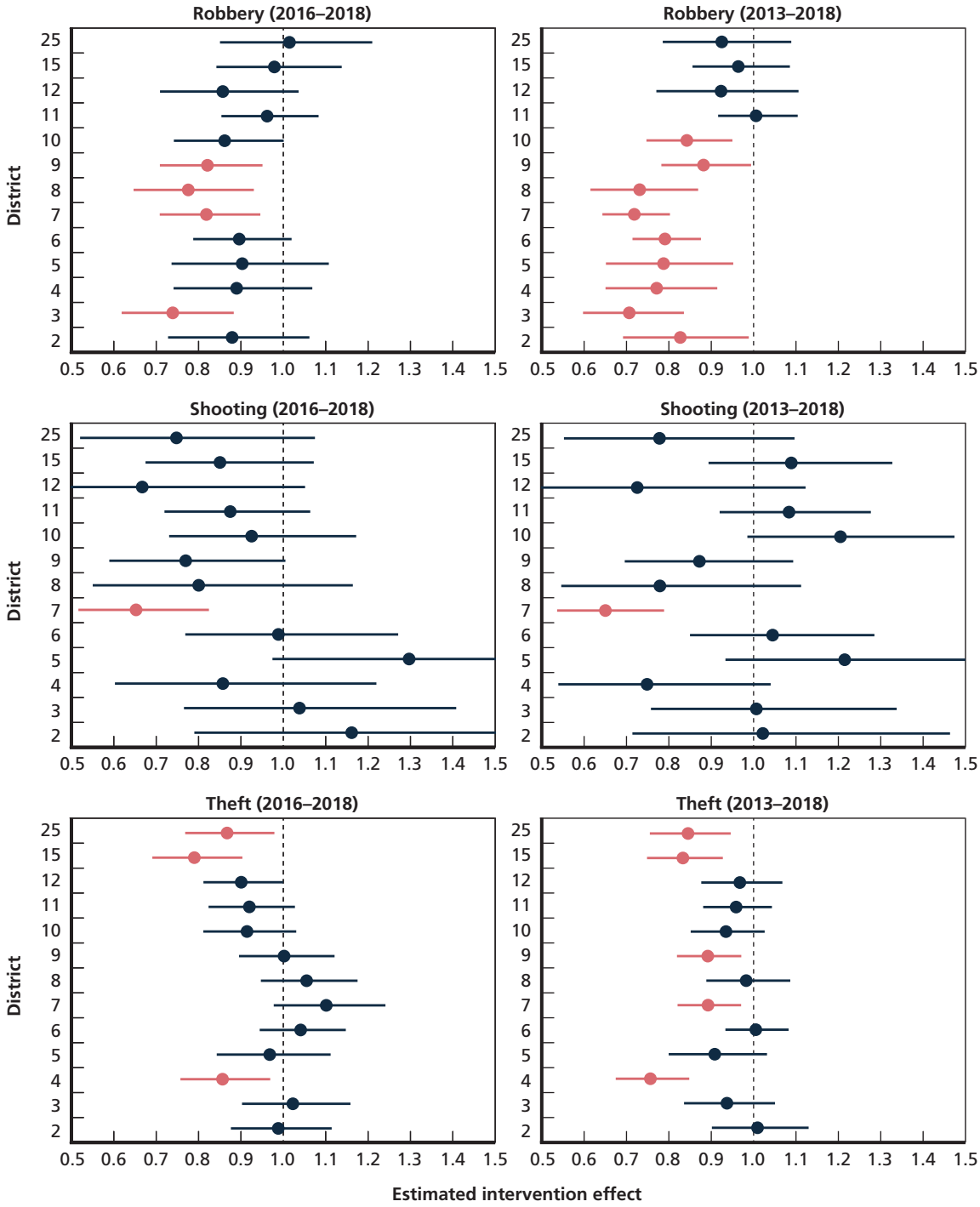
NOTES: Bonferroni-adjusted 95 percent confidence intervals given by line ranges. Estimated changes that were statistically significant are shown in red, and nonsignificant changes are shown in black. Intervention effects are given as fractions over the original; e.g., an effect of 0.85 means that adding an SDSC was associated with crimes being 85 percent of what they were before the addition.

Figure 3.4
Estimated Intervention Effects, by Crime Type (Criminal Sexual Assault, Homicide, Motor Vehicle Theft)



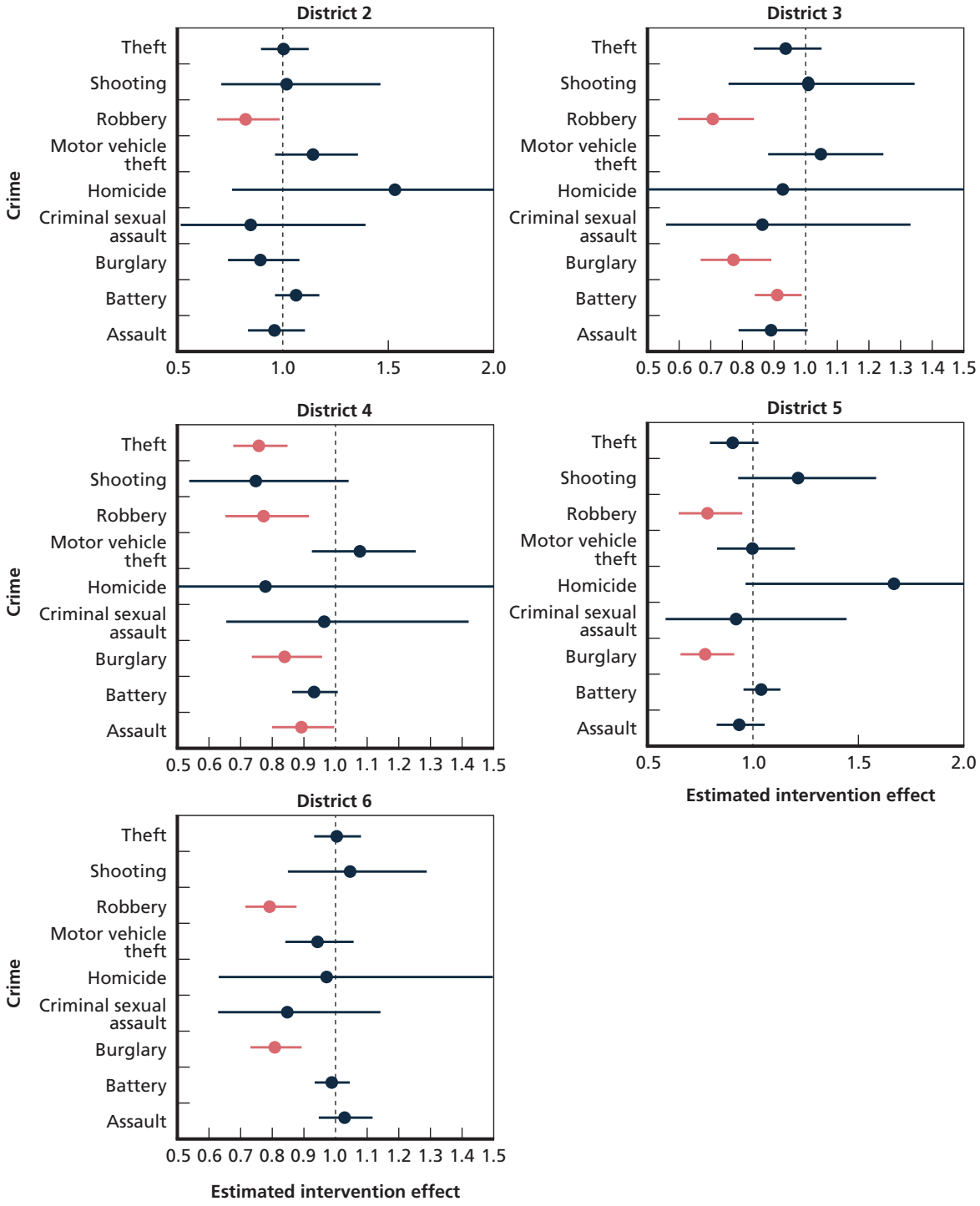
NOTES: Bonferroni-adjusted 95 percent confidence intervals given by line ranges. Estimated changes that were statistically significant are shown in red, and nonsignificant changes are shown in black. Intervention effects are given as fractions over the original; e.g., an effect of 0.85 means that adding an SDSC was associated with crimes being 85 percent of what they were before the addition. Some of the confidence intervals go beyond the ranges shown in these figures.

Figure 3.5
Estimated Intervention Effects, by Crime Type (Robbery, Shooting, Theft)



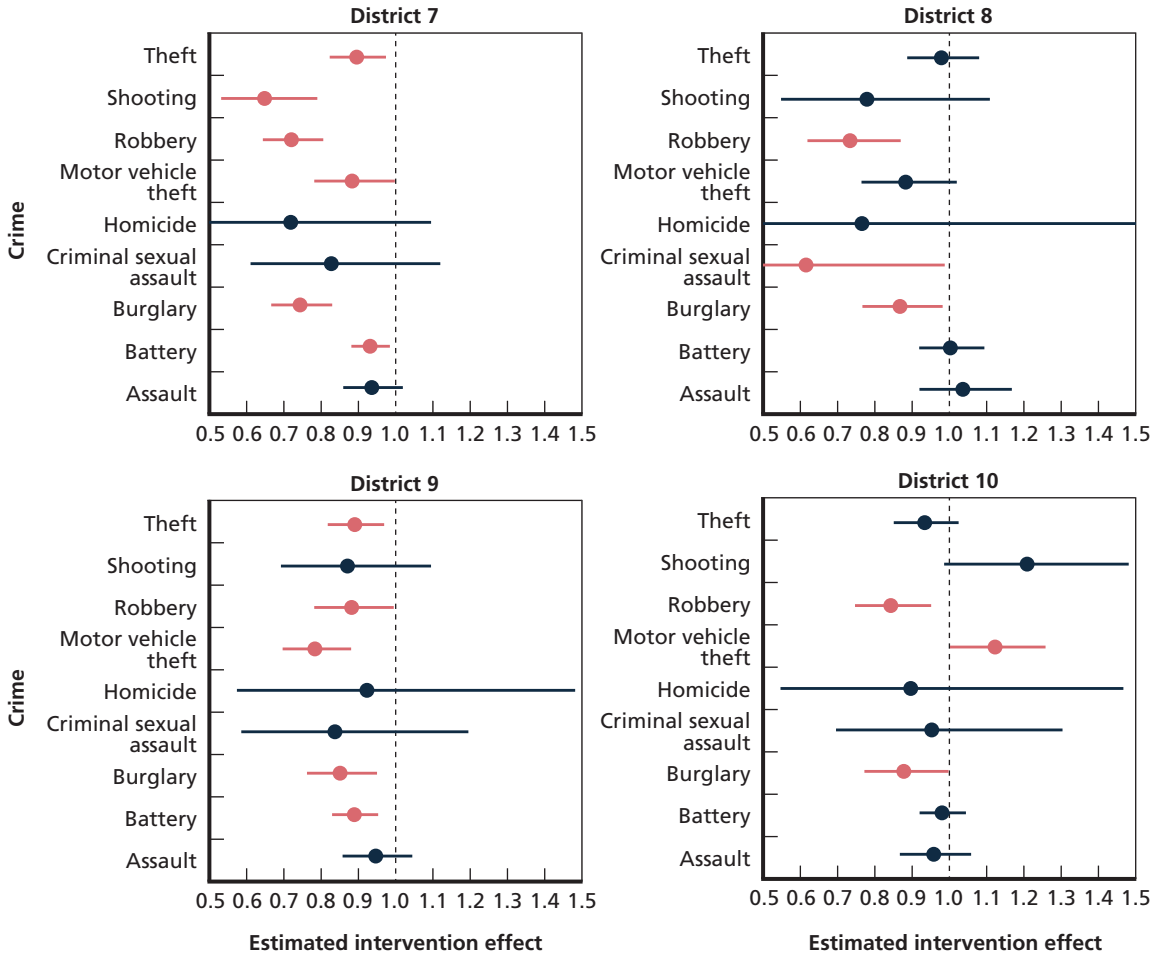
NOTES: Bonferroni-adjusted 95 percent confidence intervals given by line ranges. Estimated changes that were statistically significant are shown in red, and nonsignificant changes are shown in black. Intervention effects are given as fractions over the original; e.g., an effect of 0.85 means that adding an SDSC was associated with crimes being 85 percent of what they were before the addition. Some of the confidence intervals go beyond the ranges shown in these figures.

Figure 3.6
Estimated Intervention Effects, by District (2, 3, 4, 5, and 6)



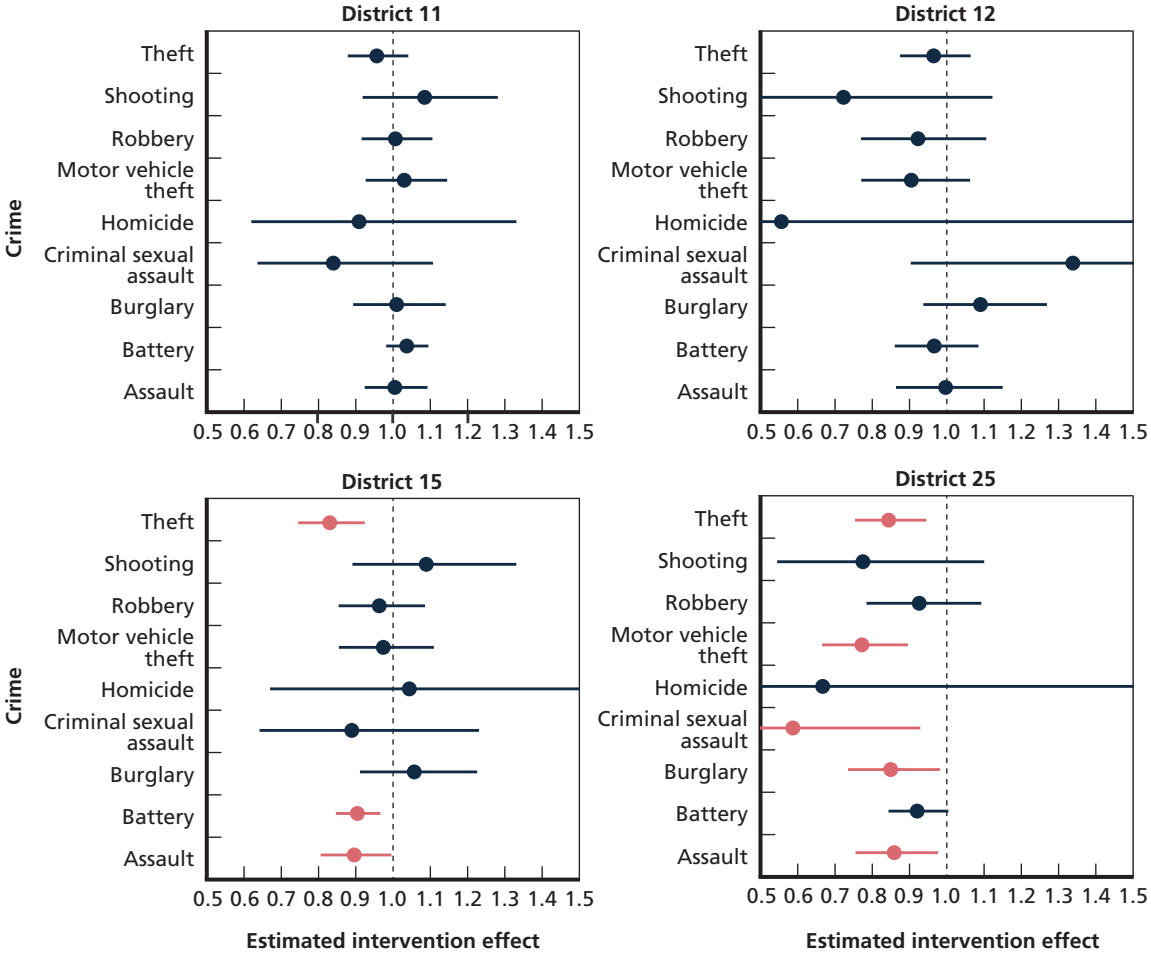
NOTES: Bonferroni-adjusted 95 percent confidence intervals given by line ranges. Estimated changes that were statistically significant are shown in red, and nonsignificant changes are shown in black. Intervention effects are given as fractions over the original; e.g., an effect of 0.85 means that adding an SDSC was associated with crimes being 85 percent of what they were before the addition. Some of the confidence intervals go beyond the ranges shown in these figures.

Figure 3.7
Estimated Intervention Effects, by District (7, 8, 9, and 10)



NOTES: Bonferroni-adjusted 95 percent confidence intervals given by line ranges. Estimated changes that were statistically significant are shown in red, and nonsignificant changes are shown in black. Intervention effects are given as fractions over the original; e.g., an effect of 0.85 means that adding an SDSC was associated with crimes being 85 percent of what they were before the addition. Some of the confidence intervals go beyond the ranges shown in these figures.

Figure 3.8
Estimated Intervention Effects, by District (11, 12, 15, and 25)



NOTES: Bonferroni-adjusted 95 percent confidence intervals given by line ranges. Estimated changes that were statistically significant are shown in red, and nonsignificant changes are shown in black. Intervention effects are given as fractions over the original; e.g., an effect of 0.85 means that adding an SDSC was associated with crimes being 85 percent of what they were before the addition. Some of the confidence intervals go beyond the ranges shown in these figures.

CHAPTER FOUR

Summary and Conclusions

Summary of Findings

Process Evaluation Findings

SDSCs serve as command, control, and communications hubs, supporting decisionmaking in response to events in real time, on daily planning cycles, and supporting longer-term operations to address chronic crime problems and hold specified offenders accountable. In general, we found evidence that SDSCs were supporting much higher levels of awareness and decisionmaking than had been present previously, with comments typically suggesting that command prior to SDSCs was largely ad hoc, based on whatever commanders and officers heard about, and that command after SDSCs was much more structured and data driven. We also observed examples of SDSCs enabling novel responses to crime incidents and crime problems that were not previously possible before the advent of SDSCs. However, we did identify substantial risks to sustainability and various areas for improvement.

Functional capabilities. SDSCs operated at fairly advanced levels of maturity from a command, control, and communications hub perspective. SDSCs went beyond data processing and presentation to analyzing historical data, making predictions, and providing real-time insights. They also enabled commanders to make data-driven planning decisions and enabled officers to engage in proactive, successful decisionmaking in the field. As a shortfall, the repertory of what was decided on—i.e., interventions in response to crime problems—tended to be limited, with the mainstays being to put more patrol resources and more camera time into problem areas.

Integration of SDSCs into district-level and CPD-wide operations. SDSCs' level of integration into district operations varied. Some SDSCs were fully integrated into their district's full suite of operations; others could be characterized as being more than independent service units but not yet achieving a partial level of integration into operations. Similarly, SDSCs provided examples of working with citywide CPD units, but such integration was limited and largely ad hoc.

Alignment with common success factors for hubs. In general, SDSCs were at least partially aligned with the eight common success factors. Shortfalls included a lack of documented processes and formal training to develop and transition staff; varying degrees of use by district and external personnel outside of SDSC staffing; technologies that were not fully integrated, with key information being separated on different systems' displays; and technologies having limited scope, with many areas not covered by cameras or other sensors.

Sustainability. This was the one assessment area showing major shortfalls, with the team finding substantial risks to sustainability in three areas: (1) insufficient organizational learn-

ing, (2) uncertain long-term support from command at headquarters and with individual district commanders, and (3) a lack of established (and budgeted) processes and knowledge materials to sustain and evolve the centers.

Information Protections. Although the team did not perform detailed technical security, privacy, and civil rights protections evaluations, we did assess alignment of SDSC practices and operations with key protections. In general, we did not identify major warning signs in this area. There were two exceptions:

- In general, as the CPD increased the number of cameras in its network—especially as it adds huge numbers of privately owned cameras—we see a need for more transparency and community involvement on which cameras are incorporated, when they are looked at, and other key issues needed to provide for both public safety and maintenance of privacy.
- The second stage of the CVRM raises issues of whether people might be singled out unfairly based on associations and victimizations, rather than such people being true drivers of violence.

Technologies. SDSC systems were described as critical enablers of SDSC operations because they provided real-time situational awareness of incidents and operations and supported analyses for longer-term decisionmaking. Cameras received the greatest amount of discussion, although the mapping and event display (Citigraf) was indirectly noted as a key display to maintaining situational awareness. Shortfalls included the following:

- Different types of information were captured in different systems' displays, meaning that some tools tended to be overlooked.
- Cameras' effectiveness was limited by where the cameras viewsheds were. We further noted that views were often left on "uninteresting" scenes, rather than regularly switching between views to search for suspicious activity.
- The CVRM's PTV risk prediction model was never technically or operationally integrated into the CPD. The model was widely misunderstood, contributing to unnecessary public fear. The CVRM's model does not provide sufficient information to identify needed interventions for the high-risk people.

Novel and improved ways of operating that could credibly support improved mission outcomes. These included the following:

- SDSCs' information analyses and daily decision cycles could support hot spots, focused deterrence, and other problem-oriented policing decisions in ways that were much timelier and more accurate than was previously possible.
- SDSCs' capabilities to view cameras regularly were described as contributing to numerous detections of crimes in progress, as well as identifying perpetrators postcrime.
- SDSCs' shot detection, camera views of suspicious activity, and monitoring of dispatch traffic were described as helping get units on scene much faster than was previously possible.
- SDSCs' capabilities to provide camera overwatch and provide past criminal history and warning information to officers on scene was credited as improving officer safety.

Outcomes Evaluation Findings

We statistically assessed the impacts of adding SDSCs for their principal objective: reducing crime. SDSCs were found in this experiment to be effective, overall, at reducing crime. In 40 models, districts' average monthly crime counts declined after adding an SDSC, albeit to a significant extent in 15 of the models (38 percent). There were models in which crime was increased. In absolute terms, estimated crime reductions, depending on crimes and times modeled, varied between 3 percent and 17 percent.

We did not assess changes in outcomes for the other three objectives of holding more offenders accountable, improving officer safety, and decreasing response times. CPD staff provided numerous examples of SDSC capabilities being used for these purposes, such as using crime analyses and cameras to solve crimes, providing key history and video overwatch information to officers, and detecting and vectoring units to incident sites much faster than standard call for service–to–central dispatch processes. Whether these examples were reflective of changes to operations large enough to produce statistically significant changes was outside the scope of this study, although it should be fairly easy to assess whether statistically significant changes occurred in future research, using existing data collected by the CPD.

Recommendations: Opportunities for Improvement

As noted, estimated crime reductions, depending on crimes and times modeled, varied between 3 percent and 17 percent. Although there are instances of interventions reducing certain types of crime by more than 40 percent (numbers that were hit by District 7 for shootings and approached by several other districts for certain crimes), there remain substantial opportunities to enhance SDSC operations to further reduce crime and support other policing objectives. To start, measures are needed to shore up the sustainability of the SDSCs.

Sustainment and Improvement Over Time

The biggest need is to sustain the progress that has been made to date and continue to experiment and to improve SDSC progress over time. The SDSC and its standard operations need to be permanently instated as the way of doing business. We make recommendations in four areas to help do so: organizational knowledge; policies and procedures, including SOPs and directives; recruiting and retention; and experimentation and continuous quality improvement.

Organizational Knowledge

Increasing organizational knowledge means building up the capital asset found in staff's collective knowledge and skill and having this asset leveraged across the organization. This process implies that knowledge needs to be consciously generated, gathered, shared, used, and reused. The policies, infrastructure, and organization behind SDSCs need to support these five tasks.

For the SDSCs to fully evolve their functional capability, there are three needed organizational knowledge components, as follows:

1. the institutional foundation to provide a basic level of knowledge (including policies and SOPs, covered below, along with infrastructure and formal training)
2. personnel with individual talent and capability (covered below under recruiting and retention)

3. the development of skill and expertise over time.

The last of these components is the most challenging, but it directly enhances SDSCs' abilities to see patterns, to react, to predict, to recommend, and to guide. This last category is a combination of organizational knowledge (as popularly captured in *The Fifth Discipline* [Senge, 1990]), individuals' ability to learn, and the opportunity to practice and reflect. We focus our organizational knowledge recommendations on this third category.

Obtaining knowledge. The following are recommended approaches for capturing new knowledge:

- Staff maintain lessons learned logs in which insights and "interesting" happenings are recorded. Although it is possible to think of rigid structures, it is recommended that these are not codified per se.
- Staff record any new solutions or new ideas and where the idea or solution worked, underlying assumptions, conditions for success, risks, limitations, and warnings for those who follow.
- Staff track any new practices, predictions, or estimates they have provided. If something worked, why? If something worked better than expected, why? If something worked out worse than expected, why? If there is no reflection, there will be no learning.
- What is being learned through these informal logs should be shared, as described next.

Sharing knowledge. The following are recommended practices for sharing knowledge within and outside the SDSC:

- New information and ideas are regularly included, and reflected on, in protocols, such as daily briefings: What have we learned, what did we learn to do or not do? New information and ideas are also used in planning by informing assessments of what is likely to happen and what will need to be done two, four, six, and eight weeks out.
  - There could be weekly reviews in each SDSC, led by the supervisor, covering what was unusual in the last week, why was it unusual, and what was learned, and this information should be recorded in a room log. This log should be reviewed by new personnel. Once every three months (roughly), each person in the room should be given the time to review the log.
  - The logs could be summarized and shared in an efficient and effective way with other rooms. A topic at a regular supervisor-level meeting can be lessons learned, including anything thought to be unusual or noteworthy.
  - Ideally, a knowledge database can be created that includes situations and ideas that can be analyzed in similar situations as well as the frequency of these situations, all of which can be summarized in training sessions. (Here, *database* is a bit of a misnomer: A searchable document will serve initially, with a database created as knowledge documentation accrues.)
  - The supervisor can do a quick check once per month on what was thought to be unusual or noteworthy in their room during the month against the master database and see what was similar or the same, making suitable notes and sharing them.

- Staff systematically learn from other rooms.
  - Rotations through peer groups is also an effective way to share and spread organizational knowledge: A room supervisor goes to another room for a day each month (for a full watch) to help out, participate, talk with room personnel, observe their processes, etc. This rotation is not for filling in for a short staffing situation, but to hang out in the room, talk to various people, and observe.
  - Other room personnel could do a similar visit to another room for a watch every two to three months.
  - Every six months, have the supervisors get together for a focus session on what they have observed on the rotations, what they think was better than their own room, etc.
  - Every six months, have a session in each room discussing what was seen in other rooms.
  - Have a way to collect and share comments on what was seen, and so forth.
- Knowledge seen as operationally useful is formally captured and disseminated.
  - Formally incorporate and update best practices and a scenario book that is used in training, so that the new personnel know that knowledge is being generated, collected, and used.
  - Room- and/or district-level newsletters that are one to two pages and summarize new developments over the past month.
  - "Thoughts from the Rocking Chair" (subtitle: "Things You Do Not Learn at the Academy"). This could be messaging with no name attributed, but put together by the senior team and offering a way to impart the elder's wisdom (i.e., the subtle things that have been learned over time).
  - "The Good, the Bad, and the Ugly" (subtitle: "Tales from the Dark Side"). This messaging could include lessons learned from recent events, missions, etc. That is, the things that everyone should know or think about: if things went well, why; if not, why? This document provides an opportunity for collective reflection, learning, thinking beyond the superficial, and providing organizational memory.

Sustaining knowledge. The following are recommended practices for onboarding new personnel:

- Best practices reaching the level of "necessary" should be captured in documented processes, training, and policy, described in the next section.
- New personnel should have shadowing sessions, in which they watch what is done, when it is done, how it is done, why it is done.
- Staff should have training sessions involving hands-on experience in controlled situations. These sessions would lead to doing the actual task in a "real" situation with the "real" pressures and context, either supervised or in a parallel virtual exercise.
- As part of senior personnel training, commanders should spend a full watch in the SDSC, sitting with the analysts and sworn officers and understanding what they do.

Policies and Procedures

Process documentation and training. Best practices and procedures need to be captured, and personnel need to be educated on them. The CPD has made progress toward these goals through governing policy, informal information exchanges, occasional all-hands meetings,

and newsletters. However, many best practices, and even some baseline practices, are created by individual initiative by leaders and staff and are at risk of being lost. SDSCs need the following:

- documented processes, starting with simple checklists
- training courses tailored to the educational needs of operational commanders, analysts, and field personnel. These should include key summaries and short quizzes to test the staff's level of knowledge and comprehension.
  - The room, district, and supervisory personnel should have objectives for what they should know and how developed their skills and abilities should be with respect to the SDSC, as well as defined pathways to get there over time.
  - There should also be smaller-scale, but widely disseminated, objectives for what district personnel in general should know about SDSCs and how to use them.
- dedicated procedures for transitioning leaders, which are key because personnel change frequently
- auditing procedures to ensure standard practices are being followed.

These efforts can be developed through the organizational learning processes described above to capture those practices and policies that need to be formalized. This report includes an initial documentation of the core practices we identified.

We emphasize that documentation and training should be as simple and useful as possible, not just documentation for the sake of documentation: Everything documented or in training materials should be used.

SOPs and directives. Especially important procedures should be captured in SOPs and/or directives, because the institutional weight and backing of these official documents have a better chance of being implemented as personnel change than a "documented process," much less an informal one. There is a need for SOPs and/or directives that are common across SDSC operations, that are designed for individual centers (tailored to local contexts), and that are designed for district operations being supported by the SDSC. Topics for SOPs or policies can include the following:

- SDSC daily operations (outside of briefings), immediate support to officers in the field, organizational knowledge, and crime analyses
- daily briefings, covering reviews of what has been learned, how that knowledge will be used, and what is likely coming up and how to respond, especially how upcoming risks will be addressed proactively (also known as a *horizon scan*)
- roll calls and other bulletins and key information for district officers
- interagency cooperation facilitated by SDSCs, such as collaboration with other CPD units (e.g., detectives), prosecutorial agencies, and other law enforcement agencies.

Recruiting and Retention

Recruiting, development, and care for retention are key to maintaining the quality of SDSC operations. The analytics and technology used in the SDSC suggest that the units should be perceived as a service unit within the CPD (at least virtually, if not as their own organizational unit) and that they are not simply standard units that staff move in and out of routinely.

Dedicated personnel could be viewed as a unit with specialized skills and expertise that will develop over time. There is a need for a growth path within SDSCs as individuals move from junior to intermediate to senior levels of skill. In some organizations, a parallel technical ladder exists for positions exhibiting cognitive skill that extends to senior technical and management levels. This path usually creates an incentive scheme for development, growth, and retention; improves morale; and allows individuals to follow one of two growth paths: technical/specialist or command/management.

Reflecting the high level of knowledge and experience needed by room leaders and staff, we recommend that room leaders in priority districts have the rank of lieutenant, if possible, or at least as close to the experience and expertise of lieutenants as possible. However, we understand the CPD's staffing limitations.

Development of morale and esprit de corps are also important to retention and attracting qualified candidates. Standard approaches for such development involve having SDSC gear, such as hats, T-shirts, jackets, and so on; hosting specific social events and fundraisers; and having awards for outstanding service, both in general and in support of specific operations.

Experimentation and Continuous Quality Improvement

Improving performance over time will require regularly identifying opportunities for improvement, testing them, and adopting them if they prove successful. Continuous improvement has two aspects: improving the value of the room to the stakeholders (effectiveness) and improving the internal operations of the room associated with generating the value (efficiency).

First, to identify goals for room evolution, we combine the functional capability and integration maturity frameworks introduced in Chapter Two to provide an assessment of where a room is today and what the next target might be for its evolution (Figure 4.1). The direction of planned, conscious evolution should be toward the lower right, meaning more integration and more functional capability.

It is important to progress from Level 1 to 6 and from Stage 1 to 3 in an orderly manner. It is important to target a limited number of goals at one time at the next level of improvement and not try to do too many changes at the same time or attempt changes that are too large. The evolutionary process will take years, not a few weeks.

The second step in experimentation and continuous improvement is to generate submissions that present ideas to improve operations. Common practices to do this include the following:

- Get feedback from all personnel on how SDSC operations are working and what the problems are. This can be done through a combination of formal means (e.g., surveys) and informal means (bimonthly, informal coffee sessions).

Figure 4.1
Characterizing SDSCs by Functional and Integration Capability

Functional and integration capability	Stage 1: No integration	Stage 2: Partial integration	Stage 3: Full integration
Level 1: Provide information			
Level 2: Acquire data			
Level 3: Acquire tools			
Level 4: Analyze data			
Level 5: Evaluate impacts			
Level 6: Create new strategies			

- Have external persons visit rooms to observe and ask "naive" questions about what is going on and how operations might be improved.
- Include continuous improvement in policies and procedures, with SOPs and policies that reflect institutional backing for needed change.
- Have dedicated discussions once per month or so on ideas for improvement.
- As part of monthly newsletters, write up challenges or problems that need ideas to solve.
- Provide incentives for staff to submit ideas for improvement, including by (1) always having dedicated groups to review and provide feedback on submitted ideas and (2) providing rewards for successful ideas (or ideas that, even if not done, showed substantial merit). The number of ideas can be limited and pre-vetted by requiring at least two staff to work together on each submitted idea.

The third step, which involves change management, is to experiment with successful ideas. Change management tips are discussed in the Better Policing Toolkit (Hollywood, Lauland, et al. 2018). Common change management approaches that appear to be especially relevant include the following:

- There is a strong need to have a positive view of innovations and controlled improvement, which specifically includes being open to failures (provided those failures are not catastrophic). Honda famously had a philosophy of encouraging a success-to-failure ratio of 99 failures for every success as it grew in quality and market share.
- Change leaders need to meet with stakeholders, work to understand any issues they have, and address those issues throughout the project, using both formal and informal means.
- The core sequence of implementing change is: (1) why do it, what is the problem, (2) what needs to be done, (3) figuring out how it needs to be done, (4) actually doing it, (5) doing it repeatedly, and (6) reducing variance. After step 6, you can then consider a seventh step: reducing waste and increasing efficiency. That is, focus first on effectiveness and then on efficiency.
- Standardizing change involves thinking about specific "hows" and "whats" to help mistake-proof new practices. A classic approach is the mistake-proofing process pioneered by Shigeo Shingo (Shingo, 1986) combined with the cause-effect analysis methods of Kaoru Ishikawa. This approach simply involves explicitly diagramming the new process and analyzing each step for possible mistakes.
  - New process descriptions need to explicitly allow for variations, uncertainties, and contingencies.
  - There is also a need to include specific provisions for reviewing and changing the standards over time.
  - There is a need to include how implementers can incorporate reasonable judgment and tailor the processes using context.

Expanding the Scope of SDSC Operations

The SDSCs are primarily scoped as patrol-supporting activities, which include developing crime patterns and hot spots and corresponding resource allocation. We observed and discussed several cases of cooperation outside of patrol support, including collaboration with

- detectives to solve cases
- citywide, dedicated units on tasks at hand
- Cook County prosecutors to discuss what needed to be done to charge suspects for major crimes
- external agencies, including both local law enforcement and federal agencies (FBI, Bureau of Alcohol, Tobacco, Firearms and Explosives) on various task forces and crime problem-solving.

We recommend that these collaborations be adopted as standard practices for SDSCs. We see supporting crime-solving (and prosecutors) as an especially crucial opportunity to improve Chicago's clearance rates. The BJA recently funded a guidebook of organizational structures and procedures employed by agencies that consistently clear more than 80 percent of their homicides (Carter, 2013); this guidebook could be useful to the CPD and the SDSCs.

Improving SDSCs' Support of Patrol Operations

From Generic Responses to Problem-Oriented Responses to Crime Problems

Although decision-support capabilities at all levels were observed and were reported to have improved substantially because of SDSCs, what the decisions were about tended to be somewhat generic. The most common responses to identified crime problems were increases in patrol activity into problem areas, perhaps coupled with extra camera-viewing time (e.g., virtual patrol). SDSCs would benefit by considering a larger range of problem-oriented policing solutions. The Better Policing Toolkit's guide on problem-oriented policing introduces core strategies and methods that are the most promising in making major-crime reductions (Hollywood, Lauland, et al., 2018). This guidance includes having structured and in-the-field discussions with residents to get information on crime problems and then systematically solve them (a seemingly obvious method that is surprisingly uncommon in policing), as well as identifying and brokering services needed by local communities to reduce local criminal involvement and victimization. The Center for Problem-Oriented Policing maintains a large library of guides that present ideas for solutions to specific crime problems (Center for Problem-Oriented Policing, undated).

An Example Strategy to Emulate: District 7 and Community Collaboration

District 7 achieved the highest number of significant crime reductions, with shootings and homicides reduced on the order of 40 percent. The distinct feature of District 7 in comparison with the other SDSCs we observed and interviewed was its focus on a certain form of collaboration with the community. This practice involved gaining trust with community residents and having positive community interactions with them; such interactions were intended to generate useful information to reduce or solve crimes, rather than just having positive community interactions for the purpose of checking boxes. Furthermore, all officers in District 7 were expected to engage in this activity, not just designated community policing officers.

To set the stage for these engagements, leadership emphasized community trust and legitimacy. As one senior officer noted, community tips are what lead to targeted crime prevention and solving crimes. It was further noted that getting these tips depends on trust from community residents, and that trust is hard to build, takes only seconds to destroy, and takes years to rebuild. Leaders also noted that improved trust makes operations safer for officers, because residents are more likely to provide useful information than fight them. It was noted that offi-

cers in District 7 were expected to be respectful but not weak. District 7 leadership were seeking to get implicit bias and procedural justice training to further improve community relations at the time of our interviews.

Personnel in District 7 were then encouraged to get out of their cars and engage the community frequently and consistently, including by talking with residents on the street and visiting stores and libraries and talking with residents there. They also attended informal residents' gatherings (parties, etc.) and, assuming the gatherings were not illegal, engaged residents in conversation rather than carrying out enforcement actions. Also of use was officers providing cards with personal email and phone numbers as another way to get tips. The commander during the observation period described sometimes being woken up by calls but said that the tips received were worth immediately forwarding to the SDSC.

The one significant weakness we observed was that the SDSC, and District 7 more broadly, was not making systematic use of the tips. Instead, individual officers were described as keeping their own notepads, and we were told that there were many cases in practice in which the tips were discussed and acted on informally (or reached sufficient criticality that they were immediately reported to the SDSC for action).

This type of activity, in which all officers are expected to build trust and collect actionable information as a result, and subsequent major reductions in crime, are consistent with prior studies of policing interventions. We recently found that the problem-oriented policing experiments with the biggest crime reductions were associated with this type of activity. Intuitively, districts need to learn about crime problems to solve them, and it is the residents who often know about crime problems. Along these lines, the CPD has informed us that they have obtained a grant from the Office of Community-Oriented Policing Services to collect and share information about community problems in a new dashboard display.

We recommend disseminating and duplicating this activity, including trust-building and active positive engagements and data collection. We further recommend systematically collecting and analyzing the resulting tips, making sure that key information moves outside of individuals' notebooks.

Enhancing Camera Operations During Virtual Patrol Missions

Operationally, we noted that cameras being used in virtual patrol (i.e., not supporting the response to a specific incident) were often left on the same view for long periods. In contrast, camera operators in other marquee camera surveillance operations, such as Detroit's Project Green Light and Baltimore's Citiwatch, frequently cycle between camera feeds, immediately switching feeds if nothing of interest is on screen. Adopting this technique could help SDSC's camera monitors greatly increase the amount of actionable events they find. Video analytics technologies, as they mature, hold promise for helping detect actionable events and capturing actionable footage, as well.

Opportunities for Technology

We found the technology in use at the SDSCs was broadly appropriate and suitable, with opportunities for improvement.

Display Integration

The biggest shortfall observed was the lack of integration, with the shot detection tool (ShotSpotter) and the predictive policing tool (HunchLab) being on separate screens from the

SDSCs' main situational awareness tool (Citigraf). The result was that these tools (especially HunchLab) sometimes were left off to the side. If technically feasible, we recommend integrating ShotSpotter's shot location hits and HunchLab's predictive squares (along with any information HunchLab can provide on what inputs were driving risk) into the Citigraf map display. Similarly, it would be of value to expedite integrating Citigraf data into Tableau to build automated performance dashboards, reducing analysts' workload.

In general, any tool that provides operationally useful location hits, either as event or point of interest icons or shapes, should be integrated into the Citigraf tool.

Camera Upgrading and Relocating

Cameras were described as key technologies throughout SDSC operations. That said, there were reported limitations because of the age of cameras, resulting in cameras that either could not provide sufficient resolution to support operations or that were broken down. It was also noted that some cameras were no longer in operationally ideal locations. There were also multiple requests for more cameras in general.

We recommend upgrading, relocating, and adding cameras as operational demands justify and as funds allow. Furthermore, we recommend developing analytic models that could help place cameras, identifying specific locations likely to capture the most events of interest, given recent historical data.

Transparency and Community Involvement in Camera Management

As the number of cameras on the network becomes ever greater, and as more private cameras are included, we envision an increasing need for transparency and community outreach to collectively identify policies for which cameras should be included and where, when they should be looked at, and other provisions to provide for public safety while protecting privacy rights.

SDSC App Display Integration

The SDSC app was identified as providing a variety of useful information to officers in the field. However, it had the limitation of providing different types of information on different screens. We identified a need for a "what's important now" screen that would push information that is most relevant to officers in the field at a given time.

CVRM Party-to-Violence Risk Assessment

The CVRM was reasonably effective at identifying persons at an elevated risk of being a PTV. However, we found that the tool was not operationally suitable because (1) it has never been integrated into CPD systems and operations, and it appears it might never be considering the developers' exit from the project; (2) it has taken months to years to prepare new risk assessment lists offline, despite the results being highly time sensitive; and (3) the tool does not provide data to guide what interventions should be prescribed to those at high risk.

We recommend rethinking the CVRM risk assessment tool, and risk assessment tools in general, with an eye toward tools and supporting methods that (1) are based on recommending specific services and interventions, and (2) are integrated with service providers, including treatment providers, outside of the CPD. Transparency and community participation and buy-in will be of high importance with any such tool.

Summary of Recommendations

Table 4.1 summarizes the major opportunities to sustain and expand on the early success of SDSCs. Issue 1 concerns improving the range of operations that SDSCs support. Issues 2–5 are focused on improving the internal structure and organization of SDSCs. Issues 6–8 are focused on technological improvements.

The CPD has informed us that they have developed, based in part on recommendations from this report, a new SDSC Oversight Panel, which includes participation from all bureaus and representatives from the University of Chicago Crime Lab. The panel coordinates the implementation and management of the SDSC initiative to ensure that goals and objectives are achieved. The CPD has also developed a series of Department Directives to define the SDSC initiative's key focus areas and to articulate roles and responsibilities. These directives include Day-to-Day Operations, overseen by the Chief of Patrol; Strategy Review, Compliance Monitoring, and Coordination, overseen by the Deputy Chief of Crime Control Strategies; Infrastructure and Technology, overseen by the Chief of Technical Services; and Training, overseen by the Chief of Organizational Development. The CPD's new processes and policies are intended to ensure that, per this report's recommendations, effective SDSC operations are normalized and are subject to regular review and improvement. The CPD is also continuing to develop the supporting technical systems; it is now testing a version of its decision support system (Genetec Citigraf) that runs on Android for smartphone use.

Conclusion

We found that SDSCs, going well beyond monitoring cameras and sensors, serve as command, control, and communications centers for personnel to gain awareness of what is happening and to decide on responses. As a result, policing decisions can be made with a much higher level of quality—timelier, more complete, and more accurate—than was typically possible before. SDSCs can also enable new types of policing activities, such as real-time reactions to events on camera. The potential of these centers is shown by their additions being consistently associated with reductions in crime. Going forward, top priorities include sustaining progress to date and improving operations over time so that the centers better support their objectives of reducing crime (ideally going from 5–15 percent reductions to 25–40 percent reductions), holding more offenders accountable, improving service times, and improving officer safety.

More broadly, we see SDSCs as a promising model for improving law enforcement agencies' awareness of their communities, improving their decisionmaking, and carrying out more effective and more efficient operations that lead to crime reductions and other policing benefits. Agencies interested in this model will also benefit from reviewing the types of issues and opportunities identified in this paper to help ensure the sustainment and improvement of RTCCs over time.

Table 4.1
Summary of Recommendations

Issue	Opportunities
1. Field operations being supported by SDSCs are largely reactive and limited to local patrol operations.	• Expand the scope of SDSC operations, including by expanding support to crime investigations. • Conduct broader training on problem-oriented policing strategies used by SDSCs and district personnel. • Emulate District 7's collaboration with community residents, specifically its ongoing positive interactions (events and informal interactions) in which officers collect information about crime problems and work to resolve them.
2. Sustainment and evolution of SDSCs are not fully integrated into the institutional fabric of the CPD, including its practices, policies, and procedures.	• The lack of common SOPs and directives across all the SDSCs presents a significant risk. Policies and directives must address issues such as continuous improvement, integration within the district, advanced risk management practices based on analytical results, and so forth. • Update the SDSC order to reflect the type of tasks and skills being used, per the functional capability maturity model. • Funding should be allocated through normal, standard budgeting procedures for room maintenance and improvements (the what and the how—i.e., effectiveness and efficiency).
3. Performance-monitoring is limited.	• Use the Functional Capability Maturity Model, Levels for Integration, and Common Success Factors for Hubs as the basis for a scorecard on the rooms' efficiency, effectiveness, reach, and capability improvements. • Have updated objectives that recognize the early gains to date. • Use the cause-and-effect (Ishikawa) model to identify likely causes for performance measurements and take remedial actions as needed.
4. Organizational learning and opportunities to drive innovation are limited.	• Adapt organizational learning approaches to include methods for obtaining knowledge, such as lessons learned logs; methods for sharing knowledge, such as inter- and intra-SDSC meetings and learning rotations; and methods for sustaining knowledge, such as capturing effective and efficient practices in guidebooks and training material. • Expand training and onboarding, including for transitioning leaders and for personnel in the field. • Using performance-monitoring results, adopt continuous improvement and change management measures to support improving operations over time.
5. Recruiting and retention measures are needed.	• Bolster the recruiting and retention of SDSC staff at all levels, furthering expertise. • SDSC supervisors should be as senior as possible, ideally at the level of lieutenant. • Adopt group identity and morale-building measures.
6. Key information is displayed across multiple tools.	• Within the SDSC, integrate shot detection, dispatcher information (including calls yet to be assigned), priority license plate reader hits, and forecasts of high-risk areas and times (from predictive policing software) into the core public safety mapping display. • For the field, develop a "what's important now" screen on the app that would push the information that is the most relevant to officers in the field at a given time.
7. Camera operations and placement should be improved.	• Adopt marquee camera surveillance operations, including by cycling between camera feeds and immediately switching feeds if nothing of interest is on screen. • Develop analytic models that could help place cameras, identifying specific locations likely to capture the most events of interest, given recent historical data. • Develop models and procedures for moving PODs to more operationally useful locations, with a rough target of up to 10 percent of PODs moved per year, should the data warrant. • Plan for additional transparency and community outreach as the number of cameras online continues to increase.
8. CVRM needs to be redirected toward operationally suitable recommendations.	• Migrate from the current CVRM toward tools that can recommend specific services and interventions that go beyond simple "high-risk" flags. • Using any such tool effectively will require collaboration with external service providers and community engagement.

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