Realizing the Potential of Technology in Policing

A Multisite Study of the Social, Organizational, and Behavioral Aspects of Implementing Policing Technologies

GEORGE MASON UNIVERSITY

POLICE EXECUTIVE RESEARCH FORUM

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Practitioner's Brief

Understanding the effects of technological change is a critical issue in contemporary policing. In recent decades, there have been many important developments with respect to information technologies (IT), analytic systems, video surveillance systems, license plate readers, DNA testing, and other technologies that have far reaching implications for policing. Technology acquisition and deployment decisions are high-priority topics for police, as law enforcement agencies at all levels of government spend vast sums on technology in the hopes of improving their efficiency and effectiveness.

It is not clear whether these changes have made police more effective. Evaluation research on police technology has tended to focus more on operation and outputs—for example, whether a technology works and makes a process faster—than on its effectiveness in reducing crime or improving service to citizens. And the evidence that is available on technology and police performance suggests that technology's impacts may be limited or offset by many factors ranging from technical problems to officer resistance. Developing a better understanding of technology's impacts and how they can be optimized is thus an important challenge for police agencies, particularly those hoping to leverage new technologies as a force multiplier to offset budget and staffing limits.

Toward this end, we investigated many of the social, organizational, and behavioral aspects of implementing police technologies in this study for the National Institute of Justice. Our goals were to more fully understand technological changes in policing and make recommendations for optimizing the use of technology in policing. Using a multimethod approach in four large agencies (both urban and suburban) that included officer surveys, field observations, extensive interviews and focus groups, and experimental and quasi-experimental evaluations, we investigated the uses and impacts of several information, analytic, surveillance, and forensics technologies that are central to everyday police functions (e.g., IT and mobile computing, crime analysis, and license plate readers). This approach allowed us to examine how these technologies affected police—in intended and unintended ways—with respect to operations, management, agency structure, culture, efficiency, effectiveness, citizen interaction, and job satisfaction. At the same time, we also tried to assess how various aspects of police organizations, culture, and behavior shape the uses of technology—and hence its impacts.

We found that technology's effects are complex and contradictory; technological advances do not always produce straightforward improvements in communication, cooperation, productivity, job satisfaction, or officers' effectiveness in reducing crime and serving citizens. Desired effects from technology, such as improving clearance rates and reducing crime, may take considerable time to materialize as agencies adapt to new technologies and refine their uses over time. Some of these challenges stem from implementation and functionality problems with new technology, which can have negative and potentially long-term ramifications for the acceptance, uses, and impacts of that technology. Further, while technology can enhance many aspects of police functioning and performance, it can detract from others (for instance, the reporting requirements of new IT and mobile computing systems may reduce the time that officers spend interacting with citizens or doing other proactive work).

Perhaps more fundamentally, police may fail to make strategically optimal uses of technology for reducing crime or achieving other aims such as improving their legitimacy with the community. One key finding is that because many officers tend to frame policing in terms of reactive response to calls for service, reactive arrest to crimes, and adherence to standard operating procedures, they emphasize the use of technology to achieve these goals. To illustrate, officers in our study sites were much more likely to use IT to guide and assist them with traditional enforcement-oriented activities (e.g., locating persons of interest and checking the call history of a location) than for more strategic, proactive tasks (e.g., identifying hot spots to patrol between calls or doing preventive problem solving). They were also much more likely to find their job satisfying when they used technology in these traditional ways.

This is not to say that technological advancement in policing is undesirable and will not bring improvement. However, technological changes may not bring about easy and substantial improvements in police performance without significant planning and effort, and without infrastructure and norms that will help agencies maximize the benefits of technology. Strategizing about technology application is thus essential and should involve careful consideration of the specific ways in which new and existing technologies can be deployed and used at all levels of the organization to meet goals for improving efficiency, effectiveness, and agency management.

Our recommendations to police practitioners are discussed in detail in Section 12 of this report. In brief, they include: allowing for a broad base of participation in the technology planning and implementation process by various personnel who will be affected by the technology; providing ample opportunities for pilot testing and refining early versions of a technology; ensuring proper levels of training for new technology; and preparing a systematic and continuous approach to follow-up, in-service training, reinforcement, ongoing technical support, and adaptation to new lessons.

To reap the full potential benefits of technological innovations, police must also arguably address traditional and long-standing philosophical and cultural norms about the role of law enforcement. Most notably, training about proactive and evidence-based strategies—and how technology can be used in support of those strategies—is needed. How, for example, can officers use their agency's information systems and crime analysis to guide their patrol activities between calls for service, identify and address problems at hot spot locations, and monitor high-risk people in their areas of responsibility? At the same time, how can managers use these technologies to encourage such work by their subordinates?

Developing an infrastructure in policing for maximizing technology's potential will also require both police and researchers to make a commitment to a strong research and development agenda regarding technology. Police can facilitate this process, for starters, by making greater efforts to systematically track the ways that new technologies are used and the outcomes of those uses. Researchers can assist practitioners by collaborating on evaluation studies that carefully assess the theories behind technology adoption (i.e., how and why is a particular technology expected to improve police effectiveness), the ways in which technology is used in police agencies, the variety of organizational and community impacts that technology may produce, and the cost efficiency of technology. In addition, research is needed to clarify what organizational strategies with respect to training, implementation, management, and evaluation are most effective for achieving desired outcomes with technology and avoiding potentially negative unintended consequences.

In all these ways, greater attention to technology implementation and evaluation by police and researchers can help police agencies optimize technology decisions and more fully realize the potential benefits of technology for policing. We hope you find this report helpful in your efforts.

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Foreword

By Chuck Wexler (Executive Director, Police Executive Research Forum)

I am pleased that the Police Executive Research Forum and George Mason University were able to conduct this important research project about policing technologies for the National Institute of Justice. New technologies are changing almost all aspects of our society, and the field of policing is no exception.

For a decade or more, police departments have been using a growing array of technologies, including crime mapping systems, predictive analytics software, license plate readers, gunshot detection systems, DNA evidence, dash cameras, body-worn cameras, social media, data mining tools, cellphone tracking, and automated monitoring of security cameras. Many police chiefs tell us that a big part of their job is studying all these technologies and how they fit together. Each city, town, or county must choose the technologies that best address the local crime problems. A city that has many car thefts but few shootings will probably spend its technology dollars on license plate readers, not a gunshot detection system. Furthermore, a technology that looks good on paper is sometimes disappointing in the real world.

The National Institute of Justice deserves credit for recognizing the need to explore technologies from the viewpoint of how they are actually being implemented in police agencies.

This report summarizes what the researchers found through case studies in four jurisdictions. By conducting interviews, focus groups, and surveys of police officers and civilians from various units and ranks, they were able to identify the "live issues" that can determine whether a new technology will fail or succeed. Here are a few of their findings:

Ease of use and a direct connection to the job of policing: *The researchers found that officers are more likely to embrace a new technology if it is easy to use and they can see directly how it helps them do their job. Officers in one agency were enthusiastic about automated license plate reader (LPR) systems, because officers could quickly see the benefits every time an LPR generates a "hit" on a stolen car.*

However, this same agency ran into problems implementing a new computerized records management system (RMS). Officers found it time-consuming to file their reports electronically, especially because the new system required much more detailed reporting about crimes.

Another frustration developed because officers were told that they would be able to file reports on mobile data terminals in their vehicles. This was promoted as an advantage, because the officers could remain in the field, maintaining a police presence on the street, rather than spending time at a precinct station manually writing reports. But in practice, the system was cumbersome and the wireless service was spotty, so filing reports electronically required time and close attention. Some officers expressed concern that they were losing "situational awareness" as they sat in their cars, huddled over their computers. This can become an issue of officer safety.

Finally, the value of the detailed crime data in the new RMS was evident to crime analysts, but not so much to the officers in the field tasked with entering the data. Because the training hours devoted to the new system were limited, the training focused on the mechanics of entering data into the system, rather than how the new system could be used for proactive purposes of investigation and problem solving.

So officers complained that the new RMS actually reduced their productivity. The agency saw a drop in traffic citations, because some officers said it was "wasn't worth it" to make traffic stops, given the difficulty of the computerized report-writing system.

***Officer safety**: From the standpoint of officers, the improvement of criminal justice databases and mobile computer systems has been very useful. Today, officers making a traffic stop or responding to a 911 call can quickly obtain information about what to expect from the motorist or the person who called the police. For example, one officer said, "If you make a traffic stop for speeding and see that [the motorist] has been arrested four times for drugs, you will pay a lot of attention." Similarly, officers responding to a domestic violence call can obtain information about previous domestic violence calls or a history of violence at the same address.*

***Investigations vs. crime prevention**: The researchers also discovered that officers are enthusiastic when they can see that a technology saves them time and makes them more effective. For example, detectives can retrieve information in seconds that in the past would have required manual searching of paper files at the records management division. "Fact-checking on suspects and witnesses can be done very quickly," one officer said. A detective added, "Information that would have taken a whole team in homicide to collect over several weeks can take a couple of guys a few days now." Data-sharing systems such as LInX, which connect various databases across multiple jurisdictions, allow investigators to obtain useful information quickly – sometimes based on very limited data, such as a suspect's nickname, or a partial license plate or telephone number.*

However, while the researchers found strong support for technologies that help police to investigate crimes, they found that officers are much less likely to discuss the effectiveness of technology in terms of preventing crime. Detectives can see how technology helps them to close cases. But the researchers uncovered a need to help officers see technology's role in hot spots policing, repeat offender units, and other crime reduction strategies.

I believe that there is an opportunity for leadership by police chiefs here, to bring a greater focus on how technology can help promote safer communities. Advances in technology clearly are one of the most important developments in policing today. These findings and the collaboration between GMU and PERF emphasize the value that research can bring to law enforcement for this priority topic. I hope that you will find this report useful.

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1. Project Overview and Summary of Key Findings[1]

1.1 Impact of Technology on Policing

Technological advancements have shaped modern policing in many important ways. One need only consider that the primary police strategy for much of the 20th century—motorized preventive patrol and rapid response to calls for service—was developed in response to the invention of the automobile, two-way radio communications, and computer-aided dispatch (911) systems. More recent technological developments have also had far-reaching effects on police agencies. Information technology (IT), video surveillance systems, DNA testing, and bullet-resistant vests, for instance, are now common and critical tools in law enforcement. Contemporary concerns over homeland security and counterterrorism have created new technological problems and demands for police, as has the growth of computer-related crime. Indeed, the late 20th and early 21st centuries have been periods of particularly rapid technological change in policing.

Yet while technological change is a fundamental force in policing that holds great promise for enhancing the effectiveness, fairness, and even legitimacy of police, relatively little research has been done on the impacts of technology in policing beyond technical, efficiency, or process evaluations (Lum, 2010a). Further, the research that is available suggests that technology does not necessarily bring anticipated benefits to police agencies; in some cases, it may even have unintended undesirable consequences (Byrne and Marx, 2011; Koper, Taylor, and Kubu, 2009; Lum, 2010a; Manning, 1992a). For example, technology may create more inefficiency in everyday tasks, have no impact on crime, or isolate the police from the community. Technology can substantially challenge organizational culture, create changes in unit and personnel relationships and power structures, and alter functions and purposes of the police. For all of these reasons, there is a need to more deeply understand how technology affects police agencies (e.g., in terms of

[1] Portions of this chapter are adapted from the article "Optimizing the Use of Technology in Policing: Results and Implications from a Multi-Site Study of the Social, Organizational, and Behavioral Aspects of Implementing Police Technologies," written by Christopher S. Koper, Cynthia Lum, and James J. Willis, and published in *Policing: A Journal of Policy and Practice* (year 2014, volume 8, issue 2, pages 212-221).

their operations, structure, culture, effectiveness, and legitimacy) and how, in turn, various aspects of police agencies and their environments shape the uses and effectiveness of policing technology. Developing a better understanding of how and why technologies affect law enforcement processes and outcomes—either positively or negatively—is essential to making sound decisions about technology adoption and use.

1.2 Research Questions

This report presents results from a multisite study funded by the National Institute of Justice (NIJ) to investigate the social, organizational, and behavioral implications of police technologies. In broad terms, the goals of the study were to: advance theory on the relationship between technology and policing; broaden thinking about outcomes and also collateral consequences of technology acquisition; help police agencies anticipate the impact that technology will have on personnel, units, and job satisfaction; and understand changes that agencies need to make to optimize the use of technology.

In pursuit of these goals, the research team focused on the uses and impacts of "core" technologies believed to be fundamentally important to policing. These include information, analytic, surveillance, and forensic technologies that are critical to primary police functions. Research questions that we addressed with respect to these technologies included the following:

- How and for what purposes are technologies used in police agencies across various ranks and organizational subunits?
- How do technologies influence police, at both the organizational and individual levels, in terms of operations, structure, culture, behavior, satisfaction, and other outcomes?
- How do these organizational and individual aspects of policing concurrently shape the uses and effectiveness of the technologies?
- How do the uses of these technologies affect crime control efforts and police-community relationships?
- What organizational practices and changes—in terms of policies, procedures, equipment, systems, culture, and/or management style—might help to optimize the use of these technologies and fully realize their potential for enhancing police effectiveness and legitimacy?

To answer these questions, we identified from the theoretical and empirical literature nine key issues, or themes, to explore using different types of methods within each of the four agencies. These themes, which we used to guide all aspects of the study, speak to the behavioral, social, and organizational aspects of policing that might be impacted by technological change. They include:

- An agency's experiences with technological innovation
- Police culture
- Organizational units, hierarchy, and structure
- Internal accountability and management systems
- Individual officer/supervisor discretion and decision making
- Efficiency of police processes and daily work productivity
- Effectiveness in reducing crime (prevention, detection, and deterrence)
- Police-citizen communication and police legitimacy
- Job satisfaction

We used various methods to investigate how our highlighted technologies affect these contextual aspects of policing, while also assessing how these contextual factors themselves shape the uses and impacts of the technologies.

1.3 Study Design, Methods, and Limitations

The research team investigated these issues through multimethod case studies conducted in four large police agencies (each with over 1,000 officers) serving a mix of urban and suburban jurisdictions, denoted Agency 1, 2, 3 and 4. For each, we studied information technologies (particularly mobile computing technology) as well as one to two other analytic, surveillance, or forensics technologies. The case study agencies were selected because of their particular experiences with one or more technologies of interest. In some cases, the agencies had extensive experience with these technologies; in others, they were still adapting to major technological changes or testing new innovations. This provided useful contrasts across the sites and helped us assess short and long-term consequences of technological change. Agency 1 is a suburban county police agency that had recently implemented a new records management system (RMS) and expanded its license plate reader (LPR) capability. Agency 2 is an urban sheriff's office with highly sophisticated crime analysis capabilities and a strong command emphasis on the use of crime analysis in its operational decisions. Agency 3 is a suburban county police agency that has its own forensics lab and is transitioning into greater use of in-car video cameras and LPRs. Agency 4 is an urban municipal police agency that has for many years equipped its entire fleet of patrol cars with cameras.

In each study site, the case studies entailed interviews, focus groups, field observations, and personnel surveys that explored the key study themes as they applied to information technology systems and the other selected technologies in the agency. In Agencies 1 and 2, the research team also conducted field evaluations and other analyses to evaluate the uses and impacts of selected technologies. In all four agencies, our methods included the following:

- **Sworn officer survey (Section 5).** We developed a technology survey (Appendix A) that was administered to all sworn personnel in the study's four agencies. The survey addressed the key themes discussed above, particularly as they pertained to information technology and analytic systems. Overall, we received responses from approximately 1,700 officers.

- **Focus groups, interviews, and field observations (Sections 6 and 7).** Interviews, focus groups, and field observations were conducted with sworn and civilian personnel from various units and ranks in each agency. The George Mason research team conducted the interviews and focus groups in Agencies 1 and 2, while the PERF research team assumed primary responsibility for the fieldwork in Agencies 3 and 4. In sum, the research teams interviewed 100 individuals in Agency 1, 141 in Agency 2, 45 in Agency 3 and 53 in Agency 4 using a semistructured interview/focus group instrument (Appendix B) that was aligned with the key study themes noted above.

In two agencies, the George Mason team also conducted a series of studies to assess the impact of technologies on different measures of agency effectiveness with respect to crime reduction. These included:

- **Trend analysis (Section 8).** In Agency 1, we examined before and after trends in crime and case clearances following the agency's implementation of a new RMS and an expansion of its LPR deployment.

- **Field experiment (Section 9).** In Agency 1, we examined the use and impacts of mobile information technology as part of a randomized experiment on hot spots policing.

- **Quasi-experimental and process evaluation (Section 10).** In Agency 2, we conducted a quasi-experimental evaluation of the effects of an internal information-sharing social media technology on the outcomes of robbery investigations

Limitations to the study should also be noted. The study is based on a small convenience sample of large police agencies. Further, our findings and conclusions are based most heavily on Agencies 1 and 2, where the research team conducted the most intensive fieldwork and obtained the highest survey response rates. Focusing on a small number of agencies enabled us to probe the research questions more deeply and make more holistic and multi-faceted assessments of technology's effects in each agency. Comparisons across the agencies also enabled us to identify commonalities and assess what cross-agency differences might imply about technology's variable impacts across different organizational contexts. The study illuminates difficulties and complexities that police agencies can face in dealing with technological change; nevertheless, caution is warranted in generalizing the findings to other agencies, particularly small ones.

In addition, many of our assessments of technology's impacts are exploratory in nature. In particular, our interviews and agency surveys (Sections 5 through 7) investigated agency personnel's experiences with and perceptions of technology. They provide insights into the dynamics of technological change in police agencies but not a basis for rigorous cause and effect assessments of technology's impacts (rather, their intention is to provide some bases for future research, innovation, and testing).

Finally, those portions of the study that entailed quantitative outcome evaluations (Sections 8 through 10) focused on crime-related performance and outcome measures such as crime levels and case clearance rates. (Other limitations to those analyses are noted in the appropriate sections.) Although we explored other organizational and community impacts from police technology in our survey and interviews, these are important topics for more systematic and in-depth inquiry.

1.4 Summary of Findings and Results

Our findings reinforce the notions that the effects of technology in policing are myriad and complex and that advances in technology do not always produce obvious or straightforward improvements in communication, cooperation, productivity, job satisfaction, or officers' effectiveness in reducing crime and serving citizens. Indeed, the uses and impacts of technology can be quite variable both within and across agencies as shown by our officer survey results. Implementing technology effectively and using it in the most optimal ways seem to be most challenging at the line level in patrol, but much can depend on management practices, agency culture, and other contextual factors. Further, desired effects from technology (like improving clearance rates and reducing crime) may take considerable time to materialize, if they do at all, as agencies adapt to new technologies and refine their uses over time.

Below, we present some broad generalizations from our findings. (See Section 11 for a more detailed synthesis of findings pertaining to each of the key themes identified above.)

The Difficulties and Complexities of Technological Change

The first generalization concerns the difficulties and contradictory effects of technological change. While cultural resistance to change is a common impediment to innovation in policing, technologically-based changes present additional complexities. For starters, implementation experiences and functionality problems with new technology have important ramifications for the acceptance, uses, and impacts of that technology. Agencies often struggle with technology implementation, particularly at the outset of using a new technology. Patrol officers' satisfaction with how their agencies implemented new technologies was no more than 60% across our agencies (the high was for Agency 2) and ranged from 11% to 36% across most of them. Agency 1, for example, experienced many difficulties with its new RMS that stemmed from technical problems, user interfaces that officers found difficult and cumbersome to use, and the requirement that officers learn new offense codes at the same time they were learning to operate the new system. This had negative effects on officer attitudes and performance that were still evident two to three years later, at which time 62% of patrol officers reported that the agency's IT had not made them more productive and 70% reported that it had not improved their job satisfaction. (In contrast, the corresponding figures for Agency 2, where the IT systems were more mature and refined, were 14% and 29%.) In Agency 1, officers commonly remarked that the difficulties of using the new RMS had even reduced proactive work like traffic stops as well as discretionary time to "go the extra mile."

Agency 1 was not alone in having such problems; in Agency 4, 54% of officers felt that IT had not enhanced their productivity and 68% indicated that it had not improved their job satisfaction. Moreover, it was common across agencies in our survey for patrol officers to feel that there was a need for more staff input in the development and adoption of technologies (a third or fewer of respondents felt their agency worked hard to get input from staff on new technology) and a need for more technical assistance and training in the implementation and use of technology (in most agencies, half or fewer of respondents felt technical support was sufficient). This would seem to be particularly true for IT and analytic technologies which have the potential to substantially transform police work and greatly impact line-level officers.

The findings on productivity and job satisfaction suggest that technology's effects can be complex and contradictory. As another illustration, many officers felt technology could improve communication across units, especially when coupled with the shared goal of reducing crime. Yet, they also recognized that technology could undermine work relationships. In the case of first-line supervisors, for example, having to sift through large amounts of data and respond accordingly drained time from other valuable activities, such as mentoring and guiding patrol officers. Technology can also worsen perceptions of inequality for line-level staff, particularly patrol officers who may feel heavily burdened and scrutinized by the reporting demands and monitoring that often come with new information and surveillance technologies (in-car and body-worn cameras provide examples of the latter). Indeed, rank and file officers were not highly inclined to believe that IT improved supervision and management in their agencies (23% to 58% agreed across agencies that this was true) despite its seemingly high potential to improve accountability. In discussions, officers expressed the view that quantitative, technology-driven assessments of performance need to be balanced with more qualitative, holistic evaluations that take account of multiple factors that might affect an officer's activity counts. All of these factors can foster resistance to technology and undermine its potentially positive effects.

Limitations to the Strategic Uses of Technology

A second critical generalization that emerged from our study is that police often fail to make strategically optimal uses of technology for reducing crime or achieving other aims like improving their legitimacy with the community (for brevity, we focus on the former issue in this summary). Perceptions and uses of technology are highly dependent on the norms and culture of an agency and how officers view their function (i.e., technological "frames" in the words of Orlikowski and Gash, 1994). Because officers continue to frame policing in terms of reactive response to calls for service, reactive arrest to crimes, and adherence to standard operating procedures, they use and are influenced by technology to achieve these goals.

To illustrate, officers were much more likely to use IT to guide and assist them with traditional enforcement-oriented activities than for more strategic, proactive tasks. Across the agencies, for example, 42% to 74% of patrol officers reported using IT often or very often to locate persons of interest and 63% to 81% did so to check the call history of a location or person before responding to a call. In contrast, 14% to 49% used IT often or very often to determine where to patrol between calls (indicative of hot spots policing) or to determine how to respond to a crime problem (indicative of problem-oriented policing). In our interviews, it was clear that officers were much more comfortable using technology to respond, enforce, react, and arrest. When given a wide range of options for using mobile computers as part of a hot spots patrol study, for instance, officers in Agency 1 overwhelmingly used IT for the actions they understood and knew best—running license plates for suspicious vehicles and wanted persons. Similarly, we found in our interviews that supervisors were less likely to use IT to form crime prevention strategies with their subordinates and more likely to use it to check reports and assess performance measures of officers and squads.

In sum, officers and supervisors often use technology in support of discretionary activities, but they are less likely to use technology to strategically guide those activities. This was true even in Agency 2, although officers in that agency were considerably more likely to use technology for proactive and prevention-oriented tasks due no doubt to the emphasis of Agency 2's leaders on proactivity and crime analysis.

Technology sometimes changes officers' behaviors (such as when an LPR officer changes his or her patrol style or routine to better make use of the technology, or when an officer chooses to use crime analysis to guide his or her patrolling between calls), but this seemed to be very individualized in the agencies, as the officers received little in the way of consistent training or direction on ways to optimize technology use in their daily work and deployment habits. Our observations suggest that while technology has fostered accountability at higher managerial levels in policing (for example, through Compstat-type management processes), the innovative use of technology as a tool by middle and lower-level supervisors to manage the performance of line-level officers still is neither institutionalized or clearly understood. Indeed, in most of our agencies (including Agency 2), less than half of patrol officers (25% to 43%) agreed that officers who use technology in creating or innovative ways are more likely to be rewarded than those who do not.

Further, some officers we interviewed expressed uncertainty about the usefulness of some technologies because their potential benefits for assisting them in how they went about doing or thinking about their daily work were not always clear. Police training for technology tends to emphasize the basics of operating the technology (such as how to properly fill out and submit reports on their mobile computer terminals); there is less emphasis, in contrast, on how officers can use technology strategically to address crime or disorder problems or how both the organization and individual officers can benefit from use of the technology through, for instance, improved information sharing inside and outside the agency.

Hence, while basic application of IT and other technologies might have marginal effects in improving police efficiency, detection capabilities in the field, and officer safety in responding to calls, these improvements may not alone be enough to discernibly enhance police performance as measured by crime reduction or even case clearances. Indeed, our trend analysis and field evaluations in Agencies 1 and 2 failed to find evidence of technology improving police effectiveness in a number of contexts: implementation of the new RMS and expansion of LPR capabilities in Agency 1 had no clear impact on crime rates and case clearances; officers' use of technology in hot spots did not appear to enhance the crime control effectiveness of hot spots patrol in Agency 1; and Agency 2's test of an internal social media technology to enhance information-sharing on robbery cases generated little enthusiasm among detectives and patrol officers and had no impact on case clearances. These findings can be attributed to several factors (e.g., functionality problems and technical limitations, unintended inefficiencies created by technology, officer resistance, mistaken assumptions about how certain technologies will work, and unintended ways in which technology might sometimes undermine officer effectiveness), but they underscore the point that achieving greater gains with technology arguably requires more strategic uses of technology for purposes of prevention and problem solving.

1.5 Implications and Recommendations for Police Executives and Researchers

This study has examined some of the complex and conflicting effects that stem from technological changes in policing and how those effects can sometimes limit and offset the potential of technology to improve police efficiency and effectiveness. This is not to say that technological advancement in policing is undesirable and will not bring improvement. However, technological changes may not bring about easy and substantial improvements in police performance without significant planning and effort, and without infrastructure and norms that help agencies maximize the benefits of technology. Technological change is thus not an easy panacea for agencies struggling with financial and staffing shortages if the foundational infrastructure of the agency—cultural and organizational—is not also considered.

Technological adoption is a long and continuous process of its own, and one that is connected to many other aspects of policing, including daily routines and deployments, job satisfaction, interaction with the community, internal relationships, and crime control outcomes. Thus, managing technological change in policing is closely connected to managing other organizational reforms (such as improving professionalism, reducing misconduct, and adopting community, problem-solving, or evidence-based policing). Accordingly, strategizing about technology application is essential and should involve careful consideration of the specific ways in which new and existing technologies can be deployed and used at all levels of the organization to meet goals for improving efficiency, effectiveness, and agency management.

In Section 12, we offer several recommendations to law enforcement agencies for improving the adoption and use of new and existing technologies. These include suggestions related to training, implementation, and evaluation, as well as to long-term strategic thinking about adjusting agency norms and practices in ways that will optimize technology use for evidence-based crime prevention and community service.

We also suggest a framework and ideas for future research on police technology (see Section 11). There is a considerable need for further evaluation studies that carefully assess the theories behind technology adoption, the ways in which technology is used in police agencies, the variety of organizational and community impacts that technology may have, and whether technology adoption and use is cost effective. Additionally, researchers should examine what organizational strategies—with respect to training, implementation, management, and evaluation—are most effective for achieving desired outcomes through technology.

Technology acquisition and deployment decisions are high priority topics for police and policy makers, as police agencies at all levels of government are spending vast sums on technology in the hopes of improving their efficiency and effectiveness. Greater attention to technology implementation and evaluation may help police agencies improve technology-related decisions and more fully realize the potential benefits of technology for policing.

1.6 Organization of this Report

The subsequent sections of this report are organized as follows. Section 2 provides a general discussion of technology in policing, highlighting some of the complexities in assessing technology's impacts on police processes and outcomes. Section 3 highlights the key technologies featured in the study, reviewing our basis for selecting them and what is known about their impacts in policing. Section 4 provides an overview of our study questions, methods, and study sites. As noted above, Sections 5 through 10 contain the analyses and findings of our research: Section 5 presents an overview of officer survey results across the four study agencies; Section 6 presents the in-depth results of fieldwork in Agencies 1 and 2; Section 7 discusses the fieldwork conducted in Agencies 3 and 4; and Sections 8 through 10 present a series of trend, experimental, and quasi-experimental analyses examining the effects of selected technologies on crime-related performance and outcome measures in Agencies 1 and 2. Synthesizing results across sites and analyses, we provide our conclusions about the key study questions in Section 11 and make recommendations for future research and evaluation on police technology.

Finally, Section 12 serves as a guide for police executives, presenting lessons and recommendations that we hope will help them in optimizing their selection and use of technology.

2. Policing Technology and Its Impacts[2]

As a concept, technology can be defined in different ways. Some organizational scholars, for example, use the term broadly to mean "a series of procedures designed to transform the raw material from one state to another in a predetermined manner" (Hasenfeld and English, 1974: 12). Manning (2008: 63) describes technology as "complex, semimagical means to accomplish ends, with both symbolic (they stand for something else) and instrumental (they do things) consequences." Our focus in this study is generally on what some refer to as "high technology," defined as "scientific technology involving the production or use of advanced or sophisticated devices especially in the fields of electronics and computers" (www.merriam-webster.com/dictionary/high%20technology). However, our discussion extends beyond electronics to include other advanced scientific applications such as DNA testing. Understood in this way, we refer to policing technologies that Chan (2003: 655), referencing Haggerty and Ericson (1999), suggests "extend[s] the physical capacity of police officers to see, hear, recognise, record, remember, match, verify, analyse and communicate (cf. Haggerty and Ericson 1999:237)." These might include information technologies such as computer-aided dispatch or records management systems (RMS), forensic technologies such as DNA testing tools or fingerprint readers, or data processing systems such as crime analysis or computerized mapping.

Such technological advances have great potential for enhancing police work. For example, technology may strengthen crime control by improving the ability of police to identify and monitor offenders (particularly repeat, high-rate offenders); facilitating the identification of places and conditions that contribute disproportionately to crime; speeding the detection of and response to crimes; enhancing evidence collection; improving police deployment and strategies; creating organizational efficiencies that put more officers in the field and for longer periods of time; enhancing communication between police and citizens; increasing perceptions of the certainty of punishment; and strengthening the ability of law

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[2] Portions of this review are adapted from other work by the authors, namely Koper et al. (2009) and Lum (2010a). For other extensive discussions of police and technology, see, for example, Byrne and Marx (2011), Byrne and Rebovich (2007), Chan (2001), Ericson and Haggerty (1997), and Manning (1992a).

enforcement to deal with technologically sophisticated forms of crime (e.g., identity theft and cybercrime) and terrorism. Technological advancements in automobiles, protective gear, weapons, and surveillance capabilities can reduce injuries and deaths to officers, suspects, and bystanders. Pressing operational needs exist in numerous areas to which technology is central, including crime analysis and information-led policing, information technology and database integration, and managing dispatch and calls for service (Koper et al., 2009). And to the extent that technology improves police effectiveness, strengthens communication between police and citizens, reduces negative outcomes from police actions, and increases police accountability, it may also have the added, indirect benefit of enhancing police legitimacy.

Yet the impact of technology on police efficiency and effectiveness may be limited by several complex factors that are related to the way in which technology interacts with police agencies. Indeed, while recent technological advances have undoubtedly enhanced policing (e.g., see Ioimo and Aronson, 2004; Danziger and Kraemer, 1985; Roth et al., 2000; Roman et al., 2008), it is not clear that they have made police more effective (Byrne and Marx, 2011; Chan, 2001; Harris, 2007; Lum 2010a). As a simple illustration, the spread of advanced technology in policing in recent years, including greater forensics capabilities and more extensive data and surveillance systems, does not seem to have improved clearance rates for criminal investigations. Clearance rates for violent and property crimes remained fairly steady, at around 46% and 17% respectively, from 1971 through 2007 (Braga, Flynn, Kelling, and Cole, 2011). Similarly, Chan, Brereton, Legosz and Doran (2001) and Chan (2003) found in field studies that only a minority of officers surveyed or interviewed tried to use technology to become more “intelligence-led” or “problem-oriented,” and that improvement in information technologies actually led to more paperwork rather than less.

This absence of a clear link between technological progress and effectiveness in policing may have a number of causes (besides lack of study). Technical, legal, and financial issues of various sorts can of course limit the impact of policing technology. These include engineering problems (i.e., whether the technologies work), difficulty in implementing and using the technology, legal or administrative limits on a technology’s use, lack of fit between the technology and the tasks for which it is used, interdependencies between different technologies (within and across agencies), ancillary costs associated with using the technology (e.g., costs associated with training, technical assistance, and maintenance), and the failure of technologies to provide certain expected benefits like time savings or increased productivity. (For studies with varying findings on these issues, see, e.g., Chan, 2003; Chan et al., 2001; Colvin, 2001; Frank, Brandl, and Watkins, 1997; Ioimo and Aronson, 2004; Koper, Moore, and Roth, 2002; Koper and Roth, 2000; Kraemer and Danziger, 1984; Manning, 2008; Nunn, 1994; Nunn and Quintet, 2002; Roth et al., 2000; Zaworski, 2004.)

2.1 Impacts of Technology on Police Agencies

A better understanding of how technology and various organizational and behavioral aspects of policing interact is needed (e.g., see Mastrofski and Willis, 2010). Technologies can produce significant changes in police agencies, but these changes may have unanticipated and collateral consequences for organizational structures, functions, goals, and mandates (Manning, 1992b; in organizational research more generally, also see Boudreau and Robey, 2005 and Robey, Boudreau, and Rose, 2000). These changes may even distort crime control or legitimacy building efforts (Lum, 2010b).

Consider the adoption of 911 systems. Today's standard 911 emergency phone and response systems were an information-technological innovation intended in large part to improve offender apprehension by reducing police response times to reported crimes. As observed by Mazerolle, Rogan, Frank, Famega, and Eck (2002), "Emergency 911 call systems comprise the single most important technological innovation that has shaped and defined police practices over the last three decades." However, the notion that 911 systems improve offender apprehension has been undermined by studies showing that response times have little effect on arrests due to delays in the reporting of crime (Sherman and Eck, 2002: 304-306). Further, the burden of answering 911 calls, roughly half or more of which are not urgent (Mazerolle et al., 2002: 98), leaves police with less time to engage in proactive or community-oriented policing.[3] Indeed, the 911 system is commonly viewed as a major force that has shaped and reinforced reactive, incident-based policing (Lum, 2010a), which is not effective (e.g., see Skogan and Frydl, 2004), and presented an obstacle to other innovative strategies (e.g., see Sparrow, Moore, and Kennedy, 1990).

[3] Nor does the 911 structure provide direction on how officers should use down time, which Kelling, Pate, Dieckman, and Brown (1979) estimated could be as high as 60%.

Technology may also create new demands and complexities in everyday police work that undermine efficiency and effectiveness. New IT systems, for instance, give officers much greater access to information in the field, but the adoption of these systems often leads to more extensive reporting requirements (i.e., officers must report more incidents and activities and document them in greater detail). Officers with laptops in their cars may not necessarily write reports faster (Colvin, 2001). Spending more time working on reports can also mean less time for officers to interact with citizens or engage in proactive policing (Chan et al., 2001).

Technology may have important structural effects on police agencies. Nunn (2001), for instance, found that police agencies with higher levels of computerization and information technology tend to have higher expenditures, a larger share of employees in technical positions, and fewer officers per capita. This suggests that agencies with more IT have fewer officers on the street (due, perhaps, to the resources required to operate and maintain IT), which could undermine their effectiveness in reducing crime unless they also make better use of their officers (e.g., Garicano and Heaton, 2010; Koper et al, 2002). Similarly, technological change can lead to organizational restructuring and changes in the relationships between units in an agency. For example, crime analysis units, which are growing in importance, are often staffed largely by civilians.

2.2 Organizational Factors That Influence Technology's Potential in Policing

In addition to assessing how technology affects police, we must also consider how organizational culture, structures, and practices within police agencies mediate the potential of technology to improve police effectiveness and legitimacy. Orlikowski and Gash (1994) argue that people interpret and use technologies based on technological "frames." These frames can be influenced by the way employees see their role and function, which is connected to organizational structure, culture, and activities. In other words, police may or may not optimize their use of technology depending on how they view that technology in relation to their organizational perspective.

Consider IT, for instance. In many respects, IT—including computer hardware, software, and specialized applications like an RMS, geographic information systems (GIS), and crime analysis—would seem to have the most potential to enhance the effectiveness of police in reducing crime. By improving the ability of police to collect, manage, and analyze data, IT can enhance the administrative efficiency of police organizations and, perhaps more importantly, help them target the people, places, and problems that contribute most to crime. Promising policing innovations such as hot spots policing (e.g., see Braga, Papachristos, and Hureau, 2012; Lum, Koper, and Telep, 2011; Telep and Weisburd, 2012) and Compstat (e.g., see Bratton, 1998; Weisburd, McNally, Mastrofski, Greenspan, and Willis, 2003; Willis, Mastrofski, Weisburd, and Greenspan, 2004; Willis, Mastrofski, and Weisburd, 2007) have been spurred largely by advances in IT. Yet these advances will bring fewer benefits if police executives fail to make other changes that are necessary to fully capitalize on them. Technologies that facilitate hot spots policing, for example, have less impact if police managers fail to focus adequate resources on crime hot spots or if the results of crime analysis are not adequately disseminated (or accepted) throughout the agency, particularly among patrol officers and first-line supervisors. Consequently, the impact of IT (and other technologies) may often depend on other organizational changes, such as the adoption of Compstat (a managerial approach that combines state-of-the-art management principles with crime analysis) and GIS (e.g., see Garicano and Heaton, 2010). At the same time, even the adoption of cutting-edge programs such as Compstat that seek to integrate IT with broader structural changes may not necessarily work as intended If they are constrained by existing features of police bureaucracy and the policing craft (Willis, Mastrofski, and Weisburd 2004; Willis 2013).

There are many other examples that illustrate how existing features of police organizations influence the implementation of technologies. Automated vehicle locators are used by police primarily for the purposes of dispatch and officer safety, but how might they also be used as a tool to enhance accountability and keep officers focused on hot spots? Such use has been inhibited in the past by unions and officers arguing that this would allow supervisors and leaders to micromanage or oversupervise officers. Putting license plate readers (LPRs) on patrol cars can improve the recovery of stolen automobiles and the apprehension of wanted persons generally. However, they will almost certainly be more effective if managers and officers concentrate their use on roadways having the highest probability of auto theft recoveries as identified by crime analysis (Koper, Taylor, and Woods, 2013; Taylor, Koper, and Woods, 2011b). Hence, managerial decisions about how to deploy LPRs (e.g., deploying them based on crime levels versus distributing them equally among an agency's geographic divisions) and how to structure officers' use of them (e.g., guiding officers on where to use them versus giving officers unfettered discretion) will likely influence the outcomes achieved through this technology. State-of-the-art integrated data systems with sophisticated querying capabilities may improve case closure rates, but they might also bring broader crime prevention benefits if officers are trained and encouraged to use these systems analytically to learn about problem groups and places in their patrol areas.

Moreover, such considerations reverberate throughout the agency. Police managers have an obvious role in setting the tone for the adoption and use of technology in their agencies. However, the reactions of line-level staff are also critical. Patrol officers, for instance, may have negative perceptions of technologies and even resist their use if they feel that those technologies limit their discretion, increase managerial control over them, impose additional burdens on them, or are simply unhelpful or difficult to use (e.g., see Chan et al., 2001; Harris, 2007; Manning, 1992a). Further, they may tend to view and use technology primarily in ways that fit their standard modes of operation, thus limiting the potential to change policing practices. Implementing new technology may require training that recognizes and takes into account an organizational culture in which line-level employees are highly suspicious of their leaders, or a culture in which organizational gaps and miscommunications exist between rank and file and technology decision makers.

All of this suggests that optimizing the use of technology in policing requires more than just a basic understanding about the efficiencies a technology provides. Changes may be needed in an agency's organizational culture, practices, and infrastructures for improvements in crime control, efficiency, and accountability to be realized. In practice, this does not necessarily occur (e.g., see Chan, 2003; Chan et al., 2001; Harris, 2007). Indeed, while police have been advancing technologically during the last few decades, we know from rigorous research that the mainstays of American policing—rapid response to 911 calls, beat patrol, case-by-case investigations, and reactive arrests—are largely ineffective in reducing crime (Skogan and Frydl, 2004; Telep and Weisburd, 2012). Moreover, as Lum (2010a) asserts, technologies intended to improve efficiency in responsiveness, such as 911 and even investigative case management systems, have arguably solidified a reactive organizational culture that emphasizes response over prevention. The importance of how technologies are used is considered more broadly in research on organizations and technology (see Boudreau and Robey, 2005; DeSanctis and Poole, 1994; Orlikowski, 2000).

And although our discussion has focused largely on crime control, many of the same issues affect the perceived legitimacy of police. Surveillance technologies such as closed circuit television networks and LPRs, for instance, are becoming increasingly popular (e.g., see Lum, Merola, Willis, and Cave, 2010; Police Executive Research Forum [PERF], 2007; Koper et al., 2009) and have significant potential for reducing crime (Koper, Taylor, and Woods, 2013; LaVigne, Lowry, Markman, and Dwyer, 2011; Welsh and Farrington, 2004). However, they also raise significant concerns about privacy, which can undermine public support for their use and, in some cases, undermine their effectiveness (Lum et al., 2010; Merola and Lum, 2013; Welsh and Farrington, 2004). Video cameras in patrol cars or worn by officers can also be a valuable tool for not only for recording suspects' behavior but also for monitoring officer professionalism in traffic stops, criminal investigations, arrests, and training (Schultz, 2008)—all of which may enhance police accountability and legitimacy (Lovett, 2013). And to what extent do police use their data systems and analytic capabilities to monitor problems related to officer use of force, racial profiling, and other problem behaviors (e.g., see Fridell, 2004; Walker and Milligan, 2005)? These all have important impacts on perceptions of police fairness and legitimacy (Skogan and Frydl, 2004). Such uses of technology would arguably contribute to accountability and transparency in policing, potentially improving community relations and the perceived legitimacy of police.

Because of these complexities, more in-depth study is needed to examine how police technologies can help (or hurt) the efficiency, effectiveness, legitimacy, and management of police agencies. As described in detail in Section 4, this study takes a multimethod approach to tackling these questions, using interviews, focus groups, observations, officer surveys, and field experiments across multiple agencies to examine the impacts of key technologies in law enforcement. Through these methods, we focus on understanding the impacts of technology on police culture, organizational hierarchy and structure, internal accountability and management systems, officer discretion and decision making, efficiencies and everyday business processes, effectiveness in reducing crime, police-citizen communication and police legitimacy, and job satisfaction. But before describing our research questions and methods, we first discuss in Section 3 the technologies selected for study.

3. Key Technologies in Law Enforcement

To better understand the impacts of technological changes in policing, we sought to examine the social, organizational, and behavioral implications of a range of relatively new and significant policing technologies that have diffused into law enforcement. Our intent was also to focus on technologies that are critical to primary police functions and central to evidence-based strategies and practices designed to reduce crime and/or enhance police legitimacy.

To select these technologies, we reviewed academic and nonacademic research literature on police technology as well as other technology reports, guides, and needs assessments produced by government agencies and policing organizations (notably, NIJ, the Community Oriented Policing Services (COPS) Office, the International Association of Chiefs of Police, and PERF).[4] We examined the technologies featured in these studies and considered experts' assessments of the impacts and importance of these technologies to policing. We also examined how commonly police use various technologies as reported in the Bureau of Justice Statistics' Law Enforcement Management and Administrative Statistics (LEMAS) surveys and other surveys of police agencies (Burch, 2012; Hickman and Reaves, 2006a, 2006b; Koper et al., 2009; Lum et al., 2010; Reaves, 2010). In so doing, we sought to select technologies that are well developed and in relatively common use (with regard to the latter, we considered both current use and trends in the adoption of various technologies).

Finally, we considered the existing evidence on evidence-based strategies to enhance police effectiveness and fairness (e.g., Braga, 2007; Eck and Weisburd, 2004; Lum et al., 2011; Skogan and Frydl, 2004) and identified technologies that have logical relevance to implementing or enhancing strategies and practices supported by policing research (e.g., Lum, 2010b). For instance, what technologies have the most potential to facilitate evidence-based practices such as hot spots policing and problem-oriented policing (Braga 2007; Lum et al.,2010; Skogan and Frydl 2004; Weisburd, Telep, Hinkle, and Eck, 2010)? Which have the most potential

[4] Project staff examined the contents of 140 reports by government and policing organizations and reviewed several dozen academic and nonacademic works discussing theory or research on police and technology.

to improve police legitimacy by increasing transparency, accountability, and/or responsiveness to the community?

Based on these assessments, the research team identified the following categories of police technologies as particularly central to everyday police work and successful practices:

- Information technologies for the collection, management, and sharing of data;
- Analytic technologies such as GIS and crime analysis;
- Communications technologies including those related to dispatch (e.g., next generation 911 and computer-aided dispatch with GPS tracking of patrol cars) and those for disseminating information to personnel in the field (e.g., mobile computers and wireless access systems);
- Surveillance and sensory technologies (e.g., CCTV networks, LPRs, and patrol car cameras); and
- Identification technologies (e.g., DNA testing and other forensics equipment).

From among these categories, we then selected the following specific technologies to aid us in understanding the impact of technology on law enforcement:

- Information technologies (IT), defined broadly as intra- and interagency systems for managing, sharing, and analyzing data, including mobile computers and wireless access systems for sharing information with officers in the field;
- Crime analysis, defined to include analytic processes and products of crime analysis as well as the mechanisms for disseminating results throughout the agency;
- License plate readers (LPRs);
- Patrol car video cameras; and
- DNA testing technology.

Note that while we cannot make any absolute claims that these technologies are the most important in law enforcement based on objective assessments, one can reasonably argue that these technologies are particularly worthy of study in view of prior research and theory, expert opinion, and usage patterns and trends. In the sections below, we discuss contemporary use of these technologies in policing and briefly review prior research on their impacts.

3.1 Information Technologies

Information technologies (IT) within police agencies include a wide array of databases and data systems (and their supporting hardware and software) for storing, managing, retrieving, sharing, and analyzing information both within and across agencies. Common IT components in police agencies include records management systems (RMS) that capture criminal incident records, computer-aided dispatch systems that record and assign calls for service, and various other databases that may contain information and/or intelligence on persons, groups, personnel, and other matters. Police agency websites used to exchange information with community members constitute another important part of police IT systems (Rosenbaum, Graziano, Stephens, and Schuck, 2011). Finally, our definition of IT also includes mobile computers and data terminals that give officers wireless access to information in the field and that allow them to file reports remotely. (Mobile computers may also be viewed as communication technologies.)

Developments in IT have enhanced records management, data sharing, crime analysis, and performance management in police agencies in many ways over the last few decades. According to the 2007 LEMAS survey, half or more of local police departments and sheriffs' offices use computers for records management, crime investigation, personnel records, information sharing, and dispatch (Burch, 2012: 15; Reaves, 2010: 22). Indeed, computers are now used for these functions in a majority of all but the smallest police agencies. Agencies also use computers to support functions like automated booking, fleet management, and resource allocation. As of 2003, the majority of police agencies maintained electronic data on incident reports, arrests, calls for service, stolen property, and traffic citations (Hickman and Reaves, 2006a: 31; 2006b: 31). Other data that agencies often maintain in electronic form include warrants, criminal histories, traffic accidents, and summonses.

In addition, more than half of local agencies reported having in-field computers or terminals for their officers as of 2007 (Burch, 2012: 16; Reaves, 2010: 23).[5] More than 90% of local police departments serving populations of 25,000 or more now have such capability, as do more than 85% of sheriffs' offices serving populations of at least 100,000. Agencies with in-field computers or terminals

[5] Since 1990, there has been more than a 12-fold increase in the percentage of local police departments with in-field computers and terminals (Reaves, 2010: 24).

typically have 40–50 such devices for every 100 officers. Most agencies use their in-field computers and terminals for writing reports, and a majority of agencies serving larger jurisdictions also use them for other communications. Information commonly accessible to officers through these computers and terminals, particularly in larger jurisdictions, include motor vehicle records, warrants, calls for service, criminal histories, protection orders, interagency information, the Internet, and, to a somewhat lesser extent, crime maps.

The development of IT systems for sharing and analyzing data within and across agencies has also been emphasized in recent years. In many agencies, various types of records maintained by different units are now integrated and are easily accessible and searchable for officers, often remotely. Police have long had the ability to access national data systems like the Federal Bureau of Investigation's (FBI) National Crime Information Center (NCIC). More recently, however, law enforcement practitioners have developed more extensive systems for sharing a wider variety of data across federal, state, and local agencies. Spurred in part by concerns over terrorism, the Department of Homeland Security has established fusion centers around the country (78 as of 2013)[6] to share information and intelligence among federal, state, and local agencies. Similarly, the Naval Criminal Investigative Service launched the LInX initiative in 2003 to promote more information sharing between law enforcement agencies at multiple levels. Currently, nine regional LInX systems involving over 760 partner agencies have been established across the United States.[7] The FBI's Law Enforcement National Data Exchange, or N-DEx, allows agencies to search and analyze data using powerful automated capabilities designed to identify links between people, places, and events.[8] In sum, current state-of-the-art systems provide many agencies with sophisticated capabilities for linking and querying databases within and across agencies.[9] For example, officers may query things like nicknames or see linkages of offenders, suspects, victims, and associates across multiple databases.

As stated above, IT is arguably the technology with the most potential to impact policing, as it affects almost all aspects of police work and management. IT may enhance various dimensions of police efficiency and effectiveness, such as: the

[6] See http://www.dhs.gov/fusion-center-locations-and-contact-information, accessed June 23, 2013.
[7] See http://www.ncis.navy.mil/PI/LEIE/Pages/default.aspx, accessed June 22, 2013.
[8] See http://www.fbi.gov/about-us/cjis/n-dex, accessed June 22, 2013.
[9] A 2008 survey of agencies affiliated with the Police Executive Research Forum (PERF) suggests that most larger police agencies already have systems linking them to regional or national systems (Koper et al., 2009).

speed and accuracy of crime reporting; the amount of time officers spend in the field; the ability of officers to identify persons, vehicles, and places of interest (thus enhancing both reactive and proactive field work and improving officers' ability to identify potential safety threats); the ability of detectives and officers to identify and locate suspects in criminal investigations; the capacity of managers to identify and respond to crime patterns and trends, monitor organizational performance, and assess the work and conduct of individual officers; the problem-solving capabilities of officers and managers; information exchange with the public; and the speed of administrative processes (Groff and McEwen, 2008). These benefits might be offset to some degree, however, by technical difficulties and complexities in use of the IT systems, additional time and resources devoted to maintaining the systems and meeting reporting requirements, reduced interaction with citizens (i.e., officers may become more engrossed in working with technology and less engaged with people), and (as alluded to previously) the inability or disinterest of officers and managers to capitalize on the strategic uses of IT.

Many police researchers have recognized the centrality of IT to police work and organizational change more generally (e.g., Boudreau and Robey, 2005; Chan, 2001, 2003; Ericson and Haggerty, 1997; Harris, 2007; Manning, 1992a; Mastrofski and Willis, 2010). Accordingly, it has been studied more extensively than other forms of police technology. Yet, this body of research has produced complex and often contradictory findings on IT's impact.

Some of the broadest assessments of the impact of IT on policing have come from studies of the federal Community Oriented Policing Services (COPS) program, which provided hundreds of millions of dollars in grants to state and local agencies for the acquisition of technologies during the 1990s. COPS grantees used much of their funding to obtain various forms of IT, including mobile and desktop computers (79% of grantees had acquired funding for the former by 1998, making it the leading type of COPS-funded technology), computer-aided dispatch systems, booking and arraignment technologies, and telephone reporting systems (Roth et al., 2000). Although grantees reported substantial benefits from these grants, largely in the form of officer hours redeployed into the field (Koper et al., 2002; Koper and Roth, 2000), studies of the COPS program have yielded mixed results as to whether the technology grants actually helped police reduce crime (e.g., U.S. Government Accountability Office, 2005; Zhao, Scheider, and Thurman, 2002, 2003). And even the most optimistic assessments suggest that the crime reduction benefits of the technology grants were less than those of grants for innovative programs and hiring officers.[10] Hence, while technology may bring tangible benefits to police agencies, it doesn't necessarily provide a cost-effective alternative to additional officers or innovative strategies.

Similarly, in a national study of large police agencies over the period of 1987-2003, Garicano and Heaton (2010) found that increases in the application of IT were not associated with reductions in crime rates, increases in clearance rates, or other productivity measures (IT that facilitates better crime reporting actually generated the appearance of lower productivity). However, they also found evidence that IT was linked to improved productivity when complemented with organizational and managerial practices, like Compstat, that reflect more strategic uses of IT (see also Nunn, 2001 for related findings).

Other studies, which have consisted largely of case studies and which examined a number of attitudinal and objective outcome measures, have also yielded mixed findings with respect to the effects of IT on officer productivity, case clearances, proactive policing, community policing, problem solving, and other outcomes, though officers have generally shown positive attitudes towards IT improvements (Agrawal, Rao, and Sanders, 2003; Brown, 2001; Brown and Brudney, 2004; Chan et al., 2001; Colvin, 2001; Danziger and Kraemer, 1985; Ioimo and Aronson, 2003, 2004; Nunn, 1994; Nunn and Quinet, 2002; Palys, Boyanowsky, and Dutton, 1984; Rocheleau, 1993; Zaworski, 2004). We examine many of the issues raised by these studies throughout our investigation. Note that we devote particular attention to IT in our case studies, given its centrality to policing and the myriad ways in which it can affect police organizations.

Despite the mixed findings of prior research, we noted earlier that important innovations like hot spots policing and Compstat have been linked to advances in IT. Strategic use of IT capabilities by police are thus likely key to realizing IT's full potential. One strategic use with demonstrated promise for improving the effectiveness of police is IT's application to crime analysis, a form of analytical technology highlighted next.

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[10] An analysis by the U.S. Government Accountability Office suggests that each dollar spent on COPS grants for technology reduced index crimes by 17 per 100,000 persons (U.S. GAO, 2005). In contrast, each dollar spent on grants for hiring new officers or innovative community policing programs reduced index crimes by 29 and 88 per 100,000 persons, respectively.

3.2 Crime Analysis

Crime analysis is the main analytic technology used by police today. As described by Taylor and Boba (2011: 6), "crime analysis involves the use of large amounts of data and modern technology—along with a set of systematic methods and techniques that identify patterns and relationships between crime data and other relevant information sources—to assist police in criminal apprehension, crime and disorder reduction, crime prevention, and evaluation." While the collection of Uniform Crime Report (UCR) statistics and counts of crime might be considered an early stage of crime analysis, the activities and analyses that fall under the umbrella of "crime analysis" are wide ranging. Common duties for crime analysts involve assisting detectives, mapping crime, identifying crime patterns, conducting network analysis, and compiling data for UCR reporting and managerial meetings (Taylor and Boba, 2011).

The development and adoption of crime analysis has been an important trend in policing over the last few decades. In a recent national survey, Taylor and Boba (2011) found that 57% of police agencies have staff whose primary responsibility is conducting crime analysis, and 89% of agencies have personnel whose primary or secondary responsibility is conducting crime analysis. Similarly, the 2007 LEMAS survey showed that the use of computers for crime analysis is quite common, particularly among larger police agencies (Burch, 2012; Reaves, 2010).[11]

This development of crime analysis has been facilitated by the improvement of police data systems and the development of computer software for specialized applications such as geographical and intelligence analyses. Indeed, Weisburd and Lum (2005) found that computerized crime mapping is an innovation that has spread widely in policing. The 2007 LEMAS found that more than 80% of local police departments serving populations of 50,000 or more use computers for crime analysis and crime mapping. The majority of these agencies also use computers for identification of hot spots (small areas of crime concentration). The majority of sheriffs' offices in jurisdictions of 100,000 or more people also use computers for

[11] Among large police agencies (those with 100 or more officers), 78% had crime analysis personnel as of 2000, and 72% of those agencies had specialized crime analysis units (O'Shea and Nicholls, 2003). There is also an international organization of crime analysts (see http://www.iaca.net/index.asp) which provides training, conferences, and support in advancing the use of crime analysis in law enforcement.

crime analysis and crime mapping. Roughly half of sheriffs serving very large jurisdictions (500,000 or more) do hot spot identification.

Crime analysis has great potential for improving the effectiveness of police. While it has perhaps been linked most prominently to hot spots policing and Compstat, crime analysis is also used heavily for investigative work and can be a valuable component of problem-oriented policing (see Taylor, Koper, and Woods, 2011a). However, with the exception of its role in supporting hot spots policing, we are not aware of any evidence demonstrating a clear link between the use of crime analysis and lower rates of crime (Lum, 2013). Although this may reflect a lack of study (for example, we have seen no before-and-after assessments evaluating the impact of establishing crime analysis units), it is also likely that, as with other technological and analytical innovations, the potential impact of crime analysis is limited by outside factors.

One such factor is that the sophistication of crime analysis capabilities and work varies considerably across agencies. Though dated, a survey conducted with larger police agencies (those having 100 or more officers) in 2000 found that crime analysis personnel in many agencies did not have sophisticated software applications, made limited or no use of databases from outside their agencies (e.g., non-law enforcement data or data from other law enforcement agencies), and/or conducted only simple (i.e., counting) forms of analysis (O'Shea and Nicholls, 2003). Important predictors of the range and sophistication of crime analysis include the availability of hardware and software, data collection capabilities, training, and structural characteristics such as whether an agency has a specialized crime analysis unit (O'Shea and Nicholls, 2003).

At the same time, obstacles to effective use of crime analysis can lessen its impact. These may include a police culture that doesn't value analytical work, the reactive nature of policing, and a disregard for crime analysis that is done largely by civilians (Lum, 2013; Taylor and Boba, 2011). In practice, officers may not use products like maps and may find them of little value in their work (Cope, 2004; Cordner and Biebel, 2005; Paulson, 2004). Indeed, crime analysis is largely produced for police managers, and while they tend to be its heaviest users (O'Shea and Nicholls, 2003; Taylor and Boba, 2011), they often focus largely on criminal apprehension and tactical short-term planning rather than long-term strategic planning (Harris, 2007; O'Shea and Nicholls, 2003). Realizing the full potential of crime analysis requires more emphasis on long-term strategic planning, more attention to developing analytical products of value to officers, and proper training, coaching, support, and reinforcement at all levels in the agency. Stronger management support and appreciation by target audiences have been shown empirically to have a positive impact on crime analysis functions and sophistication (O'Shea and Nicholls, 2003).

3.3 License Plate Readers

License plate readers (LPRs) are high-speed camera and information systems that read vehicle license plates in real-time using optical character recognition technology. Plates are checked instantaneously against databases that may contain license plate information on stolen vehicles, vehicles linked to fugitives and criminal suspects, and other vehicles of interest (e.g., vehicles linked to sex offenders, parking violators, and drivers with suspended licenses). LPRs can be assigned to mobile patrol units or deployed at fixed locations. When an LPR finds a match, it sounds an alarm or provides another type of notification. While LPRs serve an important surveillance function, they can also be viewed as information technologies, as the data they collect can be stored, analyzed, and searched for investigative purposes.

LPR technology has been used since the 1980s in Europe to prevent crimes from vehicle theft to terrorism (Gordon, 2006). LPR use is particularly extensive in the United Kingdom; all police forces in England and Wales now have LPR capability (PA Consulting Group, 2006). In the United States, LPR use is growing rapidly. About a quarter of U.S. police agencies were using LPRs as of 2009 (Roberts and Casanova, 2012), and more than a third of agencies with 100 or more officers were using them (Lum et al., 2010; also see Koper et al., 2009). Upwards of 50% of agencies having 500 or more officers used them (Roberts and Casanova, 2012), and many additional agencies were interested in acquiring them (Koper et al., 2009; Lum et al., 2010). Lum et al. (2010) have suggested that the diffusion of LPR has been quite rapid, even in comparison to other popular policing technologies such as computerized crime mapping (see Weisburd and Lum, 2005), in-field cameras, or forensic tools. At the same time, the vast majority of agencies using LPRs—86% according to one survey—had no more than 4 of the devices as of 2009 (Lum et al., 2010). This is likely due in part to the cost, which generally runs from $20,000 to $25,000 per unit.

LPR systems provide officers with the ability to scan and check hundreds of license plates in minutes, thereby automating a process that in the past was conducted by officers manually, tag-by-tag, and with much discretion. As an information technology system, LPRs can collect and store large amounts of data (plates, dates, times, and locations of vehicles) for potential use in criminal investigations, homeland security operations, and other crime prevention efforts. Visible deployment of LPRs may also have some deterrent value.[12] Given these characteristics, LPR has the unique potential to improve police effectiveness. Although police have tended to use LPR primarily to reduce auto theft (Lum et al., 2010), they seem to be considering its use for a wider range of applications (Roberts and Casanova, 2012; Lum et al., 2010; PERF, 2012).

Prior studies of LPR conducted in the United Kingdom and North America have focused largely on the accuracy and efficiency of the devices in scanning license plates and on their utility for increasing the number of arrests, recoveries of stolen vehicles, and seizure of other contraband (Cohen, Plecas and McCormack, 2007; Maryland State Highway Authority, 2005; Ohio State Highway Patrol, 2005; PA Consulting Group, 2003; Patch, 2005; Taylor, Koper, and Woods, 2011b, 2012). However, the studies found limited evidence on whether LPR use actually reduces crime.

Studies of LPR use and its effects on crime have tested small-scale deployment of LPRs with patrol units. One study that spanned two suburban jurisdictions in Virginia found that 30-minute LPR patrols conducted once every few days (on average) in selected crime hot spots for a period of two to three months did not reduce auto-related or other forms of crime in the targeted locations (Lum et al., 2010, 2011). In contrast, a study conducted in Mesa, Arizona, found that short-term deployment of an LPR team (using four of the devices) to high-crime street segments produced reductions in drug offenses at those locations that lasted for several weeks beyond the intervention (Koper et al., 2013; also see Taylor, Koper, and Woods, 2012). Other findings from that study suggested that LPR deployment might also help to reduce auto theft and personal offenses at hot spots, depending on exactly how officers use the devices. Both studies were limited, however, by the short duration or low dosage of the intervention, the small numbers of LPRs available, and the limited data fed into the LPR devices (the data consisted largely or entirely of manually downloaded information on stolen vehicles and license plates). Updated studies are needed to examine larger-scale LPR deployments and LPR operations conducted with access to more extensive data systems.

[12] For discussions of the deterrent value of surveillance cameras more generally, see Welsh and Farrington (2008) and LaVigne et al. (2011).

Further assessment is also needed of other ways that police might use LPRs. For example, data collected by LPR units have been used to identify vehicles (and thus suspects) that were near a crime scene at a given time or to determine the whereabouts, and/or confirm the alibi, of potential suspects or witnesses. In major crises, LPR data can be used to recreate vehicular movement around high-risk locations. Some agencies have also used LPR to scan and record all vehicles in and around a crime scene shortly after a crime occurred. In terms of our study, we are particularly interested in how LPR affects not only efficiencies related to investigative activities and case clearances, but also how this technology changes the way in which officers patrol their beats or detectives investigate cases.

Police adoption of LPR also has implications for community perceptions of police legitimacy insofar as it raises issues of surveillance and privacy. In their study of LPR use in Virginia, Lum et al. (2010) surveyed community residents in one of the study jurisdictions and found that while there was strong support for LPR use in general, this support varied depending on the types of LPR applications under consideration (e.g., using the devices to detect stolen automobiles received much more community support than using them to detect parking violators). Survey results also suggested that citizens prefer to have some external controls (e.g., court orders or consultation with attorneys or the community) on police storage and use of LPR data (see Merola and Lum, 2013; Merola, Lum, Cave, and Hibdon, forthcoming).

Finally, it remains to be seen how officers and agencies will adapt to LPR as its use expands. For example, do officers like using LPR technology and how does it affect the way they conduct everyday patrol and other activities? Does it increase their job satisfaction or personal motivation? Does it prompt them to be more proactive and strategic in their actions? And how do supervisors assign and monitor LPR deployment and use for its fullest effect?

3.4 In-Car Video Cameras

In-car video (ICV) systems are devices used to create video and audio records of selected events and encounters experienced by officers. The cameras are mounted within the patrol vehicle, and officers wear a wireless microphone that transmits audio signals to the system. The devices are typically activated automatically when officers put on their flashing lights or exceed a certain speed. Officers can also activate them manually.

ICV systems serve a number of purposes (e.g., see Maghan, O'Reilly, and Ho Shon, 2002; Schultz, 2008). Most notably, they can be used to monitor the legality and professionalism of officer conduct in various contexts. In this way, ICV systems can help guard against excessive use of force, illegal searches, racial profiling, and other forms of illegal, unprofessional, or abusive behavior by officers. Indeed, some agencies have adopted ICV systems in the wake of controversial use of force cases or in response to accusations of other problematic conduct by officers such as racial profiling (Maghan et al., 2002). At the same time, ICV systems also protect officers from false allegations of unlawful or unprofessional conduct, and there have been many accounts of ICV systems exonerating officers in court cases and misconduct investigations. Further, ICV systems can provide evidence for police and prosecutors in certain types of criminal cases (e.g., cases involving driving under the influence or assaults on officers). Recordings from ICV systems can also be valuable in training officers about professionalism, safety, lawful searches, and other issues.

ICV systems have been in use since at least the 1990s (Maghan et al., 2002), and their use has grown considerably since that time. As of 2007, roughly two thirds of local police agencies reported using cameras in their patrol cars (Burch, 2012: 15; Reaves, 2010: 21). Use of these systems is common among agencies of all sizes, though the largest agencies are somewhat less likely to use them, due likely to the expense of equipping their large automobile fleets.[13] Overall, local police agencies reported having nearly 100,000 cars equipped with cameras in 2007, which amounted to about a quarter of all cars they operated (calculated from Burch, 2012 and Reaves, 2010). Further, in a 2008 survey of agencies affiliated with PERF, nearly all agencies using car cameras found them to be effective, and almost half reported no significant challenges to their use (Koper et al., 2009). The main challenges agencies did identify, noted by 25% of users, were "economic and political."

With respect to political challenges, agencies may face the greatest obstacles from within their agencies. Anecdotal accounts suggest that officers often resist ICV technology out of concern that managers will use it to "spy" on them and overly scrutinize their behavior (Maghan et al., 2002). Training on the potential benefits of ICV systems to officers may help overcome this resistance, as may policies about how (and for how long) the videos will be saved and the circumstances under which

[13] Only 38% of agencies serving populations of 1 million or more reported using ICVs in 2007, as did slightly less than half of agencies serving populations of 250,000-499,999 (Reaves, 2010: 21).

they will be used by supervisors. The fact that the cameras are typically activated only in certain types of situations also means that officers need not feel that they are under continuous surveillance.

ICV systems would seem to have much potential for affecting police-community interactions and community perceptions of police fairness and legitimacy. Both police and citizens can be expected to regulate their behavior more carefully when they know that they are being recorded by ICV systems, thus potentially preventing or diffusing volatile encounters. In places where police use this technology, community members can have greater assurance that police will be held accountable for misconduct, and they may be better informed about the veracity of complaints made against the police when cases get publicized. Yet beyond anecdotal accounts (e.g., Maghan et al., 2002), there has been little, if any, systematic research on how ICV systems affect outcomes such as complaints against the police, community views of the police, use of excessive force, and the like.

Nor has there been research on how, if at all, ICV systems affect the ability of police to reduce crime. One could speculate, for instance, that ICV systems might influence the inclination of police—one way or the other—to engage in more intensive traffic enforcement or order maintenance policing. On the one hand, officers might feel inhibited by ICV systems; on the other hand, they might feel more protected against complaints. Officers in the field may also devise ways to use ICV systems for different forms of surveillance, though this might sometimes raise legal issues, depending on local eavesdropping laws (Maghan et al., 2002), and/or raise public concerns about intrusive surveillance and privacy. As the technology improves, police will also likely have more options for transmitting recordings from ICV systems and for integrating these systems with LPRs and facial recognition systems (Maghan et al., 2002).

3.5 DNA Testing

Law enforcement agencies use a variety of forensics technologies to assist them in the identification of criminal offenders. One of the most important enhancements to these capabilities in recent decades has been the development of identification tests using deoxyribonucleic acid, commonly known as DNA. DNA tests identify unique individual genetic codes from DNA samples that are extracted from biological evidence such as blood, semen, hair, and saliva. Developed in the 1980s, DNA testing has become a common method of identification, particularly for sex crimes and other violent offenses, and it is widely viewed as the state of the art in offender identification (National Research Council, 2009). In the United States, DNA testing is mostly used in violent crime cases due to its expense, but its use for property crimes is also expanding (Roman et al., 2008).

Police may collect and use DNA evidence in a number of ways. They may use DNA testing to determine whether a particular suspect can be linked to physical evidence from a particular crime scene. They may use recovered DNA evidence from a crime scene to identify suspects, though it seems that many agencies do not understand or take advantage of this potential DNA application (Strom et al., 2009). Finally, police and other criminal justice agencies take DNA samples from convicted offenders and in some states from arrestees to test them for matches to evidence from unsolved crimes and for use in future investigations.

The DNA Identification Act of 1994 authorized the FBI to establish a national DNA database with indexes for persons convicted of crimes, missing persons (and relatives of missing persons), samples recovered from crime scenes, and samples recovered from unidentified human remains (Roman et al., 2008: 13-14). This national database is combined with state and local DNA databases in a system named CODIS (for the Combined DNA Index System).

By the late 1990s, all 50 states had passed legislation requiring convicted offenders to provide DNA samples (Samuels, Davies, and Pope, 2013; Schwabe, 1999). As of 2009, 47 states collected DNA samples from all convicted felons and 37 collected samples from those convicted of certain misdemeanors (DNA Resource, 2009, as cited in Wilson, Weisburd, and McClure, 2011: 8). In addition, 28 states have laws authorizing the collection of DNA evidence from all or subsets of felony arrestees (and sometimes from misdemeanor arrestees) prior to conviction (Samuels et al., 2013). The collection of DNA from arrestees has expanded considerably since 2005 following federal legislation allowing for such information to be uploaded into CODIS.[14] Nearly 10.4 million DNA profiles were in CODIS as of 2011, up from 1.2 million in 2002 (Samuels et al., 2013: 4). Although the submission of DNA from arrestees has been interrupted in some states by recent court cases challenging the constitutionality of this procedure, the United States Supreme Court upheld the practice in the case of *Maryland v. King,* which was decided in June 2013.

[14] State laws provide for expunging this evidence if the arrestees are not convicted, but many states leave the burden of initiating these procedures on the arrestees (Samuels et al., 2013).

According to a recent survey, only 8% of local agencies have a local lab to conduct DNA testing, 88% send evidence to state labs for testing, and the remaining agencies use federal, private, or other types of labs (Strom et al., 2009: 3-12). However, many of the nation's largest agencies (which are responsible for large numbers of cases) have their own crime labs (counted above as local labs) and may thus have their own DNA testing capabilities.

In principle, greater use of DNA evidence should help police solve a greater number of crimes and improve the likelihood of convictions in those cases. This, in turn, should reduce crime through incapacitation of offenders and potentially through deterrence of those who have had their DNA taken (but see Bhati, 2010 for mixed assessments on the latter point). Further, DNA testing may be particularly helpful in identifying the most active repeat offenders who commit disproportionate numbers of crimes.

Evidence on how DNA testing impacts police performance and crime is rather limited (Wilson et al., 2011). However, a randomized experiment involving five jurisdictions in the United States found that the use of DNA evidence greatly enhanced outcomes in property crime cases, namely, residential and commercial burglaries and thefts from automobiles (Roman et al., 2008). Compared to traditional investigations, cases involving the use of DNA evidence resulted in twice as many suspects being identified, twice as many suspects being arrested, and more than twice as many cases being accepted for prosecution. Compared to the use of fingerprints, the use of DNA was also at least five times more likely to result in the identification of a suspect. Moreover, suspects identified through DNA evidence tended to be more serious offenders; overall, they had at least twice as many felony arrests and convictions as did suspects identified in other cases.[15]

Similarly, a study examining criminal cases in New South Wales, Australia, from 1995 through 2007 found that the expansion of a DNA database for imprisoned offenders started in 2001 led to increases in case clearances and cases resulting in charges for sexual assault, robbery, and burglary (Dunsmuir, Tran, and Weatherburn, 2008). However, these outcomes did not improve for assaults and motor vehicle crimes, nor did the development of the DNA database improve conviction rates for any of the offenses studied. A few other studies have also reported improvements in

[15] These findings are also consistent with evidence from the United Kingdom, where there has been a national program to expand the use of DNA evidence in property crimes. Research there indicates that the suspect identification rate in burglary cases with DNA evidence is 41% as compared to 16% in other cases (Home Office, 2005, cited in Roman et al., 2008: 7).

case outcomes stemming from the use of DNA evidence, but methodological weaknesses in these studies preclude definitive conclusions (see review in Wilson et al., 2011). Moreover, no studies have yet examined the impact of DNA testing on crime rates.

Expanding the use of DNA evidence also raises a number of organizational issues for police agencies and crime labs with respect to equipment and staffing needs and the establishment of DNA testing policies and procedures (e.g., Samuels et al., 2013). Expanded DNA use is adding to already substantial backlogs of cases with untested forensics evidence. In a 2007 survey, police agencies in the United States reported that they had handled 31,570 homicide and rape cases and over five million property cases with unanalyzed forensics evidence over the previous five years (Strom et al., 2009); roughly 40% of the homicide and rape cases in question had unanalyzed DNA evidence. Yet that report also showed that many cases went unanalyzed because police had not identified suspects in the cases. This suggests that many agencies are missing out on the potential of DNA testing to help identify leads in criminal cases. Hence, additional training and policy changes will be required for agencies to fully capitalize on the potential of DNA testing technology. Problems with resources and backlogs may also ease somewhat as DNA testing procedures improve, reducing the time and cost of DNA tests. For example, although they do not yet appear to be in common use, portable devices for the collection and testing of DNA evidence have been developed that may alleviate backlogs in DNA testing and greatly reduce the cost of such tests (Nunn, 2001).

How DNA testing might affect other aspects of police work and organizations (e.g., the everyday activities and decisions of police officers and managers) has received little attention to date. As noted by Bayley and Nixon (2010), for instance, DNA evidence allows a greater number of cases to be solved without witnesses or confessions. This could substantially change the nature of detective work and potentially reduce the reliance of the police on community cooperation (which is likely to have pros and cons) in investigating crimes.

There is also the issue of how DNA testing might affect perceptions of police fairness and legitimacy, particularly in minority communities that are likely to be disproportionately impacted by expanded DNA collection. On the one hand, DNA offers the possibility of exonerating defendants who have been wrongly accused or convicted. On the other hand, might DNA arrest policies lead to greater use of pretextual arrests as an excuse to collect DNA from suspects, a charge that has been leveled in the United Kingdom (Stanglin, 2009)? At the same time, public perceptions might put greater pressure on police to collect DNA in a wider range of cases if people come to expect the availability of DNA evidence as the norm in proving criminal cases (what is often referred to as the "CSI effect"[16]). It remains to be seen how and to what degree these considerations will affect police agencies.

3.6 Summary

These five technologies—information technology systems, crime analysis, LPRs, in-car video, and DNA analysis—are major technologies in use by many police agencies today. They reflect common types of technology used in policing more generally (i.e., informational, analytic, communications, surveillance, and forensics technologies) and could potentially have a number of intended and unintended effects in policing. In our study, we used these technologies as a starting point to prompt personnel in four law enforcement agencies to think about the role, function, and impacts of technology on their organizations and their daily lives and activities. By asking about specific types of technologies and their impacts on various aspects of the police agency, we were able to gain a stronger understanding of technology's impacts on law enforcement more generally. In the next section, we describe our approach before providing the results of the various studies we conducted.

[16] This phrase was derived based on a popular television series dramatizing the work of forensic-specialist crime scene investigators (CSIs).

4. Overview of Study Questions, Research Methods, and Study Sites

As already mentioned, few studies have tested the impact of police technologies on outcomes like crime rates and perceptions of police legitimacy. Technology evaluation studies in policing have focused much more on technical efficiencies than effectiveness. Studies that examined both the efficiency and effectiveness of technology in policing have also produced mixed results. This suggests that we need to better understand the social, organizational, and behavioral dynamics involved in implementing new police technologies and the ways in which these processes shape outcomes. Indeed, understanding these processes seems critical to fully realizing the potential of technology to enhance police performance and outcomes.

These deeper organizational issues (e.g., technology's interaction with police culture, organizational hierarchy, functions, and relationships among units) have been discussed by many police and organizational scholars (e.g., Brown and Brudney, 2003; Chan, 2001; Ericson and Haggerty, 1997; Manning, 1992a; Mastrofski and Willis, 2010; Orlikowski, 2000), but empirical studies of these issues have been limited in number and scope. Studies of technology and organizational dynamics in policing have generally been case studies in one or a small number of agencies, and they have most commonly focused on information technologies (IT). Some of these studies are now decades old and may not relate as well to the current IT environment (e.g., Colton, 1980; Danziger and Kraemer, 1985; Palys et al., 1984; Rocheleau, 1993); relatively few have been completed within the past decade (e.g., Agrawal et al., 2003; Allen and Karanasios, 2011; Brown and Brudney, 2003; Chan, 2001; Ioimo and Aronson, 2004; Sørensen and Pica, 2005; Zaworski, 2004).

Our study seeks to expand and update this body of work in multiple ways. We conducted case studies in four agencies and used multiple avenues of research to understand the impact of technology in these organizations. We conducted agency-wide, officer-level surveys to gain a broad understanding of the impact of technology in each agency and supplemented these surveys with extensive interviews, focus groups, and observations. We also complemented our qualitative and survey work with experimental and quasi-experimental outcome evaluations that examined the effects of technology in controlling crime at hot spots and clearing criminal investigations. And while we examined IT in all of our agencies, we also expanded our research to other types of "core" policing technologies This multimethod approach across four agencies thus adds to the empirical research base on these issues and provides a stronger basis for making generalizations across technologies and organizational settings.

4.1 Study Questions and Themes

The study was guided by five broad questions about technology utilization and impacts in policing.

- How and for what purposes are technologies used in police agencies across various ranks and organizational subunits?
- How do technologies influence police, at both the organizational and individual levels, in terms of operations, structure, culture, management, behavior, satisfaction, and other outcomes?
- How do these organizational and individual aspects of policing shape the perceptions, uses, and impacts of technologies?
- How do technologies affect crime control efforts and police-community relationships?
- What organizational practices and changes—in terms of policies, procedures, equipment, systems, culture, and/or management style—are needed to optimize the use of these technologies and fully realize their potential for enhancing police effectiveness and legitimacy?

To answer these questions, we identified from the theoretical and empirical literature nine key issues, or themes, to explore by different types of methods within each of the four agencies. These themes, which we used to guide all aspects of our study, speak to the behavioral, social, and organizational aspects of policing that might be impacted by technological change. They include:

- An agency's experiences with technological innovation
- Police culture
- Organizational units, hierarchy, and structure
- Internal accountability and management systems
- Individual officer/supervisor discretion and decision making
- Efficiency of police processes and daily work productivity
- Effectiveness in reducing crime (prevention, detection, and deterrence)
- Police-citizen communication and police legitimacy

- Job satisfaction

We used various methods (detailed below) to investigate how our highlighted technologies affected these contextual aspects of policing, while also assessing how these contextual factors themselves shaped the uses and impacts of the technologies. In each study site, we explored these issues with respect to IT systems and one to two other selected technologies. Below, we elaborate briefly on the types of questions that we considered under each of these themes. Note that these categories are not mutually exclusive, and they are not equally relevant to all of the technologies we studied.

Experiences with technological innovation

To begin, we examined the implementation process of the selected technologies within each agency, including the decision to adopt the technology, the process of preparing for and carrying out its implementation, and the management of the technology over time. Understanding the agency's history with current technologies can provide important clues into the philosophy of the agency and its personnel with regard to the agency's function and roles. It can also yield insights into the relationships among its units and ranks. For example, what were the reasons an agency adopted a particular type of technology? Who was involved in the implementation process? What were some of the major challenges in implementing the technology, and how were these overcome? And, what were the results of the agency's adoption of the technology, and what consequences did it have for the agency?

To provide further context, we also considered the agency's experience with technological change and innovation more generally. Had the agency experienced other major successes or failures with technology? Did the agency personnel feel that the command staff placed a high priority on technological innovation? Did staff feel that the agency managed technological change effectively? And how might these general perceptions have affected the agency's success with the technologies under study?

Agency culture

Police agencies can be resistant to technological changes as they are to other types of organizational reforms. Such resistance (or alternatively, receptivity), while itself interesting, provides a window into understanding the organizational culture and mentality of personnel about organizational change, function, and purpose more generally. Accordingly, it is important to gauge the general receptivity of an agency to technology and technological change; i.e., do officers and commanders generally view technology as a positive force in policing? Also, how are the acceptance and uses of a particular technology influenced by the views of agency personnel as to why the technology was adopted, how easy the technology is to use, and whether the technology fits their everyday needs, processes, and organizational structure? Does technological change eventually prompt a greater emphasis on technological innovation and skills within an agency?

Another cultural issue (which is relevant to our discussion of effectiveness in crime prevention, below) is how technology interacts with the traditional policing focus of an agency (i.e., its emphasis on responding to calls and reactive investigations). Do new technologies prompt police to think and act in more analytic, proactive, and problem-oriented ways, or are they primarily adopted and used in ways that reinforce traditional modes of behavior and operation? To what extent do current modes of operation and deployment determine the way a new technology might be received, interpreted, and used?

Organizational units, hierarchy, structure, and relationships

Technological change may prompt changes in the structure of an organization such as the creation or abolishment of organizational units, movements of more personnel and resources into support and analytic functions, and increases in the ratio of civilian to sworn staff. A related issue is that technological innovations can increase (or decrease) the status and relevance of particular units and staff relative to others. A notable example is the growing influence of analytical units like crime analysis that are staffed largely by civilians. In addition to their crime mapping capabilities, which are often highly valued by management, such units can also carry out functions once done by detectives or records management personnel. How do such changes alter the communication and dynamics between sworn and civilian personnel, and are the changes embraced or resisted by sworn personnel? We sought to identify such changes within the study agencies and, where applicable, assess their implications for agency functioning and effectiveness.

We also examined how technology affects relationships between units and ranks within an agency. For example, does it increase the flow of communication between line-level staff, supervisors, and higher levels of command? Does it increase the level of information sharing and coordination between different units and shifts within the organization? And, if so, do these changes create a greater sense of equality within the organization, facilitate more effective teamwork, and foster a more positive atmosphere within the agency?

Technology might alter other informal patterns of interaction and influence as well. Do people with greater understanding and mastery of technology, for instance, gain greater formal or informal influence within the organization and become important change agents? Might technology also magnify differences between younger officers who are generally more fluent with technology and older officers who are often less competent with technology but perhaps more skilled in other aspects of policing?

Internal accountability and management systems

Technology may enhance the ability of police managers to monitor organizational and individual performance in many ways. Senior police commanders can track crime trends and agency responses more rapidly and precisely using modern IT and analytic capabilities. Combining those capabilities with managerial processes like Compstat can increase accountability throughout the agency for responding effectively to crime problems. Middle and lower level supervisors can track line officers' whereabouts and activities more readily using IT and GIS, and technologies like patrol car cameras and analytic behavioral surveillance systems (i.e., early warning systems) also allow for greater scrutiny of officer conduct.

With these issues in mind, we investigated whether and how managers used technology to foster accountability for better performance and conduct within the organization. Further, we examined the perceptions of agency staff regarding the uses of technology for management and accountability and assessed how that might influence behavior in the agency. We also considered whether technological enhancements to supervision might have unintended, adverse effects on supervisory relationships, agency morale, and staff behaviors.

Individual discretion and decision making

Technology might also impact the everyday discretion and decision making of officers and supervisors. Radios and computer-aided dispatch already guide officer activities on a day to day basis, but other technologies can also have such an impact. For example, using license plate reader technologies, officers no longer have to select vehicles for investigation or call license plates into dispatch to discover whether they are stolen. After scanning all plates in its purview, LPR alerts officers when it picks up a license plate that is connected to a stolen vehicle or another crime.

Information technologies might also influence the way officers respond to certain people and incidents. New interfaces in an officer's mobile computer terminal allow him or her to see the history of a call for service location before approaching that location. Officers can look up past information about an individual that they may factor into a decision to arrest or further question a person. Information and analytic technologies might also impact officers' or detectives' overall decision-making *style*. Officers and detectives have discretionary periods when they are not answering calls or carrying out predefined duties. Choosing to use technologies during this period may influence what they do during this time.

For this theme, we asked officers about the types of tasks for which they used different technologies and the extent to which they used technology for these tasks. Further, we asked how technology affects their decisions about the types of activities to pursue and their responses to different types of incidents and problems. To what extent does technology expand and/or restrict their discretion in responding to incidents, conducting proactive enforcement, and structuring their time between calls? And for what types of tasks do they find technology most helpful? In sum, we asked questions to help us understand whether technology shapes the behavior of officers and managers in ways that are likely to impact an agency's effectiveness and legitimacy in the community.

Efficiency of police processes, work productivity, and daily business

The most straightforward impact that technology should have on police agencies (as with other organizations) is improving their efficiency. Advancements in information, scanning, investigative and computing technology in law enforcement seem well suited to increase the speed and efficiency of everyday tasks and processes such as writing reports, dispatching calls, investigating people and places, collecting and disseminating information, processing evidence, and making arrests. Yet despite the seemingly logical connection between technology and efficiency, studies point to a more complex and contradictory relationship between technology and productivity. Technology may create new requirements and complexities with respect to data gathering, reporting, and evidence collection that put more demands on the time of officers and other staff. Technology may also increase the need for more training, maintenance, and other administrative work. Technologies that appear efficient may in the long run clash with organizational systems and cultures, creating resistance to those technologies that can then reduce efficiency gains.

To gauge the impact of technology on police productivity, efficiency, and daily work, we asked officers of all ranks as well as civilian staff to comment on whether technologies made them more efficient or productive. We asked about how technology impacted the speed and ease of everyday activities, as well as about changes it made to these activities.

Effectiveness in reducing crime (prevention, detection, and deterrence)

While technologies may improve the efficiency of law enforcement work or the speed with which officers react to crime, they may have little impact on police effectiveness in preventing, detecting, deterring, or reducing crime (Chan et al., 2001; Lum, 2010). To determine how officers perceived the effectiveness of computerized records management systems (RMS), mobile computer units, crime analysis, license plate readers (LPRs), and other technologies in reducing, preventing and deterring crime, we asked agency personnel how these technologies were being used to improve the agency's effectiveness in these areas (distinguishing effectiveness from efficiency) and whether they felt the technologies were working. How and to what extent, for instance, do agency personnel use technology for activities like suspect identification, problem solving, and hot spots policing? How does technology shape officers' approach to crime control? In what ways does technology enhance their ability to reduce crime through incapacitation, deterrence, and/or prevention? What are the limits to technology's impacts on crime reduction, and how might those limits be overcome? And can we measure the impacts of technology on police efforts to reduce crime?

Police-citizen communication and police legitimacy

Different technologies might potentially influence police-community relations and police legitimacy in several ways. Some technologies might be implemented specifically to foster more communication between police and the public (e.g., police agency websites and emergency texting services) or to satisfy demands for police accountability to the public (e.g., patrol car cameras). Other technologies, particularly IT systems, can influence the nature of police-citizen contacts in the field and enhance the ability of police to respond to citizens' requests for information and assistance. To the extent that technology makes police more effective in controlling crime, it may also improve their standing in the eyes of the community. And, indeed, citizens may expect their police to be equipped and proficient with the best technology for reducing crime. At the same time, some surveillance and investigative technologies can raise privacy concerns that have the potential to harm police legitimacy. Hence, we sought to assess how these possibilities had unfolded in the study sites with respect to our highlighted technologies.

Job satisfaction

Finally, we considered how technology impacts officers' job satisfaction. Does it improve job satisfaction to the extent that it makes police personnel more productive and effective? Does it enable them to be more creative and innovative in their work? Do they enjoy their jobs more? Or, in contrast, does it reduce officers' job satisfaction, perhaps by creating new demands, taking time away from tasks they enjoy, creating stress, and/or reducing their sense of autonomy and discretion? How do these possibilities then affect the uses and impacts of technology in the agency more generally?

4.2 Overview of Study Methods

The research team investigated these issues through multimethod case studies conducted in four large police agencies (described in Section 4.3). In each study site, the case studies entailed interviews, focus groups, field observations, and personnel surveys that explored the key study themes as they applied to IT systems and one to two other selected technologies in the agency. In two sites, the research team also conducted field evaluations and other analyses to evaluate the uses and impacts of selected technologies.

For the issues under consideration, conducting in-depth case study work in a small number of sites has advantages relative to broader approaches, such as conducting a national survey. Focusing on a small number of sites enabled the research team to develop a more complete and nuanced understanding of the technological capabilities of the agencies studied, as well as their organizational structure, culture, history, and external environment (i.e., key contextual and mediating factors). This informed the development and interpretation of the officer surveys and field experiments in the sites and enabled us to develop a more in-depth and holistic understanding of the study issues. At the same time, our examination of commonalities and differences across four sites with varying contexts facilitates broader generalization of findings and lessons learned from the project. The organizational case study approach, using interviews, surveys, observations, and document reviews, is a bedrock approach for understanding the relationship of technologies and organizations more generally (see, e.g., Boudreau and Robey, 2005; Robey et al., 2000; Strauss and Corbin, 1990).

Sworn officer survey

We developed a technology survey (Appendix A) that was administered to all sworn personnel in each participating agency.[17] The survey had several items addressing general (i.e., cultural) views on technology in policing and perceptions of the agency's approach to planning and implementing technological innovations. Questions addressing the other key study themes (i.e., organizational relationships and structure, accountability and management, discretion and decision making, efficiency, effectiveness in crime reduction, use for community relations, and job satisfaction) were asked specifically in reference to IT and analytic systems, which we defined (for purposes of the survey) to include RMS, computer-aided dispatch, mobile computer units, and other mobile or stationary computer and database systems in which officers can enter and/or receive information on persons, places, incidents, crime analysis, intelligence, and other related items. We focused most of the survey on IT and analytic systems because of their central role in policing (discussed earlier) and because this provided a basis for making comparisons across agencies with regard to the uses and impacts of specific technologies.

The surveys were conducted online. Acting on behalf of the research team, the command staff of each agency sent an email to all sworn staff that provided background on the project and explained the purpose of the survey. Participation was voluntary and anonymous. We conducted the survey over several weeks in each agency, sending out periodic reminder emails through the agency's command staff. (In one agency, we supplemented this approach with hard copy distribution of the survey at selected roll calls.) Overall, we received responses from approximately 1,700 officers across the four agencies. Agency response rates varied from 17.3% to 41.7%, and breakdowns of response rates for each survey are shown in Figure 4-a. Further details about the survey results are provided in Section 5.

[17] We limited the survey to sworn personnel in part because many of the items that we developed had limited or no applicability to civilian staff. We were also most interested in how sworn personnel, particularly those in the field, have adapted to technology.

Figure 4-a. Number of participants in agency-wide, officer surveys for each site

Agency	Number of participants	Number of possible participants	Response rate
1	529	1,327	39.9%
2	674	1,616	41.7%
3	200	1,159	17.3%
4	293	1,459	20.1%

Focus groups, interviews, and field observations

The interviews, focus groups, and field observations were conducted with sworn and civilian personnel from various units and ranks in each agency. The George Mason research team conducted the interviews and focus groups in Agencies 1 and 2, while the PERF research team took primary responsibility for conducting the interviews and focus groups in Agencies 3 and 4. Participants included patrol officers, detectives, officers in specialized units, supervisory and command staff, crime analysts, research and planning staff, forensic technicians, and other administrative and support staff. We selected a variety of users of each technology as well as persons who were knowledgeable about the history of the technology in the agency. Figure 4-b shows the number of people that took part in interviews and focus groups in each of the four sites.

Figure 4-b. Number of participants in interviews and focus groups for each site

Agency	Number of participants	Agency	Number of participants
1	100	**3**	45
2	141	**4**	53

Using a semistructured interview/focus group instrument (Appendix B), we conducted interviews, focus groups, ride-alongs and work-alongs (i.e., accompanying workers during non-patrol work) to gather additional interview and observational data. For Agencies 1 and 2, at least two members of the George Mason research team were on hand during almost all of the interactions so as to conduct the interviews and simultaneously record and/or type statements made by participants. Data collected were recorded both on the spot and shortly after the interaction to retain as much information as possible about the exchange. Field notes were drafted for each of these contacts, and they were reviewed and edited by each researcher that participated. Members of the PERF research team followed similar procedures in sites 3 and 4. To analyze the data, we searched for themes and patterns in the qualitative data and assessed convergence and divergence of the views of participants across units, ranks and agencies.

Trend analysis and field studies

As another means of assessing outcomes related to selected technologies, the George Mason team examined trends over time in Uniform Crime Reports (UCR) Part I crimes and case clearances in Agency 1's jurisdiction in relation to: 1) the agency's implementation of a new RMS that gave officers in the field greater access to data on investigations, field interviews, and other information; and 2) the deployment of more than two dozen new LPRs by the agency (Section 8).

In study sites 1 and 2, the George Mason team also conducted field studies involving different forms of IT. One of these studies examined the application of IT to hot spots policing as part of a randomized experiment testing the impacts of patrol and enforcement activities at crime hot spots (discussed in Section 9). The other study involved a process and quasi-experimental outcome evaluation of an information-sharing social media technology that was designed to increase collaboration between detectives, patrol officers, and crime analysts (Section 10). A primary goal of the agency implementing this technology was to improve clearance rates in criminal investigations.

4.3 Selection of Study Sites

The case studies were conducted in four large police agencies serving a mix of urban and suburban jurisdictions.[18] Each case study agency was selected because of its particular experience with one or more technologies of interest. In some cases, our study agencies had extensive experience with these technologies; in others, they were still adapting to major technological changes or testing new innovations. This provided useful contrasts across the sites and helped us assess short and long-term consequences of technological change. At the same time, we sought agencies that

[18] We emphasized large agencies because they tend to make more extensive use of most sophisticated police technologies and because they serve jurisdictions with larger shares of the nation's population and crime.

were fairly typical among large agencies (i.e., ones that were not clear outliers in terms of their size and/or technological sophistication[19]) and that would provide some diversity in terms of their geographical locations and service populations. Below, we provide a brief description of each study agency and jurisdiction. (The agencies and jurisdictions are discussed in greater depth in Sections 6 and 7.) This is followed by Figure 4-c which provides an overview of the technologies highlighted in each agency.

Agency 1

Agency 1 is a suburban county police agency located in the upper portion of the nation's South Atlantic region (as defined by the U.S. Bureau of the Census). The agency is in the size range of 1,000 to 1,500 officers and serves a population of more than 1 million. Agency 1's jurisdiction is relatively affluent (less than 10% of the population is below the poverty line) while also being racially and ethnically diverse. The county's population is nearly two-thirds white but also has substantial segments that are Asian, Hispanic, and black. The county's geography is also diverse with a mix of highly and less urbanized areas. The county has a relatively low crime rate. As measured by its 2012 UCR, the county's crime rate is approximately 1,400 per 100,000 persons, which is considerably lower than the average crime rate of metropolitan counties (2,281 per 100,000 persons).

Agency 1 was selected for the study because it implemented a new RMS in early 2010. Officers now have the ability to file reports remotely from the field for the first time in the agency's history, and they have in-field access to a wider variety of data on crime reports, citizen contacts, and other information. This provided the research team with an opportunity to study how the agency has been affected by and adapted to a recent and significant technological change. In addition, Agency 1 recently expanded its LPR capability from three units to 29. Therefore, we selected LPR as a second technology of emphasis for study. Finally, Agency 1 served as the site for our field study of technology and hot spots policing.

Agency 2

Agency 2 is an urban sheriff's office in the size range of 1,500 to 2,000 officers. The agency serves a city of between 500,000 and 1 million persons in the lower portion of the South Atlantic region. The city's population is predominantly white, with blacks representing about a third of the population and other racial and

[19] We judged this based on our review of the technology literature, analysis of LEMAS data, and our familiarity with many police agencies.

ethnic groups accounting for only small shares. Between 10% and 20% of the city's population live below the poverty line.[20] The city has high rates of serious crime, with a 2012 UCR Part I crime rate of approximately 4,700 per 100,000 persons, close to the average 2012 crime rate of other cities with a population between 500,000 and 1 million (5,187 per 100,000).

Agency 2 was selected because it has highly sophisticated crime analysis capabilities. Further, the agency's command staff places a strong emphasis on the use of crime analysis in its operational decisions. This provided an exceptional opportunity to examine how crime analysis is received and used at both the managerial and line levels. Officers in Agency 2 also have in-field access to an exceptional amount of data from within and outside the agency. This was another angle of interest in assessing the impact of technology on officer behavior in the field. Finally, Agency 2 served as the site for our second field study, which examined the impact of a new information sharing technology that was intended to improve the outcomes of criminal investigations by facilitating more collaboration between detectives, crime analysts, and patrol officers.

Agency 3

Agency 3 is a suburban county police agency that, like Agency 1, serves a jurisdiction in the northern portion of the South Atlantic region.[21] The agency has between 1,000 and 1,500 officers and serves a population of just over 1 million. The county's population is predominantly white (63%), while blacks (18%) and Asians (nearly 15%) account for the bulk of the remaining population. Between 5% and 10% of the county population live below the poverty line. The UCR Part I crime rate for Agency 3's locality in 2012 was approximately 1,800 per 100,000 persons, a figure lower than the average for metropolitan counties nationwide (2,281 per 100,000 persons).

Agency 3 was selected because it has had its own forensics lab since 2002. Within the past five years, Agency 3 had reduced its DNA backlog from over 400 to approximately 32. Working with Agency 3 afforded an opportunity to study how this capability affects investigative and other operations. In 2013, Agency 3 greatly expanded the size and capabilities of its lab. Agency 3 was also in the process of

[20] Reported social characteristics of the study jurisdictions are based on data from the U.S. Census Bureau.
[21] We selected two agencies in the upper South Atlantic region in order to minimize travel costs, thus maximizing both the number of agencies we could study and the amount of time that we could spend onsite with each agency.

installing in-car video cameras. The relatively new use of this technology provided a contrast to other agencies in this study, particularly Agency 4.

Agency 4

Agency 4 is an urban municipal police agency located in the Midwest region. The agency has between 1,200 and 1,600 officers and serves a city of approximately 500,000 residents. City residents are approximately 59% white and 30% black, with other groups accounting for the remaining portion. Between 15% and 20% of the population live below the poverty line. Agency 4's city had a UCR Part I crime rate of approximately 6,800 per 100,000 population in 2012, which was considerably higher than the average for cities with populations between 500,000 and 1 million (5,187 per 100,000) and that for cities with populations between 250,000 and 500,000 (4,992 per 100,000).

Agency 4 drew our interest because it has had nearly its entire fleet of patrol cars equipped with cameras since 1999. The cameras were initially installed in response to a shooting incident that created substantial controversy in the community. The original cameras used a VHS system for recording. Since 2008, Agency 4 has upgraded its fleet to digital cameras. We investigated how the agency has used these cameras, how officers have adapted to them, and how officers feel the use of the cameras has affected relations inside the agency and with the outside community.

Summary

Figure 4-c summarizes the different technologies that were examined for each agency. Information technologies were examined in all agencies, and all agencies had basic mobile computing technologies for writing reports and accessing information from the field.[22] For each agency, we also posed questions related to at least two other types of technology.

[22] If an agency had mobile computing capabilities that were particularly advanced or limited, we noted that in the case study reports.

Figure 4-c. Summary table of agencies and highlighted technologies

Agencies	Agency 1 (suburban)	Agency 2 (urban)	Agency 3 (suburban)	Agency 4 (urban)
Information technologies (Includes RMS, mobile computers and in-field access, other systems)	**XX**	X	X	X
Identification technologies (DNA testing)			**XX**	
Sensor and surveillance Technologies (LPR or car cameras)	X (LPR)		X (car cameras)	**XX** (car cameras)
Analytic technologies (crime analysis)		**XX**		
Field evaluation	IT and hot spots policing	Information sharing tech.		

XX = Primary technology highlighted in site
X = Secondary technology highlighted in site

4.4 Study Limitations

As noted, our study is based on a small convenience sample of large police agencies. Further, our findings and conclusions are based most heavily on Agencies 1 and 2, where the research team conducted the most intensive fieldwork and obtained the highest survey response rates (see Section 5 regarding the latter point). The advantages to conducting in-depth case study research in a small number of agencies were discussed above. We also sought to select agencies whose experiences with technology might provide particularly illustrative lessons for the field. The study illuminates difficulties and complexities that police agencies can face in dealing with technological change, but caution is nonetheless warranted in generalizing the findings to other agencies, particularly small ones.

In addition, the surveys and interviews gauged agency personnel's experiences with and perceptions of technology. As such, these analyses are more exploratory in nature and do not provide a basis for rigorous cause and effect assessments of technology's impacts. However, they can help us to better understand the dynamics of technological change in police agencies and potentially provide some bases for future research, innovation, and testing in the application of law enforcement technology.

Finally, our trend, experimental, and quasi-experimental analyses focus on crime-related performance and outcome measures such as crime levels and case clearance rates. (Other limitations to those analyses are noted in the appropriate sections.) Although we explored other organizational and community impacts from police technology in our survey and interviews, these are important topics for more systematic and in-depth research.

5. Perceptions and Uses of Technology as Reported in Agency-Wide, Officer-Level Surveys

In order to provide a broad gauge of how officers used technology and how they perceived its effects in their agencies, we conducted an online survey of all sworn personnel in each of the study agencies (the survey instrument is provided in Appendix A). Although the in-depth interviews and focus groups (discussed in Sections 6 and 7) provide detailed information about the relationship between officers and technology, agency-wide, officer-level surveys allow us to capture general perceptions across an entire agency, and also compare survey results from multiple agencies.

As discussed in Section 4, the George Mason research team developed the survey instrument based on existing theoretical and empirical literature and research (discussed further below). Below, we discuss the instrument and survey results in more detail and examine some of the general patterns that emerged from the results. Specifically, we discuss patterns that emerged across assignments and ranks within each agency and then highlight similarities and differences in responses from line-level patrol officers in the four agencies. In Sections 6 and 7, we also integrate some of the more specific survey findings into our discussion of the interviews and focus groups.

5.1 Survey Participation

Responses across the four agencies totaled nearly 1,700. We repeat Figure 4-b as Figure 5-a below to show the number of survey respondents and the response rate for each agency.[23]

Agencies 1 and 2 also provided data on their agency demographics, which enabled us to examine how survey respondents compared to the agencies overall.

[23] In Agency 1, we boosted the survey response rate by supplementing the online administration of the survey with hard copy dissemination at randomly selected roll calls.

With some exceptions, differences between the respondent characteristics and those of the agencies overall tended not to be substantively large (even if statistically significant). In Agency 1, patrol officers represented 69% of survey respondents compared to 73% of officers in the agency; detectives accounted for 17% of respondents compared to 12% of officers in the agency; and officers in other assignments accounted for 15% of survey respondents compared to 16% of officers in the agency. In terms of rank, line-level officers accounted for 77% of survey respondents and 83% of all officers; first-line supervisors accounted for 11% of survey respondents and 5% of all officers; and higher level managers accounted for 12% of both survey respondents and all officers.

In Agency 2, patrol officers tended to be underrepresented among survey respondents, while detectives had very high response rates: patrol officers accounted for 34% of survey respondents compared to 59% of all officers, and detectives accounted for 48% of survey respondents compared to 24% of all officers. With respect to ranks in Agency 2, line-level officers accounted for 80% of survey respondents and 84% of all officers; first-line supervisors accounted for 13% of respondents and 10% of all officers; and higher level supervisors and commanders accounted for 8% of respondents and 6% of all officers.

Figure 5-a. Number of participants in agency-wide, officer surveys for each site

Agency	Number of participants	Number of people who were asked to complete survey	Response rate
1	529	1,327	39.9%
2	674	1,616	41.7%
3	200	1,159	17.3%
4	293	1,459	20.1%

In Agency 3, roughly half of the survey respondents were patrol officers, with detectives and people in other assignments accounting for about a quarter each. The distribution across ranks in Agency 3 was roughly 60% line-level, 25% first-line supervisory, and 15% higher level supervisors and commanders. For Agency 4, detectives accounted for about 20% of respondents, while patrol officers and officers in other assignments each accounted for about 40%. In terms of ranks, line-level staff accounted for about 70% of respondents from Agency 4. First-line supervisors accounted for about 20% of respondents and higher level supervisors and commanders represented about 10%.

Because of the differential response rates among officers of different units and ranks, particularly in Agency 2 and likely in Agencies 3 and 4, we do not compare overall agency averages for items or scales across agencies, as those comparisons are more likely to be confounded by differences in the composition of survey respondents across agencies. Instead, our survey analyses focus primarily on: 1) comparisons across units and ranks within each agency (we also assess how common those within-agency unit and rank differences are across agencies); and 2) comparisons of patrol officer responses across agencies.[24]

5.2 Survey Items and Scales

We devised the survey to match the nine sections corresponding to the key study themes discussed in Section 4. The first two sets of items—general views on technology and views on technology implementation—were phrased in reference to police technology in general.[25] The remaining sections focused specifically on information and analytic technologies, which were defined to include "records management systems, computer-aided dispatch, mobile computer units, and other mobile or stationary computer and database systems in which you can enter and/or receive information on persons, places, incidents, crime analysis, intelligence, etc."[26] Unless otherwise noted, respondents were asked to indicate their level of agreement or disagreement with each survey item on a four-point scale (i.e., "strongly disagree," "disagree," "agree," or "strongly agree"). The survey also asked respondents to provide several background characteristics. Here, we focus on how results varied based on the respondents' ranks and assignments.

[24] Note, however, that these comparisons could still have biases if respondents in particular groups within each agency (e.g., patrol officers) tended to have systematically different views from non-respondents in those same groups.
[25] For these sections, the survey instructions defined technology to mean "such things as records management systems, in-car cameras, forensics, computer-aided dispatch, mobile computer units, analytic technologies (like crime analysis), etc."
[26] As noted in Section 4, we focused most of the survey on IT and analytic systems because of their central role in policing and because this provided a basis for making comparisons across agencies with regard to the uses and impacts of specific technologies.

General views of technology

This section of the survey included 14 items that were developed to tap general cultural attitudes towards technology. Specific items assessed officers' attitudes towards technology (e.g., "successful policing requires keeping up with new technologies" and "I like to experiment with new technologies"); officers' views about their agency's openness and approach to technology (e.g., "my agency is generally open to implementing the latest technologies" and "my agency prioritizes the acquisition of the newest technologies"); and their views about some of the general impacts of technology on their agency's internal and external relationships (e.g., "the use of technology has led to a less trusting atmosphere in my agency" and "technology increases the community's expectations of my agency to reduce crime").[27]

Implementation of technologies

The nine-item implementation section asked about officers' views of how technologies were implemented in their respective agencies. Items assessed respondents' general views about how their agency selected and implemented technologies (e.g., "I feel that my agency adopts technologies designed to meet important needs" and "in general, I am satisfied with how new technologies are implemented in this agency") and respondents' views about whether their agency adequately consulted with and supported staff in the implementation of technology (e.g., "before implementing a new technology, command staff work hard to get input from employees" and "my agency adequately prepares me to use new technologies"). The reliability of this scale ranged from 0.84 to 0.89 across the agencies.[28]

Agency structure and relationships

This eight-item scale measured the degree to which information technology and analytic systems (we refer to these collectively as IT) affected communication, cooperation, and relationships between people, units, and ranks within the agency (e.g., "information technology improves cooperation across units and people in my agency," "information technology improves communication between me and my

[27] These items were not intended to serve as a single unitary scale. Nevertheless, they were substantially correlated, producing reliability scores of 0.67 to 0.77 across the agencies.

[28] The reliability measure is a measure of the internal consistency of the items as measured by their average correlation on a scale of 0 to 1. (A correlation closer to 1 indicates higher reliability.) We used Cronbach's alpha to measure the reliability of the survey scales.

immediate supervisor," and "information technology creates more equality among ranks and units in my agency"). The reliability of this scale ranged from 0.83 to 0.87 across the agencies.

Internal accountability and management

This seven-item scaled measured officers' perceptions of whether and how managers and supervisors used IT to monitor and evaluate officers' performance and use of technology (e.g., "my immediate supervisor uses information technology to track and monitor my daily activities", "commanders and supervisors use information technology to identify under-performing officers", and "my superiors expect me to use information technology systems to identify and respond to problems"). The scale also included items to measure officers' assessments of whether technology improved management in the organization (e.g., "information technology generates statistics that are valuable in assessing officer performance" and "information technology improves supervision and management within the agency"). The reliability of this scale ranged from 0.78 to 0.81 across the agencies.

Discretion and decision making

The survey contained several items asking respondents if they used IT "never," "rarely," "sometimes," "often," or "very often" for a variety of tasks. There were seven discretion/decision-making items asked specifically of patrol officers (e.g., "locate suspects, wanted persons, and other persons of interest," "collect and search for information during a field interview," and "determine where to patrol when not answering a call for service"). There were also six separate items asked specifically of supervisors and commanders (e.g., "monitor the daily activities of officers, detectives, or supervisors who work for you," "identify crime trends and problems in your area of responsibility," and "share information with community leaders or business owners"). Finally, all respondents were asked to indicate their level of agreement or disagreement (on the four-point scale described for other scales) with a few additional items on discretion and decision making (e.g., "when making decisions about crime problems, I tend to rely more on my own experience than using information technologies help me to engage in proactive, self-initiated activities").[29]

[29] The discretion and decision-making items do not constitute scales, and we did not calculate reliabilities for them.

Efficiencies of police processes and productivity

This scale contained four items asking about the quality of the agency's IT systems and the extent to which they made officers more or less productive (e.g., "generally, information technology in this agency is easy to use" and "overall the information technology helps me to be productive in my daily work"). The reliability of these items ranged from 0.69 to 0.78 across the agencies.

Effectiveness in reducing crime and assisting citizens

This five-item scale asked respondents whether the agency's IT systems helped them in addressing crime-related issues (e.g., "information technologies and crime analysis help me understand and respond effectively to crime problems") and assisting citizens (e.g., "information technologies improve the way I interact with citizens" and "information technology allows me to be more effective in helping victims"). The reliability for this scale ranged from 0.79 to 0.84 across the agencies. The survey also had an additional effectiveness item that asked patrol officers only about whether IT increased their capacity to prevent crime when not answering calls.

Job satisfaction

Finally, the survey included a four-item scale asking about the impact of IT on officers' job satisfaction (e.g., "the demands of using information technologies take time away from aspects of police work that I enjoy" and "information systems enhance my job satisfaction"). The reliability of this scale ranged from 0.74 to 0.81 across the agencies. An additional, related item asked whether patrol officers felt that IT enhanced their safety on the job.

5.3 Patterns across Assignments and Ranks

In analyzing the survey data, we first sought to determine whether perceptions of technology tend to differ systematically between personnel in different assignments and ranks. For each agency, we therefore compared survey responses across assignment groups, classified as patrol, detective, and other (e.g., administrative and support services), and across ranks, classified as line level, first-line supervisory, and second-line supervisory or higher. To view all of the statistics related to these findings for each agency, see Appendix C. In this section, we briefly summarize some of the key patterns across agencies.

For each of the scales described above, we tested for differences in mean scale scores across assignment and rank groups using analysis of variance (ANOVA) tests.[30] Scale scores that were significantly different across two or more of the assignment or rank groupings are denoted by an "X" in Figure 5-b (again, see the tables in Appendix C for detailed results). The results suggest that views of technology often differ significantly across personnel in different assignments and ranks, but this is not uniformly true. In Agency 1, assignment and rank groups showed significant differences for nearly every scale. In contrast, Agency 3 had few such statistically significant differences. Agencies 2 and 4 occupied a middle ground, but their patterns were opposite; views differed frequently across ranks in Agency 2 and across assignments in Agency 4.

The variation in group differences across agencies may reflect numerous factors including differences in technological capabilities, implementation experiences, management practices, and culture across the agencies. While some of these nuances cannot be discerned from the survey results themselves, the George Mason research team explored these factors in detail for Agencies 1 and 2 (see Section 6), and the PERF team explored them in Agencies 3 and 4 (see Section 7), drawing upon qualitative fieldwork. At the same time, these patterns would seem to suggest that the impacts of technology in policing are likely to be highly variable across agency contexts.

[30] Figures in Appendix D also show differences across groups in the percentage of respondents that agreed or strongly agreed with each scale item (based on logistic regressions).

Figure 5-b. Summary of survey differences across assignments and ranks within each study agency

	Agency 1		Agency 2		Agency 3		Agency 4	
	Assign	**Rank**	**Assign**	**Rank**	**Assign**	**Rank**	**Assign**	**Rank**
General views on technology	x	x		x			x	x
Implementation		x		x		x	x	x
Agency relationships	x	x		x			x	
Internal accountability and management	x	x		x	x		x	
Processes and efficiencies	x	x		x			x	
Effectiveness	x	x	x	x			x	x
Job satisfaction	x	x	x	x			x	

“Assign” refers to assignment groups (patrol, detective, and other). “Rank” refers to rank groups (line-level, first-line supervisors, and second-line supervisors or higher ranks). X denotes a significant difference across groups.

However, commonalities across agencies in the nature of the group differences also emerged from the survey. As shown in the tables in Appendix C, to the extent that there were significant differences in scale scores or individual survey items across assignment groups, attitudes about technology tended to be least positive among patrol officers in comparison to detectives and especially persons in “other” assignments (such as administrative assignments). This was particularly true in Agencies 1 and 4, which exhibited many significant differences between assignment groups.

With respect to rank groupings, views of technology tended to be more positive among managerial staff, particularly second-line supervisors and higher level managers. This was a pattern that was common across Agencies 1 and 2 and, to a lesser extent, Agency 4.

Taken together, these patterns suggest that the greatest challenges to optimal utilization of technology are in patrol and at the line-level rank. This is significant given that line-level patrol officers not only constitute the largest group of personnel in most police agencies, but will also be most affected by major technology adjustments. In the remainder of this section, we focus on survey responses from line-level patrol officers in each agency, treating them as arguably the best window into the commonalities and differences in the effects of technology across police agencies.

5.4 Line-Level Patrol Officer Results across Agencies

Figures 5-c through 5-l present the item and scale results for line-level patrol officers in each agency. For each survey item, the figures show the average score by agency (unless otherwise noted, items were scored on a four-point scale ranging from 1 = strongly disagree to 4 = strongly agree) as well as the percentage of respondents who agreed or strongly agreed with the item. We tested for differences across agencies in the percentage of respondents who agreed or strongly agreed with each item using logistic regressions in which Agency 4 served as the reference agency (hence, item-level differences show whether an agency's responses differed significantly from those for Agency 4). We assessed differences in average scale scores across agencies using ANOVA tests (adjusted where appropriate for non-homogenous variances across groups). Scale scores appearing in bold showed statistically significant differences across at least two of the agencies (we note at the outset that all scale scores showed statistically significant variation across agencies). As a general caveat, the results for Agencies 3 and 4 should be interpreted with particular caution because the sample sizes are relatively small for those agencies (roughly between 50 and 70 per agency, depending on the item; see the table notes under each figure). Hence, the responses from those agencies might be less representative of typical officer views.

General views of technology

Figure 5-c presents results for the items assessing officers' general views of technology. Officers tended to have positive views of technology as exhibited by their responses to items like "successful policing requires keeping up with new technologies" (89% to 98% of officers agreed across agencies) and "I like to experiment with new technologies" (69% to 85% of officers agreed). However, there was also agreement across agencies (85% to 92%) that older officers are generally less receptive to technology than younger ones.

Figure 5-c. Officer survey results for general views on technology

	AGENCY 1 Avg. (% agree)	AGENCY 2 Avg. (% agree)	AGENCY 3 Avg. (% agree)	AGENCY 4 Avg. (% agree)
Successful policing requires keeping up with new technologies.	3.50 (96%) †	3.76 (97%)*	3.75 (98%) †	3.36 (89%)
My agency is generally open to implementing the latest technologies.	2.42 (51%)	3.02 (82%)***	2.68 (68%)	2.52 (57%)
In general, younger officers/detectives are more receptive to using technologies than older officers/detectives.	3.12 (85%)	3.21 (87%)	3.43 (92%)	3.29 (88%)
The use of technology has led to a less trusting atmosphere inside of my agency.	2.56 (50%)	2.55 (44%)	2.56 (43%)	2.66 (49%)
My agency prioritizes the acquisition of the newest technologies.	2.12 (31%)	2.55 (57%)***	2.23 (38%)	2.08 (31%)
Technology makes my agency's decisions more transparent to the community.	2.41 (44%)	2.61 (59%)**	2.65 (67%)**	2.30 (39%)
Up-to-date technology improves the image of my agency in the eyes of the community.	2.91 (75%)***	3.06 (81%)***	3.13 (88%)***	2.55 (52%)
Technology increases the community's expectations of my agency to reduce crime.	2.86 (72%)	3.14 (82%)	3.14 (84%)	2.99 (81%)
In general, technology functions well in my agency.	1.95 (29%)	2.93 (85%)***	2.24 (44%)*	1.93 (22%)
In comparison to my fellow officers, I consider myself 'technology-savvy.'	2.82 (67%)	2.95 (73%) †	2.75 (63%)	2.62 (60%)
I like to experiment with new technologies.	2.99 (77%)	3.23 (85%)**	2.83 (71%)	2.79 (69%)
In my agency, officers who use technology in creative or innovative ways are more likely to be rewarded than those who do not.	2.39 (41%)*	2.44 (43%)*	2.50 (52%)**	2.12 (25%)
My agency puts more value on officers making decisions based on data and analysis than on officers using their personal experience.	2.52 (44%)	2.80 (60%)	2.50 (41%)	2.65 (51%)
Technology has helped make decision-making more transparent to others in the agency.	2.32 (41%)*	2.59 (56%)***	2.61 (63%)***	2.14 (28%)
Scale Score*** Overall Reliability: α = .708	2.64	2.83	2.77	2.57

Statistical significance levels for differences: †.05 < *p* < .10; **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to Agency 4. Scale scores were tested for overall mean differences across agencies (statistically significant at p<=.001). The sample size varies for each item and for each agency. The sample size range for Agency 1 is 264 to 268; Agency 2 is 143 to 152; Agency 3 is 51 to 55; and Agency 4 is 62 to 69.

While officers seemed to have positive views about policing technology in general, Figure 5-c indicates that officers could be much more critical about their own agency's applications of technology as shown by the items that asked respondents to reflect on "my agency." These items also revealed considerable variation in officer's views across agencies. This can be seen particularly in items like "in general, technology functions well in my agency" (agreement ranged from 22% to 85%), "technology has helped make decision-making more transparent to others in the agency" (agreement ranged from 28% to 63%), and "my agency puts more value on officers making decisions based on data and analysis than on officers using their personal experience" (agreement ranged from 41% to 60%). These differences contributed to a statistically significant difference across agencies in the overall average for these items (see the scale score at the bottom of Figure 5-c), with Agency 2 having overall the most positive views.[31] Interestingly, however, fewer than half of the officers in most agencies and only about half in Agency 3 agreed with the statement that officers who use technology in innovative ways are more likely to be rewarded.

Implementation of technologies

Implementation item and scale scores are illustrated in Figure 5-d. Agency 4 officers had an exceptionally negative view of how their agency handled technology implementation, and officers did not have consistently high levels of agreement across agencies for any survey item. That aside, there was notable variation in officers' views of how their agency implemented technology. This is shown by the responses to items like "I feel that my agency adopts technologies that are designed to meet important needs" (agreement ranged from 25% to 72%) and "in general, I am satisfied with how new technologies are implemented in this agency" (agreement ranged from 11% to 60%). Overall, the most positive views were expressed by officers in Agency 2.

[31] As noted above, we did not create the general views items as a unitary scale. However, since the items had fairly high correlations, we calculated their average value and presented it like a scale score as a rough means for assessing overall differences in responses across the agencies.

Figure 5-d. Officer survey results for implementation of technologies

	AGENCY 1 Avg. (% agree)	AGENCY 2 Avg. (% agree)	AGENCY 3 Avg. (% agree)	AGENCY 4 Avg. (% agree)
My agency adequately prepares me to use new technologies.	2.19 (40%)***	2.61 (59%)***	2.47 (55%)***	1.70 (6%)
Overall, supervisors and command staff in my agency work hard to generate the widespread acceptance of technology.	2.31 (45%)**	2.60 (59%)***	2.41 (50%)**	2.00 (23%)
I feel that my agency adopts technologies that are designed to meet important needs.	2.15 (41%)*	2.75 (72%)***	2.31 (47%)*	2.00 (25%)
Before implementing a new technology, command staff work hard to get input from employees.	1.66 (15%)*	2.10 (31%)***	1.54 (10%)	1.29 (5%)
After implementing a new technology, my agency seeks regular feedback from employees on how it is working.	1.79 (20%)*	2.24 (36%)***	1.76 (14%)	1.47 (8%)
After implementing a new technology, my agency provides sufficient help and support to employees who are experiencing problems with it.	2.30 (49%)***	2.64 (63%)***	2.40 (52%)***	1.87 (16%)
In general, I am satisfied with how new technologies are implemented in this agency.	1.93 (28%)**	2.60 (60%)***	2.11 (36%)**	1.64 (11%)
The successful implementation of a new technology in my agency depends on supervisors and commanders requiring its use.	2.46 (52%)	2.80 (69%)*	2.67 (65%)	2.50 (52%)
My agency tends to adopt technologies that are often not useful. [REVERSE CODED]	1.98 (28%)*	2.57 (59%)***	2.26 (37%)**	1.54 (13%)
Scale Score*** Overall Reliability: α = .893	2.08	2.51	2.19	1.76

Statistical significance levels for differences: †.05 < *p* < .10; **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to Agency 4. Scale scores were tested for overall mean differences across agencies (statistically significant at p<=.001). The sample size varies for each item and for each agency. The sample size range for Agency 1 is 266 to 270; Agency 2 is 138 to 156; Agency 3 is 50 to 56; and Agency 4 is 63 to 67.

However, it was common across agencies for officers to feel that more staff input in the adoption of technologies and greater support for staff in the implementation of technology were needed. This is illustrated by the generally low levels of agreement with items on employee input and feedback ("before implementing a new technology, command staff work hard to get input from employees," and "after implementing a new technology, my agency seeks regular feedback from employees on how it is working"). Many officers, though not necessarily majorities, also felt that their agency needed to provide more assistance to staff in using technology; in most agencies, half or less of officers agreed with the statement that “after implementing a new technology, my agency provides sufficient help and support to employees who are experiencing problems with it.” In addition, roughly half to two thirds of the officers in each agency felt that the successful implementation of technology requires supervisors and managers to mandate its use.

Agency structure and relationships

There was notable variation across agencies in the extent to which officers believed that technology improves communication and cooperation within their agency (see Figure 5-e). To illustrate, the percentage that agreed that “information technology improves cooperation across units and people in my agency” ranged from 40% to 78%, and the percentage that agreed that “information technology improves communication between me and my immediate supervisor” varied from 39% to 75%. Almost half of officers in Agencies 1 and 4 also felt that technology increased conflict among units and staff (note that this item is reverse coded in Figure 5-e). Across all agencies, most officers did not agree that technology increased equality among ranks and units in their agency, but most did feel that technology enhanced the importance of their unit. Overall, officers’ views of IT’s impacts on agency relationships tended to be more positive in Agencies 2 and 3 relative to Agencies 1 and 4 (see the scale scores in Figure 5-e).

Figure 5-e. Officer survey results for technology and agency relationships

	AGENCY 1 Avg. (% agree)	AGENCY 2 Avg. (% agree)	AGENCY 3 Avg. (% agree)	AGENCY 4 Avg. (% agree)
Information technology enhances the importance of my unit or division.	2.62 (59%)	2.95 (78%)***	2.98 (75%)*	2.49 (52%)
Information technology causes conflict between organizational units and staff. [REVERSE CODED]	2.54 (54%)	2.79 (76%)***	2.76 (74%)*	2.40 (53%)
Information technology improves cooperation across units and people in my agency.	2.55 (57%)*	2.85 (78%)***	2.81 (77%)***	2.31 (40%)
Information technology creates more equality among ranks and units in my agency.	2.12 (26%)**	2.46 (46%)***	2.33 (40%)***	1.87 (9%)
Information technology improves communication between me and my immediate supervisor.	2.46 (47%)	2.84 (75%)***	2.69 (65%)**	2.26 (39%)
Information technology improves communication that I have with the higher levels of command staff.	2.06 (28%)	2.34 (39%)***	2.33 (42%)**	1.88 (21%)
Information technology improves relationships between me and other officers / detectives / supervisors of my same rank.	2.40 (48%)	2.84 (75%)***	2.62 (64%)*	2.34 (41%)
Information technology improves relationships between sworn and civilian personnel in my agency.	2.24 (37%)*	2.59 (58%)***	2.44 (51%)***	2.16 (21%)
Scale Score*** Overall Reliability: α = .865	2.37	2.66	2.61	2.22

Statistical significance levels for differences: †.05 < *p* < .10; **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to Agency 4. Scale scores were tested for overall mean differences across agencies (statistically significant at p<=.001). The sample size varies for each item and for each agency. The sample size range for Agency 1 is 263 to 268; Agency 2 is 135 to 152; Agency 3 is 51 to 55; and Agency 4 is 67 to 70.

Internal accountability and management

Despite variation in agreement levels across agencies, the majority of officers in each agency believed that superiors used IT to track officers and units, and that superiors expected their officers to use IT to respond to crime problems (see Figure 5-f). With the exception of Agency 4, majorities also agreed that supervisors and commanders used IT to identify underperforming officers and that IT generated useful information in assessing officer and agency performance. However, officers were more divided on whether IT actually improved supervision and management within their agency, as agreement with this item ranged from a low of 23% in Agency

4 to a high of 58% in Agency 2. Thus, there appears to be a disconnect between officers' perceptions of how they are being held accountable and supervised and how that supervision is connected to the overall performance of the agency and the ability of the agency to respond to crime problems.

Figure 5-f. Officer survey results for technology, internal accountability, and management

	AGENCY 1 Avg. (% agree)	AGENCY 2 Avg. (% agree)	AGENCY 3 Avg. (% agree)	AGENCY 4 Avg. (% agree)
My immediate supervisor uses information technology to track and monitor my daily activities.	3.05 (87%)***	2.92 (80%)**	2.76 (70%)	2.63 (61%)
The command staff uses information technology to track and monitor my unit's daily activities.	3.00 (84%)***	3.06 (84%)***	2.98 (85%)*	2.69 (64%)
Commanders and supervisors use information technology to identify underperforming officers.	2.91 (81%)***	2.69 (61%)*	2.71 (65%)*	2.43 (45%)
Information technology generates statistics that are valuable in assessing officer performance.	2.50 (55%)***	2.74 (66%)***	2.60 (66%)***	2.15 (28%)
Information technology generates statistics that are valuable in assessing my agency's performance.	2.54 (57%) †	2.84 (77%)***	2.76 (71%)**	2.36 (45%)
My superiors expect me to use information technology systems to identify and respond to crime problems.	2.78 (75%) †	3.20 (92%)***	2.83 (81%)*	2.65 (65%)
Information technology improves supervision and management within the agency.	2.29 (43%)**	2.63 (58%)***	2.51 (55%)***	1.94 (23%)
Scale Score*** Overall Reliability: α = .803	2.72	2.75	2.75	2.40

Statistical significance levels for differences: †.05 < *p* < .10; **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to Agency 4. Scale scores were tested for overall mean differences across agencies (statistically significant at p<=.001). The sample size varies for each item and for each agency. The sample size range for Agency 1 is 265 to 269; Agency 2 is 147 to 153; Agency 3 is 50 to 55; and Agency 4 is 65 to 70.

Discretion and decision making

Figure 5-g illustrates the extent to which officers used IT for a variety of everyday tasks (ratings were based on a five-point scale ranging from "never" to "very often"). Here, we focus on the extent to which officers used IT "often" or "very often" for the tasks in question. In general, the variation across agencies is notable even for very standard tasks; for example, the percentage of officers that reported

using IT systems often or very often to collect and search for information during a field interview ranged from 34% in Agency 4 to 68% in Agency 2. These differences likely reflect cultural and managerial differences across the agencies as well as differences in the agencies' technological capabilities (these issues are discussed further in Sections 6 and 7).

Figure 5-g. Officer survey results for technology, discretion, and decision making among officers

To what extent do you use IT and analytic systems to do the following:		AGENCY 1	AGENCY 2	AGENCY 3	AGENCY 4
Provide information to citizens that is not related to a specific call or emergencies.	Never	24%	8%	19%	16%
	Rarely	28%	19%	32%	30%
	Sometimes	37%	44%	35%	46%
	Often	9%	21%	11%	3%
	Very Often	2%	8%	4%	4%
	Mean	2.37	3.03	2.47	2.49
Determine where to patrol when not answering a call for service.	Never	22%	6%	21%	22%
	Rarely	29%	14%	23%	29%
	Sometimes	34%	31%	26%	28%
	Often	10%	35%	18%	16%
	Very Often	4%	14%	12%	4%
	Mean	2.46	3.38	2.77	2.51
Locate suspects, wanted persons, and other persons of interest.	Never	4%	2%	4%	7%
	Rarely	8%	6%	16%	9%
	Sometimes	42%	19%	39%	36%
	Often	34%	45%	29%	38%
	Very Often	12%	29%	13%	10%
	Mean	3.42	3.93	3.30	3.35
Locate vehicles of interest.	Never	22%	6%	21%	22%
	Rarely	29%	14%	23%	29%
	Sometimes	34%	31%	26%	28%
	Often	10%	35%	18%	16%
	Very Often	4%	14%	12%	4%
	Mean	2.46	3.38	2.77	2.51
Collect and search for information during a field interview.	Never	6%	3%	2%	10%
	Rarely	9%	8%	21%	24%
	Sometimes	34%	21%	36%	32%
	Often	34%	34%	25%	24%
	Very Often	18%	34%	16%	10%
	Mean	3.50	3.90	3.32	3.00
Determine how to respond to a crime problem.	Never	15%	4%	14%	20%
	Rarely	27%	9%	30%	32%
	Sometimes	40%	38%	39%	33%
	Often	13%	29%	11%	13%
	Very Often	4%	19%	7%	1%
	Mean	2.64	3.50	2.67	2.43

Check the history of a specific location or person(s) before responding to a call for service.	Never	2%	3%	2%	10%
	Rarely	3%	8%	4%	23%
	Sometimes	27%	26%	14%	32%
	Often	43%	35%	39%	29%
	Very Often	26%	28%	42%	6%
	Mean	3.88	3.79	4.16	2.97

The sample size varies for each item and for each agency. The sample size range for Agency 1 is 267 to 268; Agency 2 is 154 to 156; Agency 3 is 56 to 57; and Agency 4 is 68 to 69.

A common pattern across agencies, however, is that officers were much more likely to use IT for traditional enforcement-oriented tasks (e.g., check call history or locate suspects) than for more strategic proactive tasks (like problem-solving or hot spots policing). To illustrate, officers were most likely to use IT often or very often to search for information during a field interview (see preceding figures), to locate persons of interest (42% to 74% across the agencies), or to check the call history of a location or person before responding to a call for service (63% to 81% across most of the agencies). In contrast, they were less likely to use IT often or very often to determine where to patrol between calls (14% to 49% across the agencies), to provide information to citizens (7% to 29%), or determine how to respond to a crime problem (14% to 48% across the agencies). Another pattern of note is that officers in Agency 2 used IT more extensively than their peers for nearly all of the listed activities, including tasks that are more proactive and strategic in nature. Indeed, about half of the officers in Agency 2 used IT often or very often to determine where to patrol between calls and to determine how to respond to crime problems.

This tendency of agencies to interpret and use technologies in more traditional law enforcement ways is important to note (and will be discussed in detail in Chapter 6). As we know from organizational studies, employees make sense of innovations or technologies through organizational frames with which they are familiar (Manning, 1992a; Orlikowski and Gash, 1994). Police are still very much focused on responding and reacting, not necessarily proactively problem solving. Although police leaders may often discuss innovations (i.e., problem-solving, evidence-based policing, intelligence-led approaches, community policing) in policing, line-level surveys seem to indicate that police are still primarily operating in a reactive, response-oriented, case-by-case enforcement mode.

A few additional items addressing discretion and decision making appear in Figure 5-h. They further reinforce this traditional mode of policing, with one exception (Agency 2). These items show that although the majority of officers in each agency (within a range of 52% to 82%) agreed that IT helped them to engage in proactive, self-initiated work, most also reported (within a range of 59% to 88%) that they relied more on their own experience than on using IT in responding to problems. Consistent with other responses discussed above, officers in Agency 2 were most likely to use IT for proactive work and least likely to rely on experience rather than IT in responding to problems.

Figure 5-h. Additional survey items on discretion and decision making

	AGENCY 1 Avg. (% agree)	AGENCY 2 Avg. (% agree)	AGENCY 3 Avg. (% agree)	AGENCY 4 Avg. (% agree)
When making decisions about crime problems, I tend to rely more on my own experience than using information technologies.	3.16 (87%)	2.69 (59%)***	3.08 (79%)	3.22 (88%)
Information technologies help me to engage in proactive, self-initiated activities.	2.49 (52%)	2.95 (82%)***	2.93 (76%) †	2.57 (60%)

Statistical significance levels for differences: †.05 < *p* < .10; **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to Agency 4. The sample size varies for each item and for each agency. The sample size for Agency 1 is 268; Agency 2 is 147; Agency 3 is 52 to 54; and Agency 4 is 65 to 68.

Efficiencies of police processes and productivity

The process and efficiency items revealed stark differences across the agencies (Figure 5-i). Three quarters or more of officers in Agency 2 reported that the agency's IT systems were easy to use, provided high quality information, and helped them be productive. Half or more of officers in Agency 3 also gave their agency favorable marks in these regards. Officers in Agencies 1 and 4 tended to report lower levels of satisfaction with their agency's IT systems. Indeed, 86% of officers in Agency 2 and 70% in Agency 3 agreed or strongly agreed that IT helped them to be more productive, while only 38% of officers in Agency 1 and 46% in Agency 4 agreed with this statement. At the same time, it is notable that IT also creates extra work for officers. This was felt most acutely by officers in Agencies 1 (86%) and 4 (83%)(note that this item is reverse-coded in Figure 5-i, so the displayed percentages represent those who did not agree that IT created extra work). Even in Agencies 2 and 3, half to 70% agreed that IT creates additional work, despite the fact that most felt IT made them more productive overall.

Figure 5-i. Officer survey results for technology and agency processes and efficiencies

	AGENCY 1 Avg. (% agree)	AGENCY 2 Avg. (% agree)	AGENCY 3 Avg. (% agree)	AGENCY 4 Avg. (% agree)
Generally, information technology in this agency is easy to use.	1.91 (27%)	2.78 (74%)***	2.30 (48%)**	1.86 (22%)
I am satisfied with the quality of information I can access from our information technology systems.	2.33 (49%)***	2.82 (76%)***	2.48 (59%)***	1.95 (26%)
The information technology my agency uses creates extra work for me. [REVERSE CODED]	1.65 (14%)	2.47 (51%)***	1.94 (30%) †	1.55 (17%)
Overall the information technology helps me be productive in my daily work.	2.21 (38%)	2.98 (86%)***	2.70 (70%)**	2.32 (46%)
Scale Score*** Overall Reliability: α = .821	2.03	2.78	2.36	1.90

Statistical significance levels for differences: †.05 < *p* < .10; **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to Agency 4. Scale scores were tested for overall mean differences across agencies (statistically significant at p<=.001). The sample size varies for each item and for each agency. The sample size range for Agency 1 is 267 to 268; Agency 2 is 136 to 152; Agency 3 is 54 to 56; and Agency 4 is 63 to 66.

Effectiveness in reducing crime and assisting citizens

As with our findings related to discretion and decision making, our findings on effectiveness also suggest that officers tend to view the effectiveness of technology through a more traditional policing lens. Across the agencies, 72% to 96% of officers agreed that IT made them more effective in locating persons of interest (see Figure 5-j). In contrast, the percentage agreeing that technology could help them "understand and respond effectively to crime problems" was lower for all agencies even though a majority agreed in each agency and 86% and 70% agreed in Agencies 2 and 3, respectively. Similarly, an additional item on crime prevention effectiveness that appears in Figure 5-l in the next subsection shows three quarters of officers in Agency 2 and about two thirds in Agency 3 agreed that IT increased their capacity to prevent crime when not answering calls. In Agencies 1 and 4, less than half (48% and 38%, respectively) agreed that this was the case.

Figure 5-j. Officer survey results for technology and police effectiveness

	AGENCY 1 Avg. (% agree)	AGENCY 2 Avg. (% agree)	AGENCY 3 Avg. (% agree)	AGENCY 4 Avg. (% agree)
Information technology makes me more effective in identifying and locating suspects, wanted persons, and other persons of interest.	2.84 (75%)	3.31 (96%)***	3.10 (84%)	2.78 (72%)
Information technologies and crime analysis help me understand and respond effectively to crime problems.	2.52 (56%)	3.07 (86%)***	2.81 (70%)	2.52 (57%)
Information technologies improve the way I interact and communicate with citizens.	2.13 (31%) †	2.64 (56%)***	2.40 (38%)*	2.08 (20%)
Information technology allows me to be more effective in helping victims.	2.25 (38%)	2.93 (79%)***	2.61 (54%)*	2.19 (31%)
It is important to citizens that I am knowledgeable about the latest information technologies.	2.45 (47%)	2.87 (71%)***	2.81 (69%)***	2.32 (37%)
Scale Score*** Overall Reliability: α = .850	2.43	2.95	2.75	2.39

Statistical significance levels for differences: †.05 < *p* < .10; **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to Agency 4. Scale scores were tested for overall mean differences across agencies (statistically significant at p<=.001). The sample size varies for each item and for each agency. The sample size range for Agency 1 is 266 to 268; Agency 2 is 142 to 150; Agency 3 is 49 to 54; and Agency 4 is 65 to 69.

Figure 5-j indicates that opinions were also variable as to whether IT helped officers in their efforts to interact with citizens and assist victims. Most officers in Agency 2 (56% and 79%, respectively) agreed that IT was helpful in these regards, and about half in Agency 3 agreed that IT helped them to assist victims. Yet most officers in Agencies 1 and 4 did not agree with these views. Similarly, while 71% of officers in Agency 2 and 69% in Agency 3 felt that it was important to citizens that they (the officers) be knowledgeable about IT, only 47% of officers believed this in Agency 1 and only 37% in Agency 4.

Job satisfaction

The job satisfaction items (see Figure 5-k) also revealed clear differences across the agencies. Officers in Agency 2 tended to report more positive effects (and fewer negative ones) from IT on their job satisfaction than did their counterparts in the other agencies. Officers from Agencies 1 and 4 reported the most negative findings. Working with IT created frustration for 67% to 83% of officers across Agencies 1, 3, and 4, and roughly half to 81% of these officers indicated that IT took time away from aspects of police work they enjoyed (note that both items were reverse-coded in Figure 5-k). On balance, IT enhanced job satisfaction for nearly three quarters of officers in Agency 2 and about half in Agency 3, but only about one third in Agencies 1 and 4. A related item in Figure 5-l, however, showed that nearly half of officers in Agency 4 and a majority of those in the other agencies believed that IT enhanced their safety.

Figure 5-k. Officer survey results for technology and job satisfaction

	AGENCY 1 Avg. (% agree)	AGENCY 2 Avg. (% agree)	AGENCY 3 Avg. (% agree)	AGENCY 4 Avg. (% agree)
Using information technologies makes my work interesting.	2.24 (42%)	2.95 (78%)***	2.77 (70%)*	2.43 (49%)
Working with information technologies in my agency frustrates me. [REVERSE CODED]	1.81 (20%)	2.63 (62%)***	2.06 (33%) †	1.70 (17%)
The demands of using information technologies take time away from aspects of police work that I enjoy. [REVERSE CODED]	1.79 (19%)	2.70 (67%)***	2.33 (51%)**	1.90 (24%)
Information systems enhance my job satisfaction.	2.13 (30%)	2.80 (71%)***	2.50 (52%)*	2.14 (32%)
Scale Score*** Overall Reliability: α = .830	2.08	2.77	2.40	2.06

Statistical significance levels for differences: †.05 < *p* < .10; **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to Agency 4. Scale scores were tested for overall mean differences across agencies (statistically significant at p<=.001). The sample size varies for each item and for each agency. The sample size range for Agency 1 is 267 to 268; Agency 2 is 133 to 153; Agency 3 is 53 to 56; and Agency 4 is 63 to 69.

Figure 5-l. Additional survey items on effectiveness and job satisfaction

	AGENCY 1 Avg. (% agree)	AGENCY 2 Avg. (% agree)	AGENCY 3 Avg. (% agree)	AGENCY 4 Avg. (% agree)
Information technology increases my capacity to prevent crime on patrol when not answering calls for service.	2.39 (48%)	2.82 (74%)***	2.72 (68%)**	2.14 (38%)
Information technology enhances my safety on the job.	2.48 (60%)*	2.97 (79%)***	2.94 (76%)***	2.34 (45%)

Statistical significance levels for differences: †.05 < *p* < .10; **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to Agency 4. The sample size varies for each item and for each agency. The sample size range for Agency 1 is 266 to 267; Agency 2 is 137 to 141; Agency 3 is 50 to 51; and Agency 4 is 62 to 63.

5.5 Summary

The results of the officer surveys illustrate some of the complexities and contradictions of technology's impacts in policing. Experiences with technology can vary considerably across ranks and assignments within agencies as well as across agency contexts. As shown by the preceding results, officers' views suggest that technology does not always produce strong improvements in communication, cooperation, productivity, job satisfaction, or officers' effectiveness in reducing crime and serving citizens. Technology does appear to generally increase perceptions of monitoring and accountability in police agencies, but it does not as consistently increase perceptions that the agency is better managed. And although officers find technology helpful for many tasks in the field, they often do not leverage technology for the types of strategic uses that can arguably most enhance their ability to reduce crime. All of this serves to underscore the argument that advances in technology do not always produce straightforward improvements in the efficiency or effectiveness of policing; much can depend on agency context (including technological capabilities, implementation experiences, management practices, and agency culture), as illustrated by the particularly positive results in Agency 2 and the more negative results of Agencies 1 and 4. In Sections 6 and 7, we draw further upon the survey results (using both within and cross-agency comparisons) to complement our qualitative fieldwork. Using both sources, we attempt to better understand the interactions of technology with various aspects of police organization, operation, and culture.

6. Agencies 1 and 2: Information Technologies, Crime Analysis and LPR[32]

6.1 History and Experience with Technology and Technological Innovations

Agency 1: Implementing a new records management system and expanding LPR capabilities

In Agency 1, we examined the impact of records management system (RMS) and related information technologies (including mobile computer units) as well as expanded license plate reader (LPR) capabilities. This agency had just implemented a new RMS in 2010 that for the first time gave officers the ability to electronically submit reports and to do so remotely using mobile computing units (MCU) from the field. Prior to the implementation of this system, Agency 1 relied on a paper-based incident reporting system in which officers would hand-write reports that were reviewed by supervisors. Once a report was written and approved, a separate records management unit in the agency would check the accuracy of the report and then enter it into an RMS. The new RMS, in addition to providing officers with wireless automated reporting capabilities from their MCU's, also gave officers access to a wider range of data in the field. For example, with the new system, officers can now search a name, license tag number, address, or phone number, and retrieve up-to-the-minute information on all incident reports and field contacts associated with that entry in the system.

The selection of Agency 1 for this study was purposeful. The change from a paper-based to a completely automated reporting system would be considered a dramatic technological shift for any agency, and one that many agencies have faced or will face in the future. While the implementation of such systems is often considered a technological advance in the law enforcement arena, such major shifts in technology can also cause problems that may offset, at least in the short run,

[32] Case studies of Agency 1 and 2 (as well as the field studies reported in Chapters 8 and 9) were conducted and written by the George Mason University research team (Koper, Lum, Willis, Hibdon). Case studies 3 and 4 were conducted and written by the PERF research team and are reported in Section 7.

some of the gains in efficiency and effectiveness that the system was meant to deliver. Further, as will be described later, the rapid adoption of a large number of LPR systems (from 3 to over 2 dozen) was another substantial technological shift for Agency 1. Both of these major changes in Agency 1—the RMS adoption and the LPR expansion—would provide an opportunity to study the impact of technology and technological change on law enforcement.

For the leadership of Agency 1, a primary motive for establishing the new RMS—in addition to greater efficiency in report writing—was to improve the accuracy and timeliness of the agency's crime statistics. One respondent told us that the chief had conveyed his vision of being able to call up current and reliable crime statistics on a computer in real-time from any patrol area. Before the RMS was established, the command staff could only review crime trends and agency performance using statistics from paper records that were entered by hand into the computer systems and were weeks or months old. Even those statistics were typically limited to a few key items that the crime analysis unit prioritized for data entry and analysis. Further, agency data systems were disjointed, with various units keeping their own databases for different purposes. The new RMS was meant to consolidate these systems (as one person put it, "to eliminate the stovepipes in the organization") and improve the accuracy of the agency's data, while also integrating incident records with the agency's computer-aided dispatch system. With the new system, the command staff could track crime trends, performance indicators, and individual cases in a much more timely and precise way (e.g., in Compstat meetings).

A related motivation was improving the agency's reporting of crime data to the state's UCR program. Agency 1 is located within a state that uses incident-based reporting (IBR) for the UCR. Prior to the RMS, however, officers did not fill out reports in IBR formats. Instead, the records management unit in Agency 1 converted officers' reports into the proper IBR classifications. Now officers must file their own reports in a manner consistent with IBR requirements.

Agency 1 planned its conversion to the new RMS over a four-year period. The lengthy process was necessary in part because the agency had to work with other county agencies (particularly the fire department and sheriff's office) in planning for the system's implementation. But Agency 1 also sought to plan and implement the process carefully so as to avoid previous missteps with information technology (IT); most notably, the agency had experienced a dramatic failure with a previous RMS that had to be discontinued after just a few months in operation (a process described by someone familiar with the process as a "traumatic experience"). As one key step in improving its IT capabilities and business practices, therefore, Agency 1 established an independent IT unit that is managed by a civilian with experience in business IT applications to ensure a smoother transition with the current RMS system.

More specifically, Agency 1 established a team of 10 sworn and civilian personnel from police, fire, and city management to determine what they wanted from a new RMS or computer aided dispatch system, and then to find a system that could fit those needs. This management team formed user groups throughout the agency to get feedback on desired capabilities, and they looked for a system that met as many of these requirements as feasible. Once a system was chosen, they also worked with various groups of end users throughout the process to test different components of the system. The agency established a 40-hour training module for line officers (shorter training modules were developed for higher ranking staff) and tried to market the new system through posters, electronic communications, and the development of a users' manual. After the system was implemented, the agency established a help desk and also formed a new user group that met regularly to address reported problems. Where possible, the user group would then recommend changes to the system to address these issues.

Despite these efforts, the implementation of the RMS has been turbulent. The most difficult part of the process was that the change to computer-based reporting and the RMS was implemented simultaneously with the new IBR crime reporting requirements. Thus, in addition to learning the mechanics of using an automated system for crime reporting, officers also had to learn an entirely new coding scheme—essentially, a new language—for preparing crime reports. While the RMS training tended to focus on the mechanics of the system, officers were less prepared for this change in reporting requirements. The IBR reports were viewed as complex and detailed, with unfamiliar definitions and coding rules. Indeed, for years officers had unknowingly coded many incidents inconsistently with IBR reporting requirements; previously, these errors were corrected by the UCR reporting unit.[33] This problem was exacerbated by certain system features such as nonintuitive system error codes that provide officers with little guidance on a problem when they enter something incorrectly.

[33] For example, officers had to learn that when reporting the brandishing of a firearm under the IBR rules, the victim should be coded as "society" rather than the person at whom the firearm was brandished.

Other features of the RMS and the agency's wireless transmission system have added to these implementation difficulties. According to many interviewees, the RMS entry fields, screens, and modules are lengthy, cumbersome, and repetitive. (Because IT changes so quickly, officers remarked that the new RMS was already somewhat antiquated by the time it was installed.) These problems apply not only to incident reports, but also to modules for entering other events like field interviews, traffic stops, summonses, and traffic accidents. There are also substantial connectivity problems with wireless transmissions, despite the efforts of planners to obtain the most reliable wireless system possible (note that this was a separate issue from the selection of the RMS). Officers sometimes have to wait several seconds for typed characters to appear onscreen, and in many places in the county officers lose their wireless connections entirely. One officer indicated that the problems had more to do with the connectivity issues than with the RMS itself; citing "major typing delays," the officer stated that the "system slows everything down so much that it makes report writing a real pain."

As a result of these problems, a familiar refrain we heard from Agency 1 personnel was that implementation of the new RMS has greatly increased the time required to do reports and thereby hindered officer productivity. This problem was especially severe in the early days of the system's implementation, but it continues to be an issue. At the time of our fieldwork (over the course of 2011 through 2013), some officers still had considerable dissatisfaction with the RMS. For example, one officer in a patrol officer focus group said:

> For drunk in public I had to write a primary report [before the new RMS]; now I have to do an arrest module. When it first came out, you had to do both and do a summons. It was basically entering the same information three times. Now they are coming out with a memo that if you write an arrest, you don't have to write an incident module.

In a different focus group, an officer expressed a similar frustration:

> Writing an accident report, including the drawing, it will take over an hour. Now you are pulling the lines over and the cars over and now you are opening all these modules. I have to open many different modules to get there. Why can't you just start with the end product and go from there?

In hindsight, interviewees also felt that the agency's training was inadequate. Because of the limited time available for training (40 hours), instructors had to focus primarily on the mechanics of using the system for entering reports.[34] Expanded training could have better prepared officers for the complexities of IBR reporting. Additionally, trainers were not able to share many of the more advanced capabilities of the system with officers; in particular, it seems that little emphasis was placed on potential strategic or proactive uses of the system for investigation and problem solving.[35] Middle- and higher level managers largely saw the RMS as a report writing system that had a more limited impact on their daily work. Their mandatory training was only eight hours. Consequently, managers were not all fully aware of how much the new RMS would change the agency's business practices, nor were they necessarily well versed at the outset in the possibilities of using the system as a strategic management tool.

In addition to examining the RMS and mobile computing information technologies in Agency 1, we also sought to understand the implementation and impacts of its expanded LPR capabilities. Agency 1 acquired its first three LPR devices in 2007. Through grant funding, the agency later acquired an additional 23 LPRs, which it deployed at the beginning of 2011. This brought the agency's total LPR deployment to 26 devices, although the agency had been experiencing technical and maintenance problems with some LPR devices at the time of our field work.

During the early stages of LPR adoption, LPRs were primarily used by a specialized auto theft unit in the agency. Also during this early stage, the agency experimented with guided deployment of LPRs in crime hot spots utilizing primarily uniformed officers in patrol. Although the agency did not continue that approach in a systematic way after the acquisition of the 23 additional devices, it did spread the devices equally among the agency's districts, where they were installed on cars working the day, evening, and night shifts. District commanders have wide latitude in deciding how their LPRs are used and who uses them. Agency policy only specifies that officers assigned to use an LPR receive a training session on using the devices.

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[34] One lieutenant who was heavily involved in the RMS implementation process noted that many in the agency would have benefited from remedial training on the basics of using computers.

[35] The complexities of searching the RMS have also perhaps tempered officers' use of the system for proactive work. Indeed, officers and detectives with access to the regional LInX system (Law Enforcement Information Exchange) were much more inclined to search this system for information about previous incidents, calls, and law enforcement activity—including data fed from Agency 1's RMS into LInX—in part because it was easier to pull Agency 1's own data from LInX than from its RMS (LInX also provides access to information from other police agencies in the region). (The LInX system was developed to facilitate regional information sharing across jurisdictions and was developed by the Naval Criminal Investigative Service, Department of the Navy. More information can be found at http://www.ncis.navy.mil/PI/LEIE/Pages/default.aspx.)

The primary data fed into the LPRs consist of state police information on stolen vehicles and license plates as reported in the state's criminal information system and the FBI's National Crime Information Center (NCIC) files. This information is updated daily at the state police level and downloaded daily by officers using vehicles with LPRs. Officers also have the ability to add other license plates into their LPR databases from the field (in response to alerts, for example). Data from LPR scans are uploaded into an agency server, where they can potentially be used for criminal investigations. Agency policy regulates who may access the data and under what circumstances. Further, the LPR data are maintained for no more than 365 days unless they are being used for an investigation.

As discussed below, officers using LPR devices find the technology useful, a "game changer" as one officer put it. Unlike the new RMS system, the LPR technology received a much more positive reception from officers, even though hits on stolen or wanted vehicles were rare. The same officers who spoke highly of LPR also spoke poorly of the RMS system, although the RMS seemed more central to their everyday work.

Agency 2: The impact of crime analytic and information technologies on law enforcement

Unlike Agency 1, Agency 2 had converted from a paper-based RMS to an automated report writing and management system in 1998. One high-level commander stated that he too had problems during this transition but "officers got over it." Further, Agency 2 had a well-developed crime analysis division that had transitioned in 2002 from a unit that focused on data entry and creating UCR statistics to a more analytic unit. Mobile computer units have also been used in Agency 2 for some time, which allow officers to write reports and quickly retrieve information from various databases. At the time of the research team's visits, Agency 2 was in transition to a new operating system for their MCUs that will improve the ability to enter data from the field.

The selection of Agency 2 provided the GMU researchers with a case study vastly different from that in Agency 1. In the case of Agency 2, crime analytic and advanced records management functions had been in place for almost 10 years, and the agency was known for its progressive leadership and advanced crime analysis products. The team hypothesized that the implementation and prioritization of analytic and information technologies may have long-term positive impacts, and that despite the innovativeness of these technologies, they would be generally well received in the agency.

The shift in information and analytic technologies that took place in Agency 2 in 2002 was primarily the result of the leadership prioritizing the crime analytic function in the agency and recruiting an experienced and highly skilled analyst who helped develop the sophistication of the unit. While the unit was within a particular bureau of the agency, the director of analysis always had a direct line of communication with the highest levels of command. The individual also consolidated analysts from different units, taught them specialized skills (especially geographic information system [GIS] analysis), and upgraded their software capabilities.

Currently the unit has 13 analysts, one person specifically dedicated to geographic information systems, and three supervisors. Additionally the unit is now comprises three squads—one for patrol and detention, one for investigations, and a third for special enforcement efforts. When the research team visited this unit, it was clear that they were highly skilled, competent, and well versed in advanced crime analysis. In particular, this agency has had highly skilled managers in crime analysis since 2002. The crime analysis unit has often developed its own systems to find, systematize, collate, manage, and analyze data. They have also developed some of their own solutions for records management problems, traditionally functions for which the information technology unit would be responsible. Commanders, lead analysts, and members of the informational technology/records management unit acknowledged that this had created some friction between the crime analysis unit and the records management/information technology unit, but that the units had learned to coexist in their respective roles.

As with other law enforcement agencies with crime analysis units, Agency 2's crime analysis unit plays an important role at the command level. The agency's leadership has made a strong commitment to crime analysis and data-driven policing, and this emphasis has been passed down through the ranks of managers and supervisors. As an illustration, the agency's lead analysts are incorporated into the agency's management meetings. In these meetings, the analysts contribute and speak, and provide commanders with information about crime patterns as well as information on specific criminal investigations, individuals, and cases. At the time of our fieldwork, Agency 2 was experimenting with a new management meeting format in which significant patterns, series, and trends identified by the crime analysis unit constituted the central focus of the meeting (as opposed to a recitation of the latest crime statistics).

The crime analysis unit is also highly integrated into the agency's problem-solving capabilities. These efforts have been facilitated by the unit's success in integrating a wide variety of different types of internal and external data. These include police data (e.g., incident reports, arrests, warrants, field interviews, and tickets), other law enforcement data (e.g., jail and prison releases and phone calls), other government data (e.g., driver's licenses, registered vehicles, and property owners), business data (e.g., employment data, electricity accounts, and other information on businesses and apartments), and various forms of geographic data (e.g. locations of bars, gas stations, bus stops, and hotels). The unit's success in leveraging these resources, as well as the analytic expertise of its staff, to facilitate effective problem solving was demonstrated in a special project that teamed analysts and officers to tackle problems at crime hot spots. The project, which was evaluated favorably by outside researchers, became the foundation for the development of a special unit that now continues this work around the city in conjunction with the crime analysis unit.

The crime analysis manager noted that hot spots policing and mapping are the "foundations of crime analysis" and that their analysis often starts from a place-based perspective rather than an offender-based perspective. However, as we discuss elsewhere in this section, the crime analysis unit is also highly connected to specific investigative and specialized units that find their services and skills invaluable. Indeed, the greatest advocates of crime analytic technology outside of the crime analysis unit and high-level commanders were major crimes detectives as well as a specialized unit focused on problem solving. Analysts receive requests from detectives to search for vehicles, names, criminal histories, witnesses, arrest information, or partial descriptors (scars, nicknames, tattoos, and family connections) to help solve cases. The crime analysis unit had the greatest interaction with these groups and also had trained detectives as well as higher ranking supervisors.

The crime analysis unit is less connected with street-level officers and patrol units themselves, although officers do have the ability to access crime analysis maps and alerts. Patrol officers generally were well aware of the crime analysis unit's website and some used the site to examine maps and alerts and do other queries. In our interviews and focus groups, there was a clear sense from officers that crime analysis was used to deploy patrol to specific areas for visible saturation. Officers are primarily impacted by crime analysis through directives from their commanders that result from crime analysis presented at managerial meetings. Commanders make demands on officers who then might ask the crime analysis unit for assistance. While the unit receives patrol requests often, such requests tend to be from the same officers, sergeants and lieutenants, and to focus on information about specific addresses (though crime analysts feels that these requests are driven by individual complaints rather than by a drive to do proactive, prevention work). At the time of the GMU team's visits, the crime analysis unit was moving towards giving officers the capability to carry out interactive mapping in the field and to provide information and feedback on crime analysis material (see Section 9 regarding a field test of the latter).

More generally, the agency had high levels of experience with different data systems intended to provide officers with more access to data in the field. The information technology unit discussed a warehouse of data in which multiple data sources (incidents, calls for service, court data, field interviews, etc.) could be combined for easier searches. A "master names" database had also been developed to help link databases by individuals' names, which facilitated searching for individuals (victims, witnesses and suspects) for purposes of solving cases faster, arresting wanted individuals, or checking the identity of suspicious persons.

As alluded to above, both the crime analysis and the information technology units are housed under the same command, but have had a history of friction. Part of this appears to be due to overlapping functions related to both units' interest in the collection and retrieval of automated information. However, it also seems that because of crime analysis needs, the crime analysis unit developed more advanced data collection, retrieval, analytic, and management systems that have in some cases allowed them to sidestep the use of the information technology/records management unit. While both units are under the same command, it appears the crime analysis unit has a much more direct and institutionalized strategic line of communication with key commanders in the agency, whereas the information technology unit personnel felt they needed, but did not have, a civilian director to oversee their function.

6.2 Impact of Technology on Police Culture

A core feature of this project was to learn about technology's relationship to culture, or the attitudes, norms, and values that give meaning and guidance to the outlooks and actions of both sworn officers and civilians who work in police agencies (Mastrofski and Willis, 2010: 96). Because police culture is often characterized as an impediment to change (Chan 1996), we were particularly interested in gauging each agency's overall receptiveness to particular technologies and to technological change in general: To what degree were particular technologies rejected or embraced in Agency 1 and Agency 2, and was technology viewed as a positive force for change?

Our second and related concern was to learn about how these agencies had attempted to facilitate the acceptance of new technologies among their personnel: What had each agency done in order to institutionalize the new technologies they had tried to implement? In this section, we explore these issues in Agency 1 and Agency 2 in relation to information/mobile computer technology, LPRs, and crime analysis. Based on our interviews and focus groups with civilians and officers at all ranks, including top leadership, we identified four major themes related to the acceptance and use of technology.

Receptivity to technology was shaped by existing belief systems about the agency's past experiences with technology.

The general view in Agency 1 was that the organization was slow to embrace new technologies. Some even commented that despite the addition of a brand new integrated records management and computer-aided dispatch system, it was already outdated in terms of some of its key features. Part of this could be attributed to how long the system took to plan and roll out given the sheer magnitude of the change (about six to seven years), which meant that new technological developments that had emerged in the interim were unable to be incorporated. This lag was recognized by both command staff and patrol officers. For example, one member of the command staff noted that the system was already "beginning to show its age" and several patrol officers made unfavorable comparisons to other police agencies in terms of Agency 1's inability to provide electronic traffic citations (E-Tickets) and the absence of sophisticated software for mapping traffic accidents. Another patrol officer was envious that an officer in a sister department could easily take a photograph with his cell phone and send it electronically department-wide. He said he could send an "I-M [instant messaging] blast" to patrol, but not with a picture attached, before remarking that his agency's new computer-aided dispatch system was "still way behind other jurisdictions in terms of its capabilities."

The general acknowledgement that Agency 1 was only just moving from an old fashioned "archaic" paper reporting system (as one patrol officer described it) to electronic reporting (when other police departments had made this change several years ago) also helped reinforce existing views that this agency was slow to adopt new technologies. According to one respondent familiar with the history of IT in Agency 1, while it might have had a reputation for being "highly professional" among outsiders, this impression was mismatched with its IT capabilities, which he described as "antiquated."

In contrast, members of Agency 2 perceived their department as being ahead of the technological curve, characterizing it as a "go-getter" or proactive department in this regard.[36] For example, in describing the history of the crime analysis unit, one interviewee described how in 2002 the chief, impressed by a particular crime analyst at a conference, approached him and then recruited him. At the time of our visit, about 10 years later, due to the efforts of top leadership, the CAU (crime analysis unit) had grown considerably, with over 10 analysts and several supervisors assigned to the unit. Furthermore, unlike Agency 1, where old-fashioned paper reports were a fresh memory, the move toward an electronic RMS in Agency 2 had taken place over a decade earlier (in 1998) and was well established. Unlike Agency 1, it is likely that memories of any resistance to this change or the obstacles it presented had faded with time, probably contributing to the more favorable impressions of Agency 2's general receptivity toward technology. For example, compared to Agency 1, patrol officers in Agency 2 were more likely to express less ambivalent views about technology. In one of our focus groups, patrol officers praised technology and its benefits, telling us they wanted to "work smarter," that "technology is part of the hunt" and it "makes the job easier." Some in the department attributed this receptivity to the large number of recent recruits, who were likely already familiar and comfortable with technology. One high-ranking official observed that there was a general understanding that they were "faster and better" with technology;

[36] These differences between Agency 1 and 2 in how employees generally perceived their department's overall receptivity to technology were also revealed in our survey. So, for example, across all assignments and ranks, respondents in Agency 2 expressed much higher levels of agreement with the statement, "My agency is open to implementing the newest technologies" than those in Agency 1. In Agency 1, about half of respondents agreed or strongly agreed with this statement compared to over 80% in Agency 2.

alluding to the youth of the department, he said that they had hired 700 new officers in the past few years. The suggestion here is that newer officers have been socialized differently to technology than older officers and are thus more likely to embrace it than their predecessors.

Our fieldwork suggested that technological change is not always going to be received positively, as employees' perceptions of their agency's history with technology can reduce receptivity and undermine an agency's attempt to use technology to produce desired results.

In addition to prior experiences, receptivity to technology also seemed to be shaped by the degree to which the nature and design of the specific technology challenged existing organizational routines, practices, and outlooks.

Receptivity to technology was not only shaped by general impressions of past experiences, but was also shaped by the degree to which the nature and design of a current technology challenged established organizational routines, practices, and outlooks. We have already noted that the implementation of the new RMS in Agency 1 was a major undertaking—in the chief's mind, "the biggest change culturally and business-wise" the department had ever undergone. Moreover, it is important to bear in mind that this upheaval coincided with another major change—Agency 1's move to become fully integrated with the state's IBR reporting system (see section 6.1 of this report).

With the introduction of the new RMS, officers were now required to fill out reports with the proper incident-based reporting classifications consistent with the National Incident-Based Reporting System (NIBRS). Thus, this technology had major implications for the way patrol officers performed and viewed their daily work, as it now required them to adjust to a significantly altered approach to report writing that was seen by many as burdensome and time consuming. Since a core technology of policing is the "production and processing of information" (Reiss, 1992: 82, referencing Manning, 1992b), we would expect that any changes in this role of the patrol officer as an information broker would provoke a powerful response (Ericson and Haggerty, 1997). In fact, even though the new RMS had the potential to broaden the scope of an officer's proactive law enforcement activities (such as running license checks), some saw it as detracting from what they saw as their crime fighting role. One patrol officer told us that he felt more like a "data entry clerk than a patrol officer," and when asked how to estimate how much of his time he spent on using the RMS for investigative (crime-related) purposes, he responded "1% percent versus 99% percent for data entry." In his mind, officers were the "data-entry point" and that is how they mainly used the records management system. This is a good example of how technology can reinforce a negative climate by detracting from aspects of the jobs that individuals like (in this case crime fighting or law enforcement). Moreover, since top leadership, command staff, and detectives were much less likely to experience daily struggles with the RMS's various technical frustrations (such as wireless connection speed when out in the field) and its considerable reporting requirements, they were generally more positive about its implementation.[37]

In contrast to the nature and design of the RMS, LPRs were user friendly, required very little change to the daily work of patrol officers, and were easily reconciled with the role of the police officer valorized by the police culture, namely, the role of crime fighter or law enforcer. As a result, officers in Agency 1 felt much more positively about this particular technology. As the chief noted, "harder" technologies "aren't as fun or well received," but "if it is sexy, they embrace it." When asked to compare the department's RMS and LPR, an officer responded that he was in "awe" of the LPR's sophisticated technology and rated its ease of use as a "50" on a 10-point scale compared to "4-5" for the RMS. Many of the officers we spoke with who used LPR technology lauded the simplicity of its use, how easily it adapted to daily patrol work, and how it could deliver immediate rewards in the form of stolen vehicle hits.

We observed similar patterns in receptivity to technology when we visited Agency 2. The easier a technology was to use and the less it disrupted daily routines and practices, the more positively it was generally received. Take the RMS, for example. Agency 2 had implemented its RMS in 1998, so by the time of our visit in 2011, it was familiar to most officers and fully integrated into existing routines and practices. It had also benefitted from modifications over the years in response to patrol officer feedback and was regarded as user friendly. We heard very few complaints about it, although the department was planning on adding a new reporting system designed to capture more information on use of force incidents. In contrast to remarks about the current RMS, the few comments we heard from

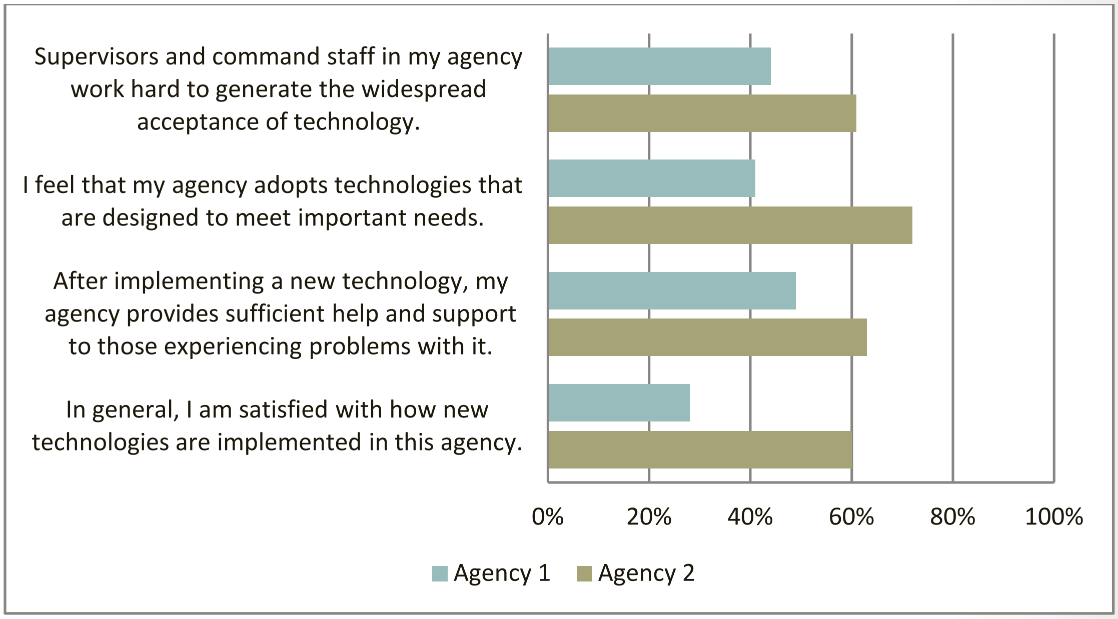
[37] According to our survey, in general there was not very a high level of satisfaction with how new technologies were implemented in Agency, 1 but detectives and higher ranking officers were more likely to be positive (based on a four-point scale, with 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree). In response to the statement, "In general I am satisfied with how new technologies are implemented in this agency," the average level of agreement for patrol was 1.93 and for detectives was 2.01. When we take rank into account, it was 1.96 for patrol officers, slightly lower for first-line supervisors (1.87), and highest for those at the second line and above.

patrol about the use-of-force changes were largely negative. The new system was portrayed as cumbersome, difficult to use, time consuming, and associated with identifying something they might have done wrong.

Crime analysis was more disruptive to established routines and practices in Agency 2—at least to middle managers. They were the key users of crime analysis technology, and they had to adapt how they worked to the maps and crime trends produced by the crime analysis unit. Although this technology was not technically difficult or cumbersome (data were presented in accessible formats such as tables or graphs), receptivity toward crime analysis was tempered among this group because of its close association with Compstat. Crime analysis was used to hold district commanders and their lieutenants personally accountable for crime in their districts during weekly Compstat meetings, and it placed a significant demand on their daily decision making. We explore this theme in more detail in the accountability section (section 6.4), but we note here that an important feature of crime analysis in Agency 2 was that it was fused with an accountability system, which reduced feelings of job autonomy and increased stress. Because patrol officers were not held similarly accountable, crime analysis did little to disrupt their established routines of answering calls for service. Although they might be directed to do additional directed patrol or field contacts, it was understood by their supervisors that they could only do this when they were freed from answering calls for service (their primary responsibility). For the most part, then, analysis did not intrude upon their traditional patrol function and their feet were not held to the fire of accountability.

Responses to several survey items (Figure 6-a) help corroborate our fieldwork findings on the factors influencing receptivity to technology. Given how disruptive the RMS was to established routines in Agency 1 and how it was linked more strongly among officers to information gathering and reporting than crime fighting, it generated significant dissatisfaction about technology more generally. This was even the case despite Agency 1’s efforts to improve the implementation process with training conducted by well-respected officers and the allocation of additional resources to tech support services. In Agency 1, patrol officers were less satisfied with their agency’s technologies and they gave their agency much lower marks for implementation (though even in Agency 2 over 40% were not entirely satisfied).

Figure 6-a. Percentage of patrol officers who agreed or strongly agreed with survey items gauging receptivity, acceptance, and satisfaction with technology



In sum, it is difficult to generalize about an agency's receptiveness to technology as the degree to which technology is embraced or rejected in an agency seems to depend on a number of factors. These include an agency's history of technological innovation, the nature and design of the technology, and its effects on established routines. Since different technologies interact with these belief systems and practices in different ways, we would expect variation in the extent to which they are embraced or rejected between different groups within a police department (leadership, command staff, patrol officers, crime analysts, etc.).

Leadership, planning, and technical support are important factors for helping institutionalize technological change, but how technology interacts with other existing and deeply held perceptions of how the organization is structured and operates can cause or reinforce negative perceptions in the agency.

As we described briefly earlier, the implementation of the new RMS in Agency 1 was accompanied by a clear plan to help ensure that its use would become institutionalized throughout the agency. One key aspect of this plan was to communicate clearly about the proposed change: why it was necessary and how it was to be accomplished. Top leadership played an important part in this process by articulating that a major purpose of the RMS was to improve organizational performance by providing real-time and accurate crime information. This message was reinforced through bulletins and web updates, which also provided a venue for updating officers on the progress of the implementation process. When we asked different ranks why they felt the new RMS had been implemented, their responses mirrored top leadership's goals.

In addition to a clear message, Agency 1 also tried to manage the expectations of patrol officers and other users, making it clear that the system was an off-the-shelf product and was not going to be able to do everything that officers would likely want, or as one command staff member said, it was "not going to butter your bread in the morning." In other words, the department tried to make it clear that learning and using the new RMS would take considerable time and effort and that the system could not possibly fulfill the very many specific requirements (in the thousands, we were told) recommended by members throughout the entire department during the planning phase.

To this end, the department provided a host of additional resources and support mechanisms. According to those responsible for the RMS implementation, ideally there would have been 50 trainers and patrol officers would have received 80 hours of training, but budget constraints limited these to 26 trainers and 40 hours. While less than desired, this was still a significant commitment of organizational resources. In addition, to mitigate rank-and-file resistance to training, the department made sure that it was led by its own patrol officers and was useful or "hands-on." Training officers were selected using criteria that were likely to improve the overall quality of the training and the receptivity of their peers, and so they were selected based on their technological ability, their proven capacity to teach (some were field training officers), and/or their reputations as informal leaders in patrol.

In addition to training, the department revised the agency's training manual to include information on the RMS (to act as an "immediate life-saver" for patrol officers) and created a help desk whose purpose was to provide quick and useful feedback to those with questions or experiencing problems. These efforts likely increased the degree to which the RMS became institutionalized throughout the agency, but officers still expressed a fairly high level of dissatisfaction with the new system. Some of this can be attributed to the technology's requirements and the challenges it presented, but some can also be attributed to how officers viewed the RMS as reinforcing their existing impressions about how the organization was structured and implemented.

Some we spoke to viewed the implementation process as typical of the department's command-and-control hierarchy, where changes were imposed from the “higher up” with insufficient attention to patrol officers’ needs and concerns. One officer in a focus group said:

> The problem is, you have higher ups—they don’t get our input. Patrol is the first line but we are the bastard children. If you go to anyone at a commander level, they don’t know anything about it.

It may be that this feeling of being excluded from the implementation process (even though patrol officers were included throughout) was exacerbated when officers learned that that there was little opportunity for changing the system based on their feedback once it was finally implemented. There was a testing period among a small group of officers for this purpose, but once this period was over and the RMS had gone “live” department-wide, the potential for making meaningful changes all but disappeared.

In addition, despite top leadership’s message of the importance of the new system to controlling crime, the RMS reporting requirements reinforced existing views about the department’s traditional focus on bureaucratic record keeping. Thus, officers seemed to struggle with making a clear and persuasive connection between changes in the reporting requirements and improvements in their crime fighting capability. In fact, this new technology seemed to reinforce negative perceptions of the agency by detracting from this aspect of the job that patrol officers enjoyed. Officers in a focus group said that the new reporting system was so time consuming that it was preventing them (patrol officers) from doing what they wanted to be doing—“going out and being cops.” In a separate interview, an officer told us that the RMS had done little to change her department’s focus on record keeping since “everything” they did on patrol “was written up as an incident” no matter how trivial (a characteristic of her department, she added, about which an officer in another department reacted incredulously).

Agency 2 was not undergoing a similar upheaval, so we did not have the opportunity to view change in action. However, we did observe some of the same patterns identified above, including leadership as an important factor in building support for new technologies. One respondent, speaking about crime analysis, observed that it was important to have leaders as champions of technology in order to “push” a culture receptive to analysis and change, and important to have others with similar views replace them when they left in order to keep this momentum. Several high-ranking officers also spoke enthusiastically about the importance of crime analysis, with one referring to it as the agency’s “lifeblood.”

We would also note that the role that crime analysis played at Compstat at the time we visited tended to reinforce the traditional rank hierarchy of police organizations, with middle managers harnessing their crime control efforts to the objectives and expectations of top leadership. In this way, a relatively new technology (crime analysis) was being institutionalized in ways that were consistent with established beliefs about the hierarchical and essentially punitive nature of police organizations. However, we should also note that following the completion of our visit, the department sought to change this feature of Compstat by making the meetings more collaborative and discussion-oriented.

In summary, views on technological change are not limited to the physical or technical aspects of a specific technology, but also include its interplay with the broader organizational context in which it operates. Existing beliefs about an organization appear to strongly shape understandings about how a technology is implemented, what it is capable of accomplishing, and how it is to be used. This finding presents a challenge to police agencies that rely, at least in part, on technological innovations to try and transform, rather than reinforce, traditional features of the military model of police organization, as officers will likely ascribe their existing assumptions and beliefs to the new technologies.

The degree to which technology is embraced is often ascribed to the attitudes and capabilities of individuals rather than to the nature of the specific technology or to broader organizational features.

A final theme to emerge in our research on how technology was understood within each agency was the common belief that the degree to which a technology is ultimately accepted or rejected depends upon an individual's attitude toward technology in general. This was a perspective that we heard frequently in both agencies and it was voiced by civilians and sworn officers at the top and bottom of the police organization. The biggest influence on whether an individual embraced or rejected a given technology had less to do with the organization, its implementation efforts, and the technical complexity of the innovation. Rather, and only with a few exceptions, it had mostly to do with a generational gap between younger officers, who were regarded as being willing to adopt and use new technologies, while older officers were viewed as more resistant. This view was also strongly supported by our survey in both Agency 1 and 2, where over approximately 80% of all respondents agreed or strongly agreed with the statement, "In general, younger officers/detectives are more receptive to using technology than older officers/detectives."

For example, while talking about the RMS, a command staff member in Agency 1 said that you have different types of officers in an agency, and some of these are officers “who hate technology and don’t want to use it.” The cause of this antipathy was generational, since for officers who have been around 15 or 20 years, this represented a big change. He added, “Guys who use it the least, struggle the most.” Crime analysts in Agency 1 also suggested that how technology was viewed and used was generational, as did patrol officers. In a focus group we heard, “A lot of senior guys and gals don’t like technology. They like the old style of policing. There is a generation gap in my opinion.” We heard similar comments in Agency 2, where commanders stated that new officers were more “tech savvy” compared to older officers, and a sergeant in a focus group said, “The other generational issue is some of the older guys don’t like computers. They never wanted computers in the car. But now they have learned they cannot work without computers.” However, this obstacle was not viewed by everyone as insurmountable. A top manager in Agency 2 offered the observation that older officers could not just be forced to use technology, but that two factors would win people over: good examples of successful usage and increased interaction with actual technology.

Summary

In this section we examined technology’s relationship to culture, and our findings are consistent with other scholars who have stressed “the active role of organizational members and the importance of social context and processes that produce the meanings of technology” (Chan, 2003: 669). The complex interplay between the technical aspects of a specific technology, general attitudes about the organization in which it is implemented, and the degree to which it impacts the work routines and practices of different groups means it is hazardous to make simplistic generalizations about organizational receptivity to technological change. At the risk of doing so, we will conclude with three observations: (1) the more intrusive and burdensome a technology, the more resistance it is likely to generate; (2) how technological change is understood is determined by a technology’s technical aspects and by its relationship to broader cultural assumptions about the police organization; (3) and attributing the acceptance or rejection of technology to differences between generations can deflect sustained attention from determining how existing beliefs can be shaped to improve the overall prospects of its implementation.

6.3 Impact of Technology on Organizational Units, Hierarchy, and Structure

The implementation of new technologies also has the potential to disrupt an agency's organizational structure, people's roles, and/or the relationships between employees. For example, alterations to how data is collected, managed, and analyzed might lead to specific units or positions being removed, created, or merged. This, in turn, can result in new alliances or divisions, as people have to adjust to their new role within the organization and to changes in how resources are allocated.

In the course of our fieldwork, we asked police officers and civilians how information and analytic technologies, and LPRs, had affected the organization's "layout" and employee relations. Based on their responses and our own observations, we concluded that technology's impact on organizational structures and relationships varied and was contingent upon the type of technology and the nature of the police organization. The major themes to emerge were that technology had the capacity to change or reinforce existing organizational structures and to facilitate teamwork or create conflict in workplace relations. Put simply, technology seemed to have the capacity to both enhance and detract from existing relationships. These findings are explored in more detail below.

Technology has the capacity to reshape existing organizational structures.

Formal organizational structures (hierarchy, rules, etc.) are designed to help an agency accomplish its goals by coordinating and controlling the activities of its members (Mastrofski, 2004: 103). We would expect, therefore, that the introduction of technologies that attempt to shape how police agencies' accomplish their work would also have broader impacts on formal organizational structures.

In Agency 1, the implementation of the new RMS was accompanied with the creation of a new unit. Based on challenges the agency had experienced in the past with updating its old RMS and those anticipated to accompany the implementation of its new system, Agency 1 split its existing Research and Information Bureau. In doing so, it created an Information Technology Bureau headed by a civilian specifically hired for his expertise in information technology. This bureau was assigned responsibility for identifying and addressing any concerns about information technology within the entire department. This decision by the Chief underscored the importance he was now assigning to the role of information technology within the department. At the same time, Agency 1 also created an Office of Research and Support that fell directly under his command and focused on strategic planning or "business intelligence."

In addition a new unit to help handle the collection, storage, and management of large amounts of data (servers, networks, security, etc.), the new technology also created a the need for more support services. A lesson here is that as agencies upgrade their technology, more staff and resources will likely need to be assigned to technology support. At both sites we heard of a coterie of positions for providing help to users struggling with technical issues. These took the form of help desks or "Technical Advisory Groups" charged with soliciting feedback and trouble-shooting individual problems. At Agency 2, we also heard about the ad hoc formation of "Technical Advisory Committees" whenever police leadership or management wished to focus on a larger technological need confronting the agency (such as whether to purchase a new database). The effective use of license place recognition readers in Agency 1 also required a fairly sophisticated infrastructure for managing data as well as personnel who were trained in trouble-shooting. However, because LPR use was limited to a small number of officers within patrol, their impact on existing organizational structures and work relationships was far less pronounced than that of the new RMS.

Along with the creation of new units and support structures, the implementation of the RMS also resulted in some significant changes to existing units. With patrol officers now responsible for much of Agency 1's data entry through the new RMS, the number of civilians working in the records room was reduced in size. Moreover, those record clerks who remained saw their tasks change, as they were no longer primarily responsible for changing officer's report codes. They were still expected to check these codes, but ultimately it was the patrol officer with the guidance of his or her sergeant who was held accountable for correcting any errors. While discussing these and other organizational changes, the Chief talked about the significant "adjustment" period that accompanied the implementation of the new RMS within Agency 1. With the prospect of information collection and management becoming increasingly automated (and several respondents mentioned the virtues of automation during our interviews at Agency 2), we would anticipate that technology will continue to shape important aspects of how police agencies are structured and operate.

Technology has the capacity to reshape existing workplace relations.

Changes to the organization of the workplace can have important consequences for employees' roles, relationships, work routines, and communication patterns. In both Agency 1 and Agency 2, advances in technology and top leadership's emphasis on crime analysis had increased the stature of crime analysts within each department. This is not to say that the traditional distinction in the police subculture between sworn and civilian personnel had been effaced, but that it may have shifted slightly as crime analysts had become more visible and consequential. For example, the fact that the new RMS allowed crime analysts in Agency 1 to focus much more of their time on timely crime analysis and not simply on data entry had "glorified the analyst," according to one with whom we spoke. Under the old system, an analyst told us, there was a constant backlog of reports—"never less than a week"—that needed to be entered into the system. This was the trend for both the Records Bureau and for the analysts, as two separate systems housed incident reports. Before the introduction of the new system, the analyst said she would spend the first half of her work day on data entry. Now real-time data is available and "everything is in one location, speaking the same language" so she can focus on analysis. This analyst said patrol officers familiar with the crime analysis unit's new capabilities were now more likely to approach members of the unit and request crime information than they were before the new RMS. In other words, officers' expectations in Agency 1 for "details and the latest information to help them when they are working an area" had increased, as one analyst noted. The growing influence of the crime analysis unit was even more pronounced in Agency 2, where, as we have already noted, top leadership had made a concerted attempt to make it central to the department's daily operations. One of the analysts we interviewed noted how crime analysts had become key players within Agency 2 (using Compstat, as one example), not only because of the support they had received from the department hierarchy but also because of their special analytic skills. As a way of illustrating this new power, he mentioned that now when there was a command incident, the crime analysis unit was automatically notified. We also note that as the capabilities of the crime analysis unit in Agency 2 developed, so too did its relationship with specific units that stood to benefit most directly from the analysis and intelligence it produced. Thus the CAU enjoyed close working relationships with detectives and with a special problem-solving unit within the agency, which was charged with using crime analysis when determining how to implement effective crime prevention strategies.

At the same time, it did not seem that many officers or detectives considered decision making based on crime analysis as superior to that based on craft or experience. Although crime analysis was seen as important to success, sworn personnel in Agencies 1 and 2 also seemed to believe that good police work consisted of a combination of traditional police skills (such as verbal facility and being observant) and using timely crime information. In short, due to the unique nature of police work in which a great deal of street-level decision making is strongly influenced by the specific situational context in which it takes place (Manning 2013), electronic technologies were seen as informing or helping "augment" skilled police work, but not determining it (Flanagin, 2002: 95).

At the rank-and-file level we also heard about how technology was influencing workplace relations. During one of our focus groups with patrol officers at Agency 1, we were told that the RMS had contributed to the administrative burden on first-line supervisors. E-mail already consumed a lot of this rank's time as did meetings, and now the RMS's new reporting requirements presented an additional set of time-consuming tasks, which meant that sergeants were not "out there" as much on the street working with their officers. We heard a similar complaint from sergeants in Agency 2, who said that due to the speed and amount of information available, "your time is more limited. You have less time to build relationships with officers." On this point, a sergeant mentioned that time was also consumed by sitting at a computer and having to study maps. Another sergeant said:

> I feel like my role has changed from leader to manager. Where I used to go out and work with my guys, or indeed, more hands on, and show up on calls, and be there with them and talk to them and interact with them as someone else has said. I don't have time for that any more. I am just like, I have a crime problem over in [Area X], pssshutt [sound of e-mail being sent] … send them an e-mail: "Hey can you handle a complaint with a lady who says someone broke into her neighbor's home. Phsshuttt…."

This impression was reinforced by some of the command staff, who were concerned about the limited number of face-to-face interactions between sergeants and their officers. In fact, top leadership was requiring that supervisors meet with their officers every day. In Agency 2, we also heard that the absence of paper reports further undermined the kinds of face-to-face interactions important for building relationships between supervisors and their officers. Electronic reporting, a sergeant told us bluntly, reduces "face time."

Power obviously exists in relationships *between* people and so shifts in power have the potential to affect how different individuals or groups relate to one another. In Agency 2, the status of those working in information technology had not increased to the same extent as that of crime analysts. While we were told that the relationship between the two groups was generally positive, we also heard that the IT unit did not experience the same level of institutional support as the CAU. IT managed the collection and storage of information, but the agency's focus was primarily on the outputs or analysis components of this process, thus elevating the status of the end user. As one analyst put it, CAU was the consumer and analysis drove the agency's IT requirements: IT was the "keeper of the data" but CAU held them to task. Moreover, at the time we visited, members of the IT unit noted that Agency 2 seemed to lack an overall strategic plan for the goals and development of information technology within the department. Indeed, because technologies were implemented on an ad hoc basis according to "personalities and the power structure" within the department (rather than according to specific technological needs), some felt that the agency was not well prepared "to manage technological change." This lack of consultation over the role of IT now and in the future led to some sense of it being somewhat marginalized within Agency 2.

What we see here is that technology's influence goes well beyond its material or purely technical aspects to include complex social relationships. In Agency 1, for instance, we heard the concern that because some top and middle managers were less familiar with how the new RMS worked than patrol officers, they might lose some respect from their subordinates. As one middle manager said rhetorically: "What you have to realize is that I'm going to be a commander, and I'm going to judge the officer on what they are doing. How would you feel if you are the officer and the officer knows you can't even put a parking or warning ticket into [the RMS?]" In this particular instance, the respondent was identifying how technology had the potential to reshape existing expectations between supervisors and subordinates within the organization's traditional command hierarchy.

Technology has the capacity to reshape existing patterns of communication.

Within the traditional command hierarchy, decision making flows from the top down and information has been characterized as being guarded jealously by those who consider it their property (Manning, 1992b). Given the development of new information technologies, the question naturally arises as to whether these features of police operations had changed to any degree at the sites we visited.

In both Agency 1 and 2 and consistent with some prior research (Chan, 2001: 59-60), many of those we spoke to seemed to feel that information sharing within the organization had improved as a result of technology's capacity to enhance communication. In Agency 1, for example, we heard about officers posting information on a "pass-along board" in order that one shift could learn what another shift had been doing (the challenge of communicating and sharing information across shifts was also noted by some respondents in Agency 2). For some, technology's capacity to enhance information sharing had also contributed to greater teamwork within the agency. A patrol lieutenant in Agency 2 said:

> I'll tell you one thing that just stuck out in my mind as we were talking…. The style is the information sharing between officers and between patrol and detective division is *much* better because it's supposed to be. And now … everyone just wants that dot [referring to a crime incident on a crime map] to go away, and we don't care who makes it go away. Back in the old days, man, it was like this … "This is your case, this is *my* case" and I wanted to make the arrest. And that is the way it was in lot of the detective division in burglary, auto theft, they didn't want some patrol officer arresting their criminal, they wanted to arrest their criminal. You know, there was a lot of that going on. And this changed it all. Now *everybody* knows what is going on and because everyone knows what is going on, there is more, uh, accountability for what is going on. And everybody is asking questions about it. And now everybody just wants the dot to go away … it is a big difference to me; just the teamwork that is involved. [italics are officer's emphasis]

On a few occasions we did hear that not everyone was willing to share information, but this was the exception rather than the norm.

While information sharing seemed to have improved due to technology, this did not seem to have made decision making more democratic (that is, inclusive or participatory) at the sites we visited. Both in terms of technology implementation and in terms of deciding where and how to mobilize patrol officers, key decisions flowed from the top of the organization down the command hierarchy to those at the bottom. This contrasts with many current reform efforts, such as community and problem-oriented policing, which try to flatten the traditional command hierarchy by assigning greater decision-making autonomy to the rank and file, particularly when it comes to surfacing innovative problem-solving ideas or responses. Patrol officers in Agency 2 talked about crime analysis being "pushed down" to them from their superiors, an approach that was criticized by a lieutenant during a focus group:

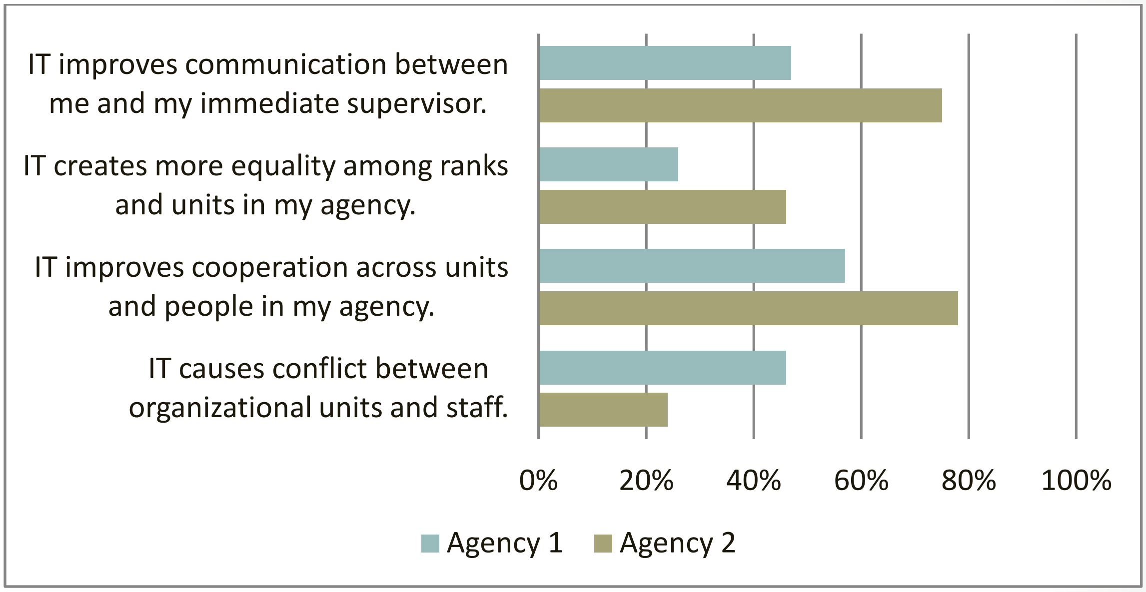
> A better way to do it [than top down] would be information needs to start somewhere and then let me do the research, bring it down to me I'll look at it and say, "Sergeant, I have a burglary problem in Riverside … go deal with it." That's what I am saying. I am not going to tell him to go write FIRs [field investigation reports] or do stakeouts. That's his job; he knows how to do it.

In a focus group of patrol officers in Agency 1, while discussing the implementation of the new RMS we were told about decisions being made "at higher levels that suit them."

Summary

For the most part, these fieldwork findings were supported by our survey (see Figure 6-b). Patrol officers, for example, viewed technology as both contributing to and detracting from workplace relations. Perhaps most notably, IT did not do a great deal to create a more equal workplace. This was particularly true in Agency 1, where it was also regarded as more likely to cause conflict than in Agency 2.

Figure 6-b. Percentage of patrol officers who agreed or strongly agreed regarding items in the survey gauging technology's impact on workplace relations



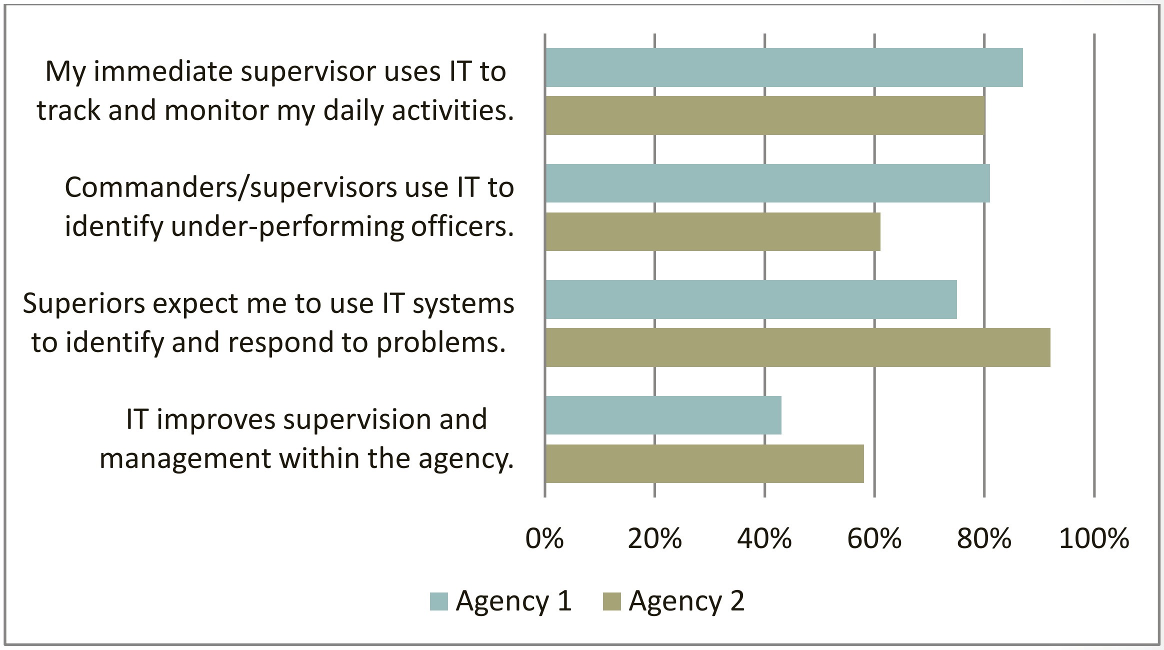
In sum, our research revealed that technology has important implications for how organizations are structured, for destabilizing power balances within the organization, for reshaping norms and expectations that help define employee relationships, and for influencing patterns of communication and decision making. To some degree technology helped mitigate some of the dysfunctions long associated with bureaucratic organizations (such as limitations to information sharing between different units), and yet when it came to communication or decision making, the traditional top-down approach prevailed. Moreover, technology altered some of the power balances between different segments within the organization (such as crime analysis and the IT unit in Agency 2) and helped reshape existing relationships in both positive and negative ways. Knowing how these effects are negotiated and change over time within police organizations are important areas for future research. We should also note that as demands for information sharing increase *across* organizations and not just within them, an important area for future exploration is how the implementation and use of technology affects interorganizational communication and relationships. For example, what kinds of interorganizational databases (criminal records, Department of Motor Vehicles, gang data, etc.) are considered most valuable and why, and how might these be improved upon? Furthermore, to what degree do information networks between departments improve crime fighting effectiveness or reduce the economic costs of obtaining crime-related data (Flanagin, 2002)?

6.4 Impact of Technology on Internal Accountability and Management Systems

The literature on police and information technology suggests that such technology can increase an agency's capacity to scrutinize the work activities of its employees as well as its own performance (Chan, 2003: 661). It can also be used to hold an agency more accountable to external constituents by providing them with information on the agency's performance and its progress toward meeting its goals, such as reducing crime. To learn about this relationship between technology and accountability, we asked how, if at all, technology was being used to assess the performance of the agency, managers, line- level and other personnel and whether this had changed due to the recent introduction of technologies such as the RMS, LPR, or crime analysis. Moreover, we were interested in learning if and how technology had changed how employees felt about the way accountability operated within their agency.

Based on our survey (see figure 6-c), it was clear that employees in both police departments felt that technology played a substantial role in strengthening internal accountability and management systems.

Figure 6-c. Percentage of patrol officers who agreed or strongly agreed on items gauging their perceptions related to technology and supervision



In what follows, we draw on our fieldwork data to develop some of these major themes.

Agencies used information and analytic technologies to enhance internal accountability.

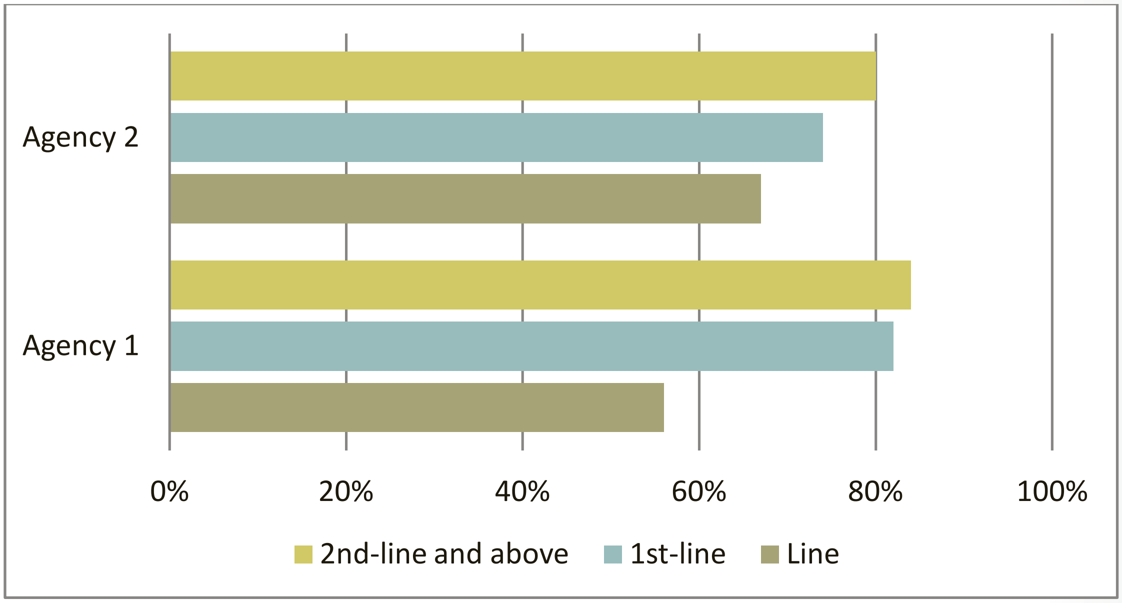
The implementation of the new RMS in Agency 1 had increased internal accountability in a number of different ways, especially for patrol officers. Most obviously, it had made them more responsible for the accuracy of their report writing, since the system software would not allow them to proceed if it detected inaccuracies in how a field was coded. Previously this had been the responsibility of clerks in the record room, who checked to see if officers had identified crime codes correctly. Now, according to the chief, officers were being "forced" to perform this function, but as a consequence the department had "a significantly higher compliance rate with the state."

The new RMS had also increased the capacity of police managers to monitor the work activities of those under their command. Because data on individual officers' activities were now readily available, it was much easier for command staff and first-line supervisors to quickly quantify an officer's workload over a given period (daily, weekly, monthly, etc.). Under the old system, this information was only available on a quarterly basis. According to one patrol officer, the RMS had magnified accountability "100 times" since managers could mine the data from the RMS to create reports such as "who is my number one ticket writer?" This link between information technology and accountability was consistent with our survey in Agency 1, where over 75% of line, first-line, and second-line police officers agreed or strongly agreed with the statement, "Commanders and supervisors use information technology to identify underperforming officers."

Some district commanders used information from the RMS to post officers' statistics outside of roll call, ranking their productivity based on a number of measures including a district's top 10 DWI or drug arresting officers. Other performance categories included number of field contacts and incident reports. The purpose, according to one commander who engaged in this practice, was primarily to use peer pressure to motivate officers to work harder. In addition to encouraging officers to compare themselves to others in their squad, these rankings sometimes compared officers to those in other districts. This competition was designed to spur productivity department-wide (we were told about this in terms of one squad seeking to have the most DWI arrests).

Department leadership and district commanders seemed especially pleased about this new monitoring capability. For the former, we heard how the new RMS facilitated the promotions process by providing useful information on officer performance. A district commander told us that RMS data helped give him a clear sense of what his squads were doing. These data also helped him assign hours and manage his manpower, including how to allocate his resources to a given problem area. Another told us it gave the agency "a better handle on who is doing what … who is productive or less productive." Responses to our survey item about the utility of IT for assessing individual performance shows how higher ranking officers were generally more positive about this aspect of technology than those line officers (including detectives) at the bottom of the organizational hierarchy (Figure 6-d).

Figure 6-d. Percentage who agreed or strongly agreed that information technology generates statistics valuable for assessing officer performance



Compared to responses from those in command staff positions and above, the response of patrol officers to this increased monitoring in Agency 1 was decidedly mixed. On the more negative side, some were skeptical of its value because it was too blunt an instrument for evaluating officer performance, one that failed to capture adequately the quality (as opposed to quantity) of the work they did. As one told us:

> You know the top 10. But you look at them and feel that the numbers don't necessarily reflect how much work an officer is doing. You look at the stats and think that the person with the good numbers is not necessarily a decent cop. I'm not trying to sound weird. Numbers can be deceiving. You might be someone who makes a thousand arrests, but then you look at their arrests and they are all traffic arrests. It can be kind of deceiving.

Statistics might be helpful, but what was most important was having a first-line supervisor who knew an officer's role (for example, a crime scene officer getting called to lots of scenes would necessarily have fewer opportunities to write tickets than someone on patrol) and could take this into account when gauging his or her work.

We heard a similar statement about the limitations of existing data as measures of performance in our sergeant's focus group in Agency 2. Here they acknowledged they could identify the activities of their officers through the CAU, but most said they knew about the officers already. Technology "or numbers and statistics" could not tell you whether an officer was working hard, as one might be assigned to a busy area and another might not.

Others were more direct in expressing their disapproval of a "numbers-based" approach to performance. A patrol officer in Agency 1 said he could not care about the numbers, as for him "quality always trumps quantity." He thought the top 10 list was "stupid," and he was frustrated every time he came in to the station and saw it, saying, "I don't like to look at it."

Other patrol officers viewed the ranking board more positively, feeling it recognized the hard work they were doing, or that it showed how they were covering for any slackers in their squads. Still others were content with being in the middle of the pack, or saw it as evidence that they needed to do more. The implementation of the RMS in Agency 1 required the implementation of AVL (automatic vehicle location) technologies, which helped reinforce the impression among patrol officers that they were under greater surveillance than in years past. In one focus group a patrol officer said, "Some bosses can use it against you because of the GPS [Global Positioning System]," and then conversation shifted to when a general order would be put in place that stipulated under what conditions "GPS information" could be pulled for this purpose. These suspicions of remote surveillance notwithstanding, command staff and first-line supervisors did not report using AVL to monitor carefully the activities of patrol officers.

The RMS was also used by Agency 1 as a tool to hold first-line supervisors more accountable for their officers' reports, particularly in terms of the timeliness in their approval. Reports that had been generated but not yet approved were assigned a special code ("zero"), and we heard from both managers and patrol officers that supervisors were now under greater pressure to minimize the number of zeros in their squads. The expectation was that a report had to be approved and submitted within 24 hours of being generated. Top management said they wanted "zero level zeroes." We did not hear of a similar mechanism in Agency 2, and while supervisors were expected to be reading reports to know what their officers were doing on a daily basis, none of our respondents referred to an automated system for ensuring that they were fulfilling this management expectation.

The RMS also contributed to changes in Agency 1's management and accountability systems. Members of top command were interested in developing "Bureaustat" that would use the department's enhanced data capabilities to improve the organization's administrative performance. This would be a venue for tracking a range of measures important to management, including days off, staffing issues, and reports that had not been submitted. Agency 1 also had a more traditional Compstat approach to focus on crime-related issues, which was being revamped due to the switch to the new RMS. Top command noted that the availability of more timely and accurate data made for a more "interactive" and less canned experience. "Live" data allowed top leadership to ask questions on the spot rather than relying on district commanders to pick and choose which statistics to show. Unlike in Agency 2, we did not hear about crime data and analysis being used to strengthen Compstat's existing accountability mechanism. Thus the Chief noted that crime information allowed them to ask "better questions" at Compstat, but he did not say that timely crime data helped to significantly increase pressure on middle managers for crime-related performance. In fact, in contrast to Agency 2, we did not hear anyone describe Agency 1's Compstat as a meeting that was tense or could lead to the public embarrassment of presenters for what top leadership perceived as subpar performance.

In Agency 2, our primary focus was on the agency's crime analysis unit. We noted earlier how crime analysis contributed to perceptions of accountability through the department's Compstat approach (one top manager said that crime analysis had had a "huge impact" on accountability, especially for lieutenants and sergeants). A comment from a former member of the crime analysis unit underscored the importance of crime data for management purposes. According to him, data usage had changed from solving crimes to "stats and management numbers." Now they "toss data" at officers and it could be hard to follow. Here we explore in more detail how crime analysis actually operated to heighten accountability within the agency.[38]

Specifically, crime information was used by top leadership to hold middle managers accountable for knowing their command, being well acquainted with its problems, and demonstrating a diligent effort to measurably reduce them. Those who failed to do so risked public embarrassment. We also heard that sector captains were appointed by the executive and served at his pleasure (i.e., they not protected by civil service regulations). Technically they could be removed for subpar performance, although we did not hear of this happening on account of Compstat.

[38] As mentioned earlier, since our site visit the department has modified its Compstat process to be more strategic. Rather than having district commanders report on a list of serious crimes (assaults, burglaries, etc.), crime analysis identifies crime problems and these become the basis for discussion and brainstorming.

Still, Compstat seemed to have a powerful effect on many of those with whom we spoke. As one sergeant put it when referring to preparations for Compstat, "Everyone runs around scared, just because they don't want to get embarrassed in front of [top leadership]."

The fact that internal accountability was integral to the department's Compstat program was acknowledged by many department members, and especially by middle managers, the group primarily responsible for answering questions on crime in their districts. In response to a question in a focus group about who was giving lieutenants instructions about what specific strategies to implement in response to a particular crime problem, one lieutenant said: "No one is saying you have to do anything. But I assure you, if you walk back into Compstat and the chief pulls up a map and asks what you are doing about it, you had better be able to talk about what you have been doing." Another said, "It not only makes us accountable to our superiors … but the technology that is in place puts us on top of crime trends and some cases in front of crime trends."

This accountability trickled down to sergeants, but since they did not have to present at Compstat they did not experience it as intensely. They were, however, expected to be using crime analysis in their daily decision making and mentioned that their lieutenants could check online to see whether they had actually visited the CAU's website to look at crime trends and hot spots, as they had been instructed to do. As one put it, "It is put out there as part of our routine that we should all be looking at that [CAU] resource." Accountability was most diluted at the bottom of the command hierarchy, where patrol officers were not held directly responsible for ensuring that the dots disappeared. The rank and file experienced Compstat mainly in the form of directives telling them where to deploy during their shifts. Both agencies encouraged their patrol officers to use crime analysis, but there was not a similarly strict accountability mechanism in Compstat to ensure that they did so. Thus the degree to which they used it largely depended on the style of the particular supervisor and the will and skill of the individual officer. Our survey of Agency 2 suggested this message about the relevance of crime analysis to street-level decision making had been received by line officers, with close to nine in 10 line-level patrol officers agreeing or strongly agreeing with the statement, "My superiors expect me to use information technology systems to identify and respond to crime problems;" this figure rose to 97% for second-line officers and above.

We have noted here how accountability was experienced less intensely at Compstat in Agency 1 compared to Agency 2, but both agencies used data to measure "activity," or doing something, over assessing "outcomes," or doing the best thing. Thus, crime analysis at Compstat in Agency 2 was used to monitor what middle managers were doing in response to a crime problem, rather than to conduct systematic follow-ups to learn whether a particular strategy had been successful. What mattered most to top leadership was that middle managers could show they were doing something about a crime problem. For example, at the time of our visit, Agency 2 was dealing with a burglary problem that was assumed to be connected to truancy. Whether or not this was the case, top leadership expected middle managers to be directing those under their command to be increasing field investigation reports (FIRS) in high burglary areas presumably to deter future crime. If there were fewer burglaries at the next Compstat meeting, the strategy was considered a success. In the words of a patrol sergeant, "The chief will lay over the dots places you stopped people. If the dots go away for 30 days, we can't assume we fixed the problem, but if the dots go away, we have taken care of it, at least for now." This pressure to respond to crime was referred to as "chasing the dots," with one lieutenant remarking, "we just want those dots to go away."

Technology's emphasis on monitoring activity rather than assessing results was illustrated by comments by other groups as well. For example, when we asked detectives in Agency 1 about whether the availability of the RMS and other information technologies (including the web and other information databases like LInX) had put them under greater pressure to close cases, they responded that this was not the case. Detectives traditionally have a great deal of autonomy in what work they do and how they do it, but with new information and analytic technologies there was a sense that their work activities were more visible to their superiors. As one detective from Agency 1 said, there was not a sense of "Hey, you have to hit this performance level," but, "Hey, you need to be doing what you are supposed to be doing" (including being able to identify patterns). Supervisors could use technology to more easily identify cases that were inactive and whether or not timely updates were being made. At the same time, patrol officers could also see how a particular case was progressing, such as a homicide, and view the follow-ups (creating more accountability between officers). He added that now, "It is a lot harder to hide, and it is a lot easier to keep track." This view that technology helped break down the tradition of detectives being protective of their case files was consistent with what we heard from upper management. One of the interviewees said he wanted an automated case management system, as he believed that "keeping information to yourself sometimes undermines accountability." In Agency 2, we did hear of one example of how the examination of case files had led to changes in accountability structures. Specifically, while looking for patterns in sex offenses, a crime analyst found some discrepancies in some of the case files, with some cases not being properly upgraded. This error led to a change in policy that clarified when cases should be upgraded and the implementation of a system for monitoring more carefully the cases of those working in the sex crimes unit.

We might anticipate that a technology whose primary purpose is to reduce, prevent, or to clear crime (e.g., auto theft), such as LPR (Lum et al.,2011), would create a greater pressure on its users for results, but this also did not seem to be the case based on our study of Agency 1. Again, command staff and supervisors seemed to put more emphasis on putting the equipment into the field than maximizing its potential. When we asked officers in an LPR focus group whether or not they were expected to get so many "hits" per month, one participant responded, "We have no expectations for hits on LPR." Similarly, we heard from command staff that LPR did not change officer accountability or productivity in any way. In the program's infancy, officers using LPR were required to record their activity, but now it was "accepted" that LPR would be used in ways that fit into their existing patrol responsibilities. If they happened to get a hit, that was a "bonus."

***Both agencies also used technology to enhance external accountability, although much greater stress was placed on using technology to enhance internal accountability within the organization*.**

In both Agency 1 and Agency 2, technology helped strengthen their accountability to outside constituents, but the use of data for this purpose was less developed than it was for internal accountability. Organizations are obviously cautious about exposing themselves to public scrutiny, and the provision of crime statistics and strategies for external consumption could expose the police to the unwelcome pressure of increased criticism. Perhaps this helps explain why only 44% of all those assigned to patrol in Agency 1 and 60% in Agency 2 agreed or strongly agreed that "technology makes my agency's decisions more transparent to the community."

In the case of Agency 1's RMS, one important constituency was the state and its rules and formats for reporting crime. The department was now being held to a higher standard of reporting than under its previous system since it was seeking to supply the state with crime information in the required IBR format.

There was also some recognition by mid-level managers and above that RMS and crime analysis had increased external accountability by making their agencies more transparent to members of the public. For example, in response to the question of whether the RMS had helped accountability in Agency 1, the Chief replied, “It makes us accountable to the public, because now the public can also get information and we share it with them sooner.” In Agency 2, crime information was shared with the public at local community meetings, and also community members could go to the department’s website to see where crime was occurring. On our survey, higher ranking officers in both agencies (second-line police officers and above) were the rank most likely to agree that technology had made their agency’s decisions more transparent to the public. Some of those we interviewed also felt that technology, particularly forensics, had increased public expectations for solving crime, or the CSI effect. According to our survey, over 70% of respondents in Agency 1 and over 80% of respondents in Agency 2 agreed or strongly agreed that “technology increases the community’s expectations of my agency to reduce crime”. At the same time, we did not hear of either agency setting a specific crime reduction goal (e.g., “reduce crime by 10 percent in the first year”), as William Bratton did in the New York City Police Department. Such a specific crime reduction target would have significantly increased public expectations for agency performance and resulted in adverse consequences should the agency fail to reach this goal. In sum, information technologies and crime analysis might have increased accountability by rendering the efforts of the agency more visible to outsiders, but they were not used to establish clear goals and give detailed knowledge about the department’s progress in meeting such goals.

Summary

In sum, technology had facilitated the tracking and monitoring of daily activities in the agencies we visited, with some groups experiencing a new accountability more intensely than others depending on how the technology was used. This perspective was especially true in Agency 1, where survey respondents were more likely to think that technology was used to identify underperforming officers than respondents in Agency 2. Reactions within each department to the organization’s increased capacity to scrutinize work activities were mixed, with some considering it a useful management and motivational tool, while others viewing it as intrusive and less helpful. This ambivalence was also seen in responses to our more general survey item about technology’s capacity to improve supervision and management within the agency. Respondents in Agency 2 were generally more positive about this item than respondents in Agency 1, though there were significant differences across ranks. Those in supervisory or command roles were much more likely to view information technology’s contributions to supervision and management in a more positive light.[39] Among patrol officers, only 48% in Agency 1 agreed or strongly agreed with this view, while 63% in Agency 2 did.

However, technology was much less likely to be used to conduct careful follow-up assessments of the quality of organizational or individual performance, particularly in terms of reducing crime. As for external accountability, technology had given outside constituents greater access to department information, particularly crime data and maps, but it had not given greater access to the department's decision making processes or to explicit measures of organizational performance. These would have exposed these agencies to a higher level of accountability and the likelihood of more critical public assessments.

6.5 Impact of Technology on Police Discretion

Another way that technology might impact policing is in the everyday discretion and decision making of officers and supervisors. Radios and computer-aided dispatch have long been fixtures in American policing, but more recent technologies may also impact police decision making. For example, when using LPR technologies, officers no longer have to select which vehicles they will investigate (they had to call in suspicious vehicle plates into dispatch to discover wrongdoing). Instead, an LPR unit can scan all license plates in its purview, alerting officers when a stolen vehicle, plate, or other crime that is logged into the LPR database is detected. When LPR is used, it fundamentally changes the decision-making process of an officer with regard to stopping suspicious vehicles.

Information technologies might also influence the way officers respond to certain people and incidents. New interfaces in an officer's mobile computer terminal allow him or her to see the history of a location of a call for service even before responding to the call. The same information technologies allow officers to look up past information about an individual that may factor into whether or not the officer chooses to arrest or further question a stopped individual. Information and analytic technologies might also impact an officer's or detective's overall decision-making style. Officers and detectives have discretionary periods when they are not

[39] The average level of agreement for this item on our survey for line, first-line, and second-line officers was 2.28, 2.51. and 2.84 in Agency 1, respectively, and 2.68. 2.86, and 3.14 in Agency 2, respectively (where 1 = strongly disagree, 2 = disagree, 3 = agree, and 4 = strongly agree). These differences between ranks at both agencies were statistically significant.

answering calls or carrying out predefined duties. Choosing to use technologies during this time may influence what they do during their down time.

To better understand the impact that technology has on officer discretion and decision making, we asked officers, supervisors, detectives, civilians, and command staff in Agencies 1 and 2 how information technologies, mobile computer terminals, LPRs, and crime analytic technologies impacted their everyday decisions regarding responding to calls for service, dealing with crime and disorder in their areas of responsibility, or deciding what to do during their discretionary periods. To better understand the impact of technology on their discretion, we asked: (1) For what types of tasks do they use different technologies, and how extensively do they use technology for these tasks? (2) How does technology affect their decisions about the types of activities to pursue and their responses to different types of incidents and problems? (3) To what extent does technology expand and/or restrict their discretion in responding to incidents, conducting proactive enforcement, and structuring their time between calls? and (4) For what types of tasks do they find technology most helpful?

In our interviews and focus groups, officers and detectives discussed three primary ways in which technology influences their discretion. First, police personnel most often said that technology impacts their discretion when responding to incidents, cases, and situations. Our second finding was that they were much less likely to use technology to proactively guide decision making and discretion, especially during noncommitted or "downtime." Finally, respondents remarked that technology sometimes inhibited, restricted, constrained, or reduced discretion and discretionary time.

Technology most commonly shapes officer discretion in that it allows officers to obtain more information when responding to a call for service, encountering a situation, or investigating a criminal case or person, which in turn might adjust their decision making about that call, situation, case, or individual.

In our discussions with personnel from Agencies 1 and 2, the strongest influence of technology on officer discretion appears to be its ability to provide officers more information when reacting or responding to a call for service, situation, stopped individual, or criminal investigation. Data obtained from mobile computer systems, databases, and crime analysis were seen as valuable in reducing risk and uncertainty in these fundamental tasks of. For example, a few officers with whom we spoke stated that they could now, in response to a call of domestic violence, access their mobile computer units to determine the history of domestic violence at that location before approaching the home. One crime analyst from Agency 2 added that perhaps an alert that automatically tells the officers the level of risk at a particular place he or she was responding to would be helpful.[40] As indicated in Section 4, the survey found that officers in Agency 1 found this aspect of technology especially useful; 70% responded that they used technology often or very often to “check the history of a specific location or persons(s) before responding to a call for service” as opposed to 50% of their counterparts surveyed in Agency 2.

Agency 2 detectives also remarked that their use of crime analysis and its related technologies was most often to further a particular case they were investigating, in particular, in finding or identifying witnesses and suspects of a crime already committed. Indeed, in both agencies, we discovered the most common use of crime analysis by detectives was for these more reactive purposes, rather than to proactively reduce or prevent crime. One exception was provided by detectives in Agency 2, who stated that on some occasions they would use information on a crime series to anticipate future events or to determine patterns within a *modus operandi*. However, this was much less common than using crime analysis to solve individual crimes that had already occurred.

Most of the time, information was sought to find wrongdoing or warning signs of problems within existing situations, which would shape an officer’s subsequent decisions. One officer in Agency 1 stated, “If you make a traffic stop for speeding and see that someone has been arrested four times for drugs, you will pay a lot of attention.” Some officers also suggested that having such information helped guide their discretion about *not* pursuing an arrest: “If you are going to cut somebody a break,” one officer pointed out, “you are more informed on their background [because of the information technology].” Others said it was useful when working with kids to better understand the situation or background of the juvenile.

Officers also acknowledged the limitations of the use of technology. While technology could give them information about an individual or situation, it could not tell them what to do about a situation or problem. One officer suggested that the use of checklists might be helpful in ensuring certain inquiries or steps were

[40] For example, technologies that increase officers’ situational awareness about past crime histories of areas they are patrolling in have been developed. See the work done by The Omega Group, at http://info.theomegagroup.com/introducing-the-industrys-first-proactive-policing-mobile-application/.

completed when encountering a suspicious individual or examining a situation. But ultimately, officers still had wide discretion in terms of how to use and apply information received from technology.

Our interviews aligned with our survey results in regard to technology and discretion. Officers in both agencies responded that they were likely to use technology most often to locate individuals of interest in an investigation, collect and search for information during a field interview, or determine how to respond to a crime problem rather than for other, more proactive uses not prompted by an existing situation or call. A commander from Agency 2 concurred that these were the most likely uses of both information technologies and crime analysis, rather than more proactive uses. This was not surprising, given that we hypothesized from existing literature that technology is most likely to be viewed from existing cultural frames of police agencies, and are therefore used to support those reactive and response-based functions, activities, and styles that officers know best.

Technology can also limit, constrain, or reduce discretion and discretionary time by reducing/restricting officer choices in particular situations or burdening them so much that they choose not to act.

Sometimes technology created burdens for officers by locking them into a particular decision or activity that they tried to avoid by using technology. For example, when Agency 1 transitioned to the new reporting system, officers remarked that the automated system seemed to take much longer than the paper system, and the learning curve was steep. Thus, at the beginning of the transition, Agency 1 experienced a significant drop in traffic citations as some officers stated that writing traffic citations "wasn't worth it" given the difficulty of the computerized report writing system.

Another officer in Agency 1 indicated that in order to input a report on the new computerized system and not lose his work, he had to find a mobile "hot spot" so that he could get good reception. Rather than stopping and writing his reports in an area where his visibility to prevent crime might be effective, he writes his reports near places that receive good intranet connectivity. Other officers noted that unlike with paper reports, they were reluctant to write electronic reports in high crime areas because they had to concentrate on the technology, suggesting officer safety concerns. It was unclear whether officers wrote reports in high crime places to increase their visibility before the advent of the new automated system, but their raising this point was nonetheless interesting.

We also interviewed a number of officers in Agency 1 who use LPR technology on their vehicles. Some officers remarked that they have changed their patrol patterns with LPR. Specifically, they try to go to places where running tags are easier or where they might think they can get a "hit."

Officers suggested that one unanticipated outcome of adopting and adjusting to new technologies was the *reduction* of officer discretionary time. This point was made to the research team especially by those from Agency 1, which had just undergone a major change from a paper-based system to an automated one. Although this will be discussed in length in section 6.6, it is worth noting this finding here. Many officers in Agency 1 complained that the new automated system made them take longer writing reports, which reduced their noncommitted time. We also discovered that the new system allowed supervisors to monitor when reports were turned in (and corrected for mistakes). Officers remarked that the pressure to ensure reports were turned in on time also reduced their noncommitted time. Some officers remarked that law enforcement had little downtime at all ("we go call to call to call"), and that technology simply made things worse.

While some officers used technology to proactively shape their discretionary activities during noncommitted or "down" time, this type of technology use was limited, unsystematic, and most often found in specialized units.

Research indicates that officer use of their noncommitted time to carry out proactive, place-based, and problem-solving activities can not only reduce calls for service, but also lead to real reductions in crime (see Eck and Weisburd, 2004; Lum et al., 2011; Sherman and Eck, 2002). Technology might be used to more accurately identify hot spots of crime to target during this time, identify and monitor high-risk individuals (suspects and victims), or determine the nature of specific problems at specific places to help sharpen deployment options. Mobile terminals could also act as information delivery systems, to provide field officers and supervisors with crime analytics to better guide proactive deployment and anticipate crime.

A few with whom we spoke mentioned that technology could be used to help officers be more proactive in these ways. For example, in Agency 1 during our interactions with a specialized unit involved in our field experiment (see Section 9), we noticed that mobile information technologies were heavily used to run license plates of vehicles to decide whether to engage with individuals in cars in hot spots. While the running of license plates has been a regular activity by many police agencies since the arrival of computer-aided dispatch, mobile terminals allow officers to do these checks on their own, without asking a dispatcher for help. One specialized unit officer we spoke to argued that “running tags gives you information on people and vehicles without having to stop them per se.” Ironically, officers from the same unit mentioned that such technologies have possibly led to the reduction of proactive stops, because they can run everything from inside of their cars. In both instances, the ability to run tags and criminal histories on individuals without stopping them is an example of how technology sharpens the focus of an officer’s discretion on the most potentially problematic people and incidents. An LPR officer told us that for larger investigations, LPR is used to sweep areas around homicides to run tags of people who might have been at the scene.

However, officers also told us that there was no systematic approach to using technology in these proactive ways, and this type of technology use was highly dependent on individual officer style and personality. We found variations by officer, unit, and rank in terms of use of technology to guide proactivity, problem-solving or community-oriented activity during downtime, and also variations in officers’ views about this type of behavior. This use of technology was more prevalent in specialized units than in patrol or traditional investigative units. In both agencies specialized units were often assigned to conduct proactive work in areas identified by crime analysis, and carry out tasks such as canvassing areas, interviewing citizens, making field contacts, gaining intelligence, or enforcing truancy or other disorder ordinances. Indeed, one unit in Agency 2 was specifically designed to carry out problem-solving exercises and enjoyed a positive and close relationship with crime analysis, which they used to identify, analyze, respond, and evaluate problems and solutions and to guide their deployment. Proactive units in Agency 1 that did not have any responsibility for answering calls for service also seemed more amenable to using technology and information more proactively. Detective units varied, with some (such as sex offender units) using crime analysis and information technologies to view series, patterns, and trends, while others (such as homicide units) used these technologies to help with specific cases. One detective commander from Agency 1 pointed out that information technologies could help repeat offender units find out who just got out of jail and needed monitoring.

Officers and commanders from both agencies mentioned that using technology for more creative, proactive, or nontraditional patrol operations was not a cultural norm. One patrol officer in Agency 1 said that officers don’t really do such proactive activities unless they get bored or are personally motivated. An officer in Agency 2 mentioned that while he checks the crime analysis unit’s website at the beginning of his shift, he doesn’t believe this to be the norm with other officers. Even the specialized unit officers in Agency 1 remarked that they were less prompted to conduct proactive or problem-solving activities at places by the technologies available to them, and more prompted by visual cues at those places. Thus, technology was less often used proactively to identify or attack problems, and more often used in response to experiential and visual cues. Another officer in Agency 2 remarked that officer activities during noncommitted time were often guided by the “flavor of the week” as opposed to information arising regularly from crime analysis.

Officers in Agency 2 remarked how crime analysis and the use of analysis in management meetings prompted patrol officers to have to carry out certain deployments during their nondiscretionary time. Although discussed more in the section on police effectiveness (section 6.7), it is worth noting here that officers felt that once hot spots were established through crime analysis, they were required to go to those spots and conduct field interview reports or curfew checks, with little understanding as to why. On the other hand, analysts in Agency 1 suggested that they “didn’t have a clear sense of how officers use the data they generate.”

We also found differences between agencies in whether they used technology in more proactive ways in patrol. Agency 2 had a much more well-developed crime analytic unit than Agency 1, and officers, detectives, and supervisors tended to show greater understanding of the proactive use of analytic technologies. Further, in Agency 2 we found that patrol officers were more likely to be given directives about what to do during their noncommitted time given the importance placed on analytic information and proactive policing. Indeed, as the survey indicated (Figure 6-e), patrol officers in Agency 2 were much more likely than those in Agency 1 to respond that they “often” or “very often” use technology to “determine where to patrol when not answering a call for service” (47% versus 15%, respectively). More supervisors and commanders in Agency 2 (Figure 6-f) were “often” or “very often” likely to “determine what to do about crime trends and problems in your area of responsibility” than those in Agency 1 (51% versus 34%, respectively). Further, Agency 1 and 2 differed in the frequency with which they were likely to use technology to determine *how* to respond to existing problems. Officers in Agency 2 were more likely than Agency 1 to do so (48% compared to 19%, respectively, responded that they “often” or “very often” used technology in this way).

Figure 6-e. Percentage of officers who use information technology often or very often for specific tasks

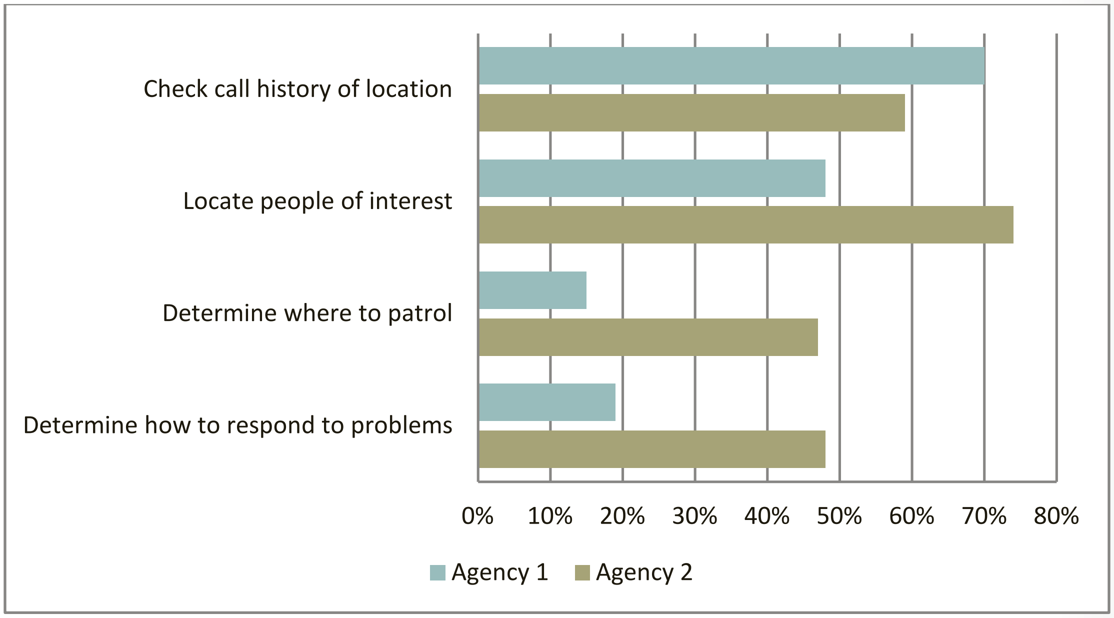
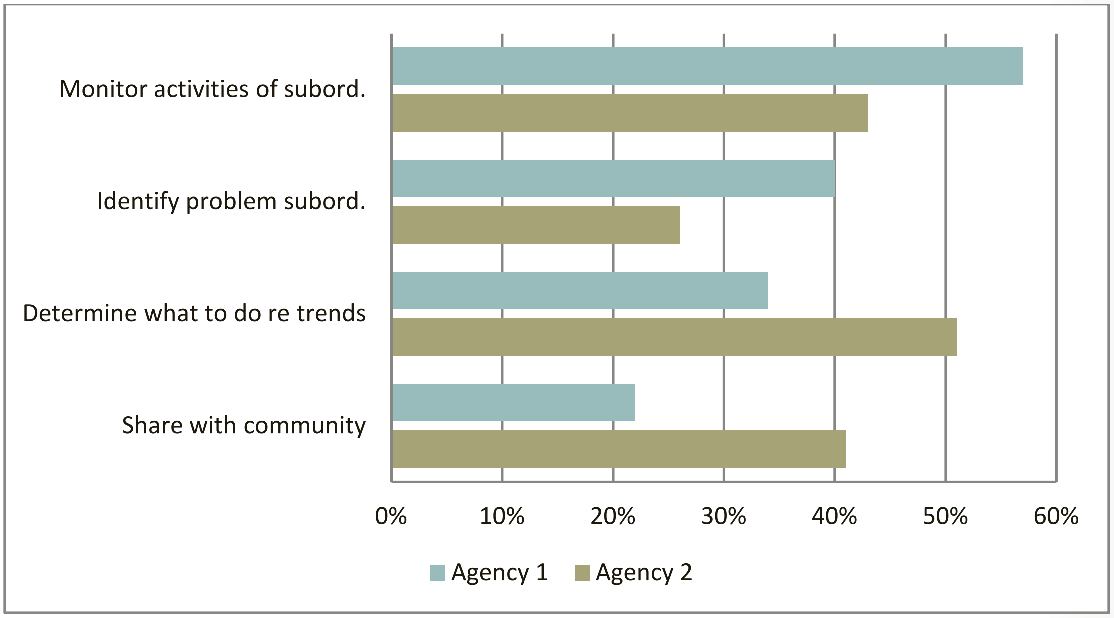


Figure 6-f. Percentage of supervisors who use information technology often or very often for specific tasks



In general, the influence of technology on the noncommitted, discretionary time of those with whom we spoke was not great. Officers, supervisors and commanders from both agencies pointed out three main reasons for this state of affairs. The first was the lack of supervisory or command-level directives that required (or pushed) them to do such activities. Many sergeants and lieutenants that we spoke with did not shut out the possibility of crime analytic or information technologies helping them to deploy officers during patrol downtime, although some denied that downtime existed (e.g., “we go call to call to call” or “what downtime?”). While being told what to do was often viewed disdainfully, officers readily acknowledged that supervisors held the burden of getting officers to change their approach. An analyst in Agency 2 asserted that supervisors are key in how crime analysis or technology gets to and is used by officers. Higher ranks might believe this is happening, but it may not be. However, one commander in Agency 2 remarked that even with supervisor guidance, officers still had to know what to substantively do when given information. He stressed the importance of making the use of such information part of performance measures of supervisors. One commander stated that while crime analysis was useful for management meetings (like Compstat), he was uncertain whether analysis was useful in changing officer behavior on the street, remarking that “the information isn’t used in that way.”

The second reason offered by officers and commanders from both agencies indicated that organizational “culture” (discussed previously in section 6.2), or the ways in which the department had come to operate and carry out daily tasks and decision-making, did not necessarily encourage officers to do such activities during their downtime. One commander from Agency 2 was optimistic, arguing that crime analysis and related technologies could “help officers think outside the box.” A commanding officer of a detective unit in Agency 1 added that information technologies might also adjust the types of questions that detectives might ask, suggesting that they might take a different approach to the way they conduct their investigations. A Lieutenant from Agency 2 remarked that sometimes crime analysis was not translated into more operational forms or was not be available at certain times or for specific problems faced by a particular district. While he acknowledged that analytic technologies were beneficial to the agency and had helped him be more effective, he said that he could use some guidance in working through some of the implementation issues.

And finally, connected to supervision and culture, respondents mentioned that the lack of training contributed to the low rate of technology use during noncommitted time. Agency 1 commanders and officers readily acknowledged how young officers who had been trained in the new information technology system exhibited fewer problems and resistance to the system than older officers, but they still needed to learn what to do with the information for reach proactive and problem-solving goals.

Despite these issues, the research team saw the promise that information and analytic technologies could bring to proactive operations to prevent and reduce crime. In Agency 2, a specialized unit designed specifically to engage with these technologies to reduce crime had a number of officers who had positively experienced going from a reactive, arrest-only approach to policing to one that was more proactive and analytic in nature. One officer mentioned that before he was in the specialized unit he often had “a knee jerk reaction to search and arrest,” but now he “sees the value of not doing that to collect information for problem solving.”

Summary

Overall, it appears that technology impacts police discretion most in ways that enhance more reactive, traditional, and case-by-case approaches to crime. Technologies have allowed officers and detectives to dig deeper into investigating people, incidents, or crime cases, and also have been used by them to anticipate events before they arrive at the scene. Although officers are not regularly driven to use technology to guide their noncommitted time, they acknowledge and sometimes use information and crime analytic technologies for purposes of proactive, place-based and problem-solving policing.

The impact of technology on discretion across officers, units, ranks, and agencies appeared to vary. More senior-rank officers could more readily see the benefits of technology in guiding deployment, although they also saw how lack of supervision, translation, and training would stifle this particular impact of technology on discretion. In Agency 1, it was very clear that the use of technology to guide decision making on the street was extremely officer dependent. Officers often remarked that it was a more personal decision to “do extra” and to learn the ins and outs of the information system. In Agency 2, although the use and understanding of the importance of crime analysis was clear at the command level, how first-line supervisors used crime analytic information and technology also depended on the individual and not necessarily on directives. A number of officers (although a minority) expressed willingness to use these technologies and obtain more training.

Specialized units were much more likely to engage with technology to accomplish proactive policing, and often saw more benefits to its impact on their activities than patrol officers. Traditional detective units tended to use crime analytic and information technology to solve cases, while other detectives remarked that technology and analysis could help identify crime patterns and series or analyze modus operandi. Even at the agency level differences were apparent. Agency 2 had a highly developed and sophisticated crime analysis unit and information technology system, while Agency 1 had only recently transitioned from a paper system to an automated system. Thus, officers in Agency 1 were much more likely to complain about the difficulties of the change in their everyday activities, while Agency 2 officers tended to complain about being directed to “flavors of the day” and special operations (e.g., truancy stops) that were viewed as products of an interest to “put cops on the dots” (as opposed to conducting “real” police work).

In both agencies, officers, supervisors and civilians acknowledged that technology could only affect their decision making up to a certain point. One commander in Agency 2 stated, “Even though technology might get them to a hot spot, officers still had to do something when they get there. They also still need to interact with people.” Another officer in Agency 1 stated that “[the records management system] can make you a better police officer, but you have to recognize what it can do for you.”

6.6 Impact on Police Productivity, Efficiency, and Daily Work

The most straightforward impact that technology should have on a law enforcement organization is improving agency efficiency, which is often the motivation behind technological adoption (Allen and Karanasios, 2011). Advancements in information, scanning, investigative, and computing technologies in law enforcement seem well suited to increasing the speed and efficiency of everyday tasks and processes such as writing reports, dispatching calls, investigating people and places, collecting and disseminating information, processing evidence, and making arrests.

Yet despite the seemingly logical connection between technology and efficiency, research on technology in organizations has pointed to a more complex and contradictory logic in their relationship. Technology may create new requirements and complexities with respect to data gathering, reporting, and evidence collection that put more demands on the time of officers and other staff. Technology may also increase the need for more resources to be invested in training, maintenance, and other administrative work. Technologies that appear efficient may, in the long run, clash with organizational systems and cultures, creating resistance and thwarting efficiency gains.

To gauge the impact of technology on police productivity, efficiency, and daily work, we asked officers of all ranks and civilian staff to comment on whether crime analytic and information management technologies, as well as sensory and surveillance technology (i.e., LPRs), made them more efficient or productive. We asked about how technology and changes in technology impacted the speed and ease of performing everyday activities. Four main themes emerged from our focus groups and interviews. First, officers clearly recognized that technology *in general* has increased the speed and efficiency by which they work. At the same time, technologies can also slow their work down, make their efforts more laborious, and increase frustration. Further, we discovered a great deal of variation in the views toward the efficiency of new technology across individuals, ranks, units, and agencies. And finally, it was clear that the promise of greater efficiency was limited by a number of factors. Each will now be discussed in turn.

Technology can make certain tasks easier and quicker to accomplish, and officers more productive.

Officers and analysts from Agencies 1 and 2 readily acknowledged that technology has been a positive development in policing and society. Computers, the Internet, automated systems, and faster processing of reports, data, and evidence were often viewed as important to and improving policing, despite the problems that technology could also bring. This sentiment was most strongly expressed during discussions about license-plate-reader (LPR) technologies and, to a lesser extent, other information technologies such as mobile computer units. One officer in Agency 1 remarked that "LPR is very easy to use, [it is] fast, efficient. Officers really, really like it. You can scan tags for auto theft, but you can also use it for investigations." One officer described it as a "game changer" because it automates a process that in the past had taken much more time (officers would run individual tags through motor vehicle and criminal records either by calling dispatch or typing tags into their mobile computer units).

Mobile computer terminals were also spoken of positively, and officers remarked that such technologies made information much more "instantaneous." They said that mobile terminals give them greater ability to "do checks in the field" and retrieve information that in the past would have had to be done through the dispatch or manual searching of files at the records management division. One officer stated, "Under the old system, it would have been impossible to find someone if you just had a name." Having access to information technology both in the station and in the field seemed especially useful when officers stopped people for minor crimes and they could not produce any identification. Another officer in Agency 1 remarked that "instead of waiting for info back from the dispatcher, mobile units allow officers to obtain data quickly." Officers in Agency 2 agreed with this, arguing that this was a "major positive [aspect] about technology" and that "fact checking on suspects and witnesses can be done very quickly."

Agency 2 detectives were asked about crime analysis technologies, to which they replied that such technologies were "very useful, and frees us to do actual detective work—knock on doors, interview people, and talk to folks." Furthermore, they asserted that "information that would have taken a whole team in homicide to collect over several weeks can take a couple of guys a few days now."

Some systems were seen as more useful than others with regard to quickly accessing and investigating data and information, which officers viewed as central to their function. For example, even though both agencies had an internal information technology system in which officers could search and find information, officers in Agency 1 preferred LInX, a regional information sharing system.[41] Officers and detectives in Agency 1 felt the LINX system was much more user friendly, and Agency 1 officers often discussed LInX to make a point about their displeasure with their agency's internal system. Others found public systems, including Facebook, the Internet, email, and other databases helpful to investigations. Further, being able to access computer-aided dispatch systems from their mobile computer units to see the call history of specific addresses—and to obtain this information without interacting with dispatchers—was viewed as a positive technological advance.

In Agency 2, commanders noted how both crime analytic and information technology has improved the productivity and work of their officers. One commander remarked that technology "allowed for more data connectivity" and that "certain things are now done faster, such as DNA or fingerprinting." In particular, commanders from both agencies felt that advances in technology helped to increase exchanges between officers, which they viewed as essential for quicker response to incidents and investigations. One detective commander remarked that computerized case management systems for detectives were a major leap forward in greater connectivity and information sharing across criminal cases.

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[41] See http://www.northropgrumman.com/Capabilities/PublicSafety/Pages/LawEnforcementInformationExchange.aspx

At the same time, officers found that technology reduced their efficiency.

Although gains in efficiency were readily acknowledged by personnel in both agencies, officers also indicated that technologies sometimes made them less efficient. This was more apparent in Agency 1 than in Agency 2, and reflected the general findings of the officer-level surveys. Recall from Section 5 that officers in Agency 1 felt more strongly that technology created greater work for them than officers in Agency 2, a finding that was consistent in Agency 1 officers across all ranks and assignments in our survey (and also discovered by Chan et al. [2001] in their analysis). For example, one officer in Agency 1 indicated that technology does help in certain ways ("looking up information"), but was difficult in other ways ("doing reports"). This contradiction was most apparent in Agency 1, which had just converted from a paper-based reporting system to an automated reporting system. One commander, reflecting about this move, stated that it "may sound good at the strategic level, but on the ground it may be more difficult.… Paper is part of a larger system; when you go from paper to digital, it disrupts that system." He pointed to a disconnect between those purchasing and envisioning the benefits of acquiring technology with those using it, stating that "strategic folks are outside the realm of implementation."

A number of reasons were given for this contradiction in how officers regarded the efficiency of technology. As previously discussed, Agency 1 adopted a new RMS at the same time a major change took place in how the agency classified crime incidents (they transitioned to an incident-based reporting system [IBRS]). The change in classifications was built into the new automated reporting system, creating challenges in not only adapting to the new technology, but also at the same time to the new classification system. This simultaneous adoption led many officers to associate the new RMS with problems related to adjusting to the new crime classification system, exacerbating the negative view of the new technology.

Technology was also seen as inefficient when the technology didn't match personnel expectations about it or task at hand. Electronic reporting interfaces on a computer screen may appear completely different from a paper form, requiring officers to readjust. A number of officers in Agency 1 stated that they knew exactly what to write in specific areas of the paper report, and had already "memorized the fields." However, the new system included pull-down menus for specific choices, and required different "tricks" in entering data. In some cases, data had to be entered twice in one location, and figuring out how to cut and paste within the new system without losing data was a challenge.

These new interfaces and different reporting requirements led officers in Agency 1 to complain that the new system of computerized report writing took longer than manually writing the reports. Interestingly, the same officers who found license plate recognition systems to be incredibly beneficial and technologically efficient expressed a strong dislike about the new RMS. They cited specific examples such as “typing takes longer,” “the browser and Internet is slow,” and “auto-fill fields were unreliable,” and said that officers often had to “key in every single piece of property in a separate field screen.” One officer in Agency 1 detailed how difficult it was to delete information. All of this was seen as incredibly time consuming. As one officer put it, “The computer does not work for us to meet our needs; we are slaves to the computer.”

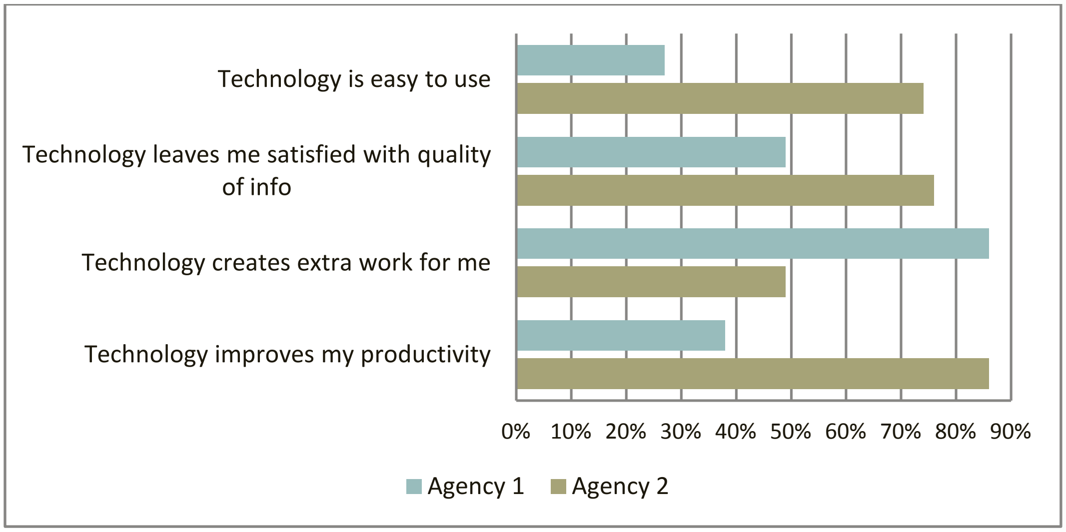
A number of officers in Agency 1 argued that technology had the additional effect of removing them from their everyday duties to finish reports. One officer stated that he “used to be able to make a few trips to the jail, have all reports written, including traffic reports, and have time for business checks and breakfast. Today, that would be impossible. Now it takes so much time to process someone, along with the time it takes for data entry.” Others found ways to use portions of their shift to write reports at the station. Some officers in Agency 1 expressed frustration about parts of information technologies and the RMS that they felt were unnecessary and time consuming, but that they also felt were used to keep officers accountable. In particular, some believed that portions of the system that were “forced fields” (i.e., fields in which officers were forced to choose selections) were designed to control their data entry and activities. This reduction in discretion in how they could write the report created frustration. As one officer summarized: “Bottom line is that it is taking us longer to do our job and document what we do—whether we are tech savvy or not.” Another officer remarked that he could “previously process 10 traffic tickets in the time it now takes him to complete seven.”

Officers also pointed to “data overload,” saying that “too much data and information was being thrown at them,” making the information hard to process or interpret. It was clear that the issue of technology undermining efficiency was much more apparent in Agency 1 than in Agency 2, most likely because of the major RMS changes the agency had experienced shortly before our study. As will be discussed below, new officers coming into the agency or those who had transferred from other agencies that used the same RMS system did not seem to have the same complaints.

One interesting finding regarding efficiency emerged when during interviews with civilian staff in Agency 2 who worked in records management. Advances in both information technology and crime analysis blurred unit lines between the two units (records management/information technology and crime analysis). One civilian employee of the records management division stated that "when one area of technology advances, others might not be able to keep up, which causes glitches in the system—ripple effects—that can affect daily work. … In some cases, [the crime analysis unit] has overtaken jobs that [the information technology unit] is supposed to do, but may not have been able to do." In other words, technology that made one unit much more efficient led to another unit playing catch up.

Members of the two agencies also differed in the extent to which they felt technology increased their productivity, as our survey also showed (Figure 6-g).

Figure 6-g. Percentage of officers who agree or strongly agree about efficiency aspects of technology



Perceptions of how technology impacted efficiency and productivity varied across officers, ranks, and units.

As with many other aspects of technology, perceptions of the impact (positive or negative) of technology on personnel efficiency and work productivity varied across types of officers, ranks, and units. Again, there were contradictions within units, especially when discussing technologies like LPR, which were viewed as essential to improving efficiency, compared to information technologies, which was viewed as both beneficial and detrimental to efficiency. Age mattered, specifically at unranked levels. Officers of higher ranks, who tended to be older, seemed to believe more often in gains in efficiency, but this was not necessarily true for older unranked patrol officers. While younger unranked officers were adept at using personal computing technologies, older unranked officers were much more likely to be suspicious of technology, especially systems they perceived were trying to hold them accountable. These perceptions were also prevalent among first-line, immediate supervisors. In Agency 1, for example, first-line supervisors were less receptive to the new records management system than second-line supervisors (lieutenants and captains), who often saw some value in the new system. Higher ranking officers found reports easier to read and share with other shift supervisors, and many were able to quickly account for reports that were supposed to be written by officers.

At the same time, some officers we encountered had little trouble with the new technology. One officer we interviewed in Agency 1 had used the system before in a previous agency. Other officers stated that the new report system was being taught in the academy, and many new recruits were easily adapting. Still others within units had become specialists in using the technology, becoming the "go-to" people in helping others.

Perceptions of the efficiency of technology also varied across units. Crime analysts in both Agencies 1 and 2 saw many benefits to improvements in information technology and the use of crime analysis. One analyst in Agency 1 described the agency's transition to a new RMS as a "huge leap forward," and said that "data is more accurately and timely entered, and information is right at your fingertips." Analysts argued that the new system allowed them to "have real-time data" and that "transition to the new system has improved the integrity of their data" as well. An analyst and a commander in Agency 1 agreed that although some "bugs" existed, the new automated system "gave them more confidence in their numbers and statistics." Analysts also found the new system improved their efficiency a great deal, arguing that the analytic portion of the new system allowed for quick searches of data without having to enter programming language.

A number of detective units in Agency 2 felt that both crime analytic and information technologies were incredibly valuable to their work productivity. Analysts could help to find individuals, locate information, and help solve crimes more quickly. Detectives in Agency 1, while sympathetic to officers dealing with the new electronic reporting system, also were similar to those in Agency 2in that they found the new technology useful in finding individuals and conducting deeper investigations. One detective remarked that he “couldn’t care less” about the statistical or supervisory functions in the new RMS, but that the system helped them to “dig deeper into investigations.” At least two specialized units that the research team spent a great deal of time with (one in each agency) remarked extensively about the efficiencies gained by crime analytic, information, and sensory technologies.

However, patrol units in Agency 1 and 2 did not share the sentiments of their counterparts in investigations or specialized units about technological efficiencies, as already discussed. In Agency 2, for example, patrol officers did not have as strong of a bond with crime analysts as detectives did, and felt the analysts were responsible for them doing “whack-a-mole”[42] policing. Some gave the example of filling out required field interview reports. Officers noted that once the crime analysis unit came out with the hot spots, then officers had to go and conduct field interviews at that hot spot. Many resented this approach and felt that it was unproductive; some stated that they did not understand how this could reduce crime. It appeared that the wide variation in the use of crime analytic technologies (and personnel) for purposes of investigations versus patrol contributed to differences in perceptions about the usefulness in improving work productivity of each unit.

These findings from our interviews and focus groups echoed our findings in the individual-level surveys for Agency 1, but not for Agency 2. In Agency 1, differences across assignments and ranks differed in terms of the perceived productivity gains (or losses) of technology. For example, detective and other units significantly differed (55% and 57%, respectively) with patrol units (41%) in their agreement with the statement, “Overall the information technology helps me be productive in my daily work” (Figure 6-h). Second-line and above command staff (see Figure 6-i) also significantly differed with rank-and-file officers on this same statement (74% versus 42%, respectively), although first-line supervisors did not differ significantly from patrol (42% agreed with the statement).

[42] “Whack-a-mole” refers to a popular carnival game developed by Aaron Fetcher in the 1970s in which one tries to strike a toy mole that pops up from a hole before it quickly retreats into the hole. Colloquially, the term is used to describe a problem that occurs again and again, but disappears before it can be addressed (and it just pops up elsewhere). We will return to this discussion in Section 6.7.

Figure 6-h. Technology and efficiency across different assignments (% agree)

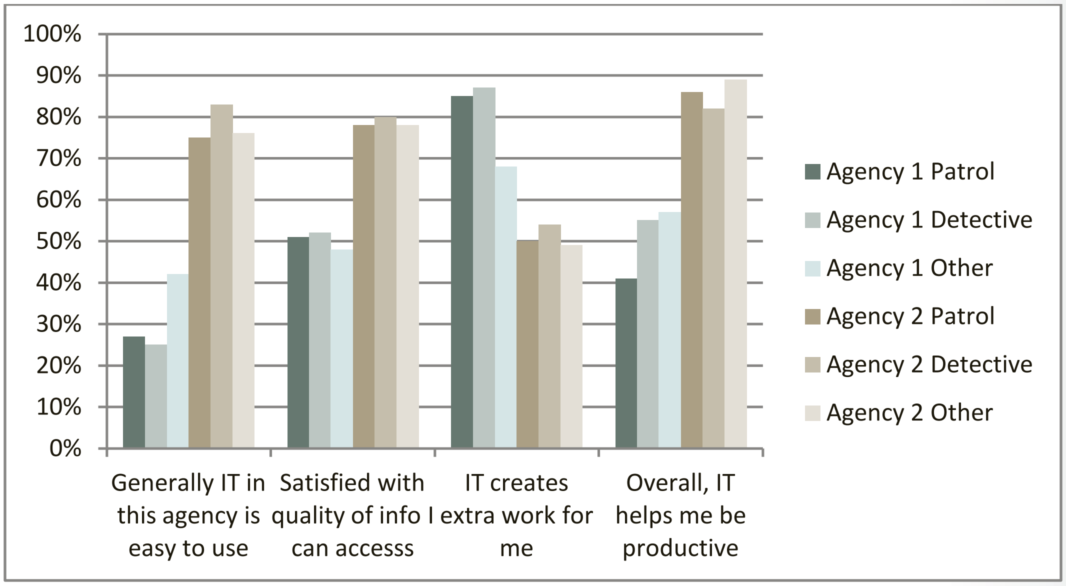
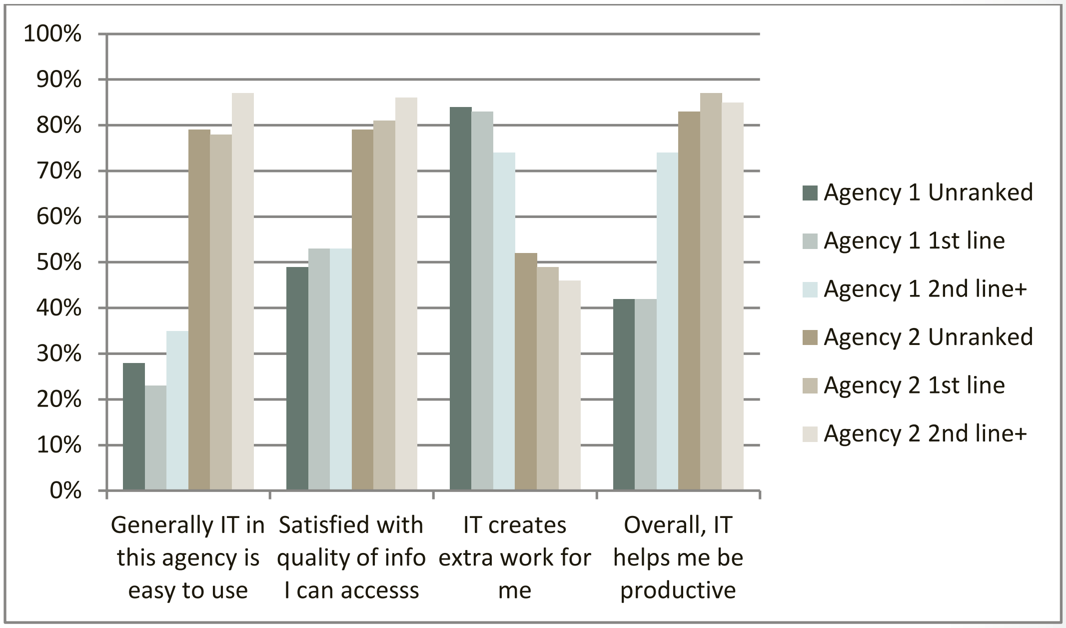


Figure 6-i. Technology and efficiency across different ranks (% agree)



(the "+" in "2nd line+" indicates 2nd line supervisors and above)

Agency 2, however, which had not recently undergone a major change in RMS or information technology, had much more similar levels of agreement across ranks and units. No rank or unit significantly differed with another in Agency 2 across almost all measures of efficiency in the survey,[43] suggesting agency-level differences in the perception of technology's contribution to overall work productivity.

Technology can improve efficiency, but only to a certain extent; human and other factors limit its potential.

One central theme throughout our interviews, in both positive and negative discussions of technology, was the acknowledgement that the impact of technology on improving the efficiency and work productivity of daily activities of law enforcement was limited by a number of human and other factors that were viewed as outside the realm of the abilities (and challenges) of the technology itself. As one officer stated, "It's only as good as how it is used." In other words, how people use technology and how it is possibly facilitated by other systems (technology or otherwise) in the organization are critical.

For example, crime analysts in Agency 1 and 2 both argued that even if the best crime analysis was generated, disseminating that information and getting officers to receive and use it to improve work productivity proved challenging. Dissemination of information in Agency 1, said one analyst, had not kept up with the times. Email, roll call boards, and roll call itself might be used. While there was an online system to disseminate information, only some officers had access. In Agency 2, where crime analysis was much more integrated into the organization, the understanding and dissemination of crime analytic products seemed to be concentrated at higher ranks or in detective and specialized units. This raises another interesting concern; technologies may be interdependent. Crime analysis might depend on dissemination technologies and interactions with other systems (such as mobile computer units).

Further, despite some unit hostility, many officers, detectives, supervisors, and commanders from both police agencies felt it would beneficial to have informational and technological links between datasets and units. Better connectivity and communication using technology could improve the productivity of all, but it was unclear how this might be achieved. This also extended to non-police data and information systems. Detectives from Agency 1 talked about how the county government might shut down computers at night to save energy, but that detectives would need access at all hours.

[43] Only for one question, "Generally, information technology in this agency is easy to use" did we see significantly more detectives (83%) agree with this statement than their patrol (75%) or "other" (76%) counterparts.

Those officers using LPR or other regional databases acknowledged that those information technologies were only as good as the information placed into them. Despite the great efficiencies that LPR provided, if stolen vehicles are not entered quickly enough into the database, or if more data about wanted individuals is not entered in ways that is useful, LPR will scan a stolen vehicle's license plate without alerting the officer (if the report has not yet been entered into LPR). One detective reflected on the fact that recently he had gotten a hit from a 2005 sex offense case due to DNA that was identified more recently. The data gotten from the sex offense kit wasn't completed and entered into the system until 2008. One officer in Agency 2 stated that "efficiency is largely driven by the information available," and that if good data are not entered, it is "garbage in-garbage out."

Finally, many officers and detectives we spoke with, including those very proficient in using technology, argued that efficient technologies were only part of the equation of good policing. As one senior official in Agency 1 put it, "This system was not going to butter your bread in the morning." In a conversation with a specialized unit about mobile computing technology, they spoke at length about how having a two-person car was essential to taking full advantage of mobile computer units (one person drives, the other focuses on running tags and using the technology).

Summary

Technology was seen by officers and commanders as having the potential to both increase efficiency as well as reduce it, and different ranks and units had different views about the extent to which technology could improve work productivity. Different types of technologies were also viewed differently. Technologies such as LPRs were considered very efficient, while technologies such as the new RMS implemented in Agency 1 was seen as less efficient. Nonetheless, officers and detectives seemed to emphasize that efficiency of technology also depended upon the systems and data that supported those technologies, as well as the humans operating them.

6.7 Impact of Technology on the Effectiveness in Reducing, Preventing, Detecting, and Deterring Crime

While technologies may improve the efficiency of law enforcement work or the speed with which officers react to crime, they may have little impact on police effectiveness in preventing, detecting, deterring, or reducing crime (Lum, 2010a). The effectiveness of policing technologies in helping police achieve these fundamental goals depends heavily on how they are perceived and then used. To determine how officers perceived the effectiveness of computerized records management systems, mobile computer units, crime analysis, and LPRs in reducing, preventing, and deterring crime, we asked employees from Agencies 1 and 2 whether these technologies were being used to improve effectiveness in these areas (distinguishing from efficiency) and whether they worked.

Four themes emerged in our discussions of the effectiveness of technology with law enforcement personnel from Agencies 1 and 2. First, the effectiveness of technology is most often measured in the same way police effectiveness more generally is measured, by the ability to identify people to solve cases and make arrests. Second, officers were much less likely to discuss the effectiveness of technology in terms of reducing and preventing crime (through more proactive policing measures). Third, some with whom we spoke were cynical about the impact of technology on effectiveness. And finally, others felt technology might *reduce* effectiveness.

The effectiveness of technology in policing was often associated with the ability to help quickly identify suspects, victims, witnesses, and other aspects of crimes to resolve cases.

This first theme is closely connected to our findings regarding the efficiency that technology brings to policing. Our conversations revealed that officers, detectives, supervisors, commanders, and civilians were more likely to speak about the efficiency of technologies rather than the impact that technology might have on crime control, reduction, or prevention effectiveness. Particularly, officers viewed technology as effective when it helped them solve crimes by quickly identifying suspects, victims, and witnesses, or linking different clues and pieces of evidence (e.g., a license plate, a partial description of a suspect, a tattoo, a phone number) to data sources to locate individuals involved in criminal cases.

This finding was aligned with the findings from the individual-level surveys of both agencies. When we asked officers of different ranks whether they agreed that "Information technology makes me more effective in identifying and locating suspects, wanted persons, and other persons of interest," we received the highest levels of agreement compared to all other questions about effectiveness of technology, with Agency 2 having stronger agreement than Agency 1. Across the different ranks who were surveyed, 94%, 92%, and 100% of rank and file, first-line supervisors, and second-line and higher command staff, respectively, in Agency 2 agreed with this question, compared to 78%, 76%, and 91% in Agency 1. Law enforcement personnel also tend to value technology when it can increase the speed with which officers respond to and address crimes already committed, rather than viewing the its effectiveness from a more proactive or problem-solving lens.

One detective in Agency 1 stated that he used information technology "multiple times a day and without it [he'd just] have a bunch of dead ends." He viewed efficiency and effectiveness as one and the same; it made him more effective because it improved the speed with which he could investigate and look up things, or build cases from partial information. Another detective from Agency 2 stated that crime analysts "saved him days of looking for stuff." Patrol officers in both Agency 1 and 2 also highlighted the investigative advantage of technology, discussing how technology could help them know ahead of time about situations they were about to enter, or help them search for information about suspected vehicles and drivers before engaging with them. Having this type of information in advance was not only viewed as beneficial to their safety and discretion, as discussed in other sections, but also contributed to their ability to "do good police work."

This emphasis on technology's effectiveness as measured by case closure and arrest was apparent when officers in both agencies spoke about the LInX information technology system.[44] LInX is a regional information sharing system available to law enforcement agencies that connects numerous databases across jurisdictions for ease in searching names and other identifying information across large regions. One detective in Agency 1 cited how databases such as LInX allowed investigators to easily search through large amounts of data to match pieces of evidence (such as a nickname or telephone number) to clear cases faster. Officers in Agency 1 pointed out how mobile computers allowed them to more fully investigate crimes, and help them find out more about suspects and victims to solve cases more quickly. When we asked them whether this actually occurred, the officers mentioned that this was something they just knew was happening from anecdotal information. One division commander cited the example of a date rape in which investigators only had a partial phone number to go on and LinX helped them track down a suspect. (Another officer mentioned doing a similar investigation just with a partial license plate).

[44] See http://www.ncis.navy.mil/PI/LEIE/Pages/default.aspx

Officers reflected about the effectiveness of LPR in the same way. Some of the same officers who spoke negatively about the new records management system, felt that LPR had "amazing potential" for law enforcement because it could detect stolen automobiles, thus resolving open criminal investigations or catching offenders in the act. Officers also noted that LPR could assist law in helping to identify suspects or wanted individuals by scanning vehicles possibly associated with those suspects or using LPRs to assist with crime scene processing for major crimes. One LPR officer stated that LPR technology "changes the set format of normal police responses to incidents," remarking how supervisors are now asking for LPR to help investigate major crimes. Past practices of writing down tags of every car near a crime scene have been replaced by a quick sweep by LPR of cars in the area.

This emphasis on effectiveness as measured by case closure and arrest prompted an investigative commander in Agency 2 to discuss how the automation of investigative reporting and case folders was yet another way technology could assist detectives in being more effective. He commented that automated case management systems could help to connect cases, people, and investigations to find individuals and solve cases more quickly. Another older detective supervisor described when he started and now as "two different worlds" regarding information discovered by detectives, use of analysis, and collaboration. He said that in the past, "there was lots of data that was kept close, especially with Narcotics. Detective culture is about holding information close. However, leadership has changed this information exchange, as has crime analysis." He now sees more connectivity between units, in that different units can see each other's data as well as follow up on leads immediately, which can lead to case closures. He also argued that the exchange of information is facilitated by crime analysis.

Crime analysts from both agencies asserted that information technologies could assist with increasing the numbers of case closures. However, they were more cautious in making a causal connection between the use of these technologies and actual case clearance rates and trends. As with officers, analysts shared anecdotal stories about the use of technology to quickly clear crimes and find suspects. However, they also viewed any overall increase in case closures over time as the result of many factors, not just the use of technology.

While technology was sometimes seen as contributing to crime prevention and reduction by its ability to identify trends and patterns for targeted deployment, officers were much less likely to discuss the effectiveness of technology in this way.

Crime analytic, information-sharing, and records management technology have been used by some agencies to develop strategies to proactively target patrol and investigative activities to reduce and prevent crime. Hot spots policing, for example, utilizes crime analysis and information technologies to identify concentrations of crime and to direct patrol. Repeat offender units might identify the "top 100" offenders on probation or parole and keep track of these individuals or assist probation and parole with supervision efforts. Data collected from LPR units might be used to better understand traffic patterns and movement. Despite these innovations in the field, officers, detectives, and commanders that the research team interviewed were much less likely to discuss the effectiveness of technology in reducing and preventing crime through these types of uses. However, some did discuss how technology contributed to crime reduction strategies in patrol, although most of these individuals were high-level commanders or civilian crime analysts.

Some high-level commanders we spoke to recognized the value of crime analysis technologies in identifying crime patterns and series for purposes of strategic planning. One commander in Agency 2 gave an example of traffic accidents and offenses in his jurisdiction. He remarked that officers were initially working shifts starting at 7 a.m. and ending at 2 p.m. However, crime analysis found that accidents and fatalities were concentrated between the hours of 4 p.m. and 7 p.m. This commanding officer used that information to adjust the shift of traffic officers to better align with the time trend of accidents and fatalities, and believes that the decline in traffic crashes and fatalities after this change was due to this application of analysis.

Another commander in Agency 1 mentioned that the new RMS could allow the agency to more quickly respond to emerging patterns and problems, a view echoed by some in Agency 2. One Agency 2 detective described how some years ago, they had missed a pattern of robberies that would not be missed now with crime analytic technologies able to quickly see patterns as they arise. Another commander in Agency 1 suggested that having a better IT system could more accurately decipher crime trends and data, especially for command meetings. When interviewing an officer working within a jail setting, that officer suggested that information technologies and crime analysis helped them proactively anticipate problems and prevent crimes inside of the jails.

Officers of a specialized unit within Agency 2, who directly and consistently interacted with the crime analysis unit, found crime analysis technology to be absolutely valuable to their work. However, they were also trained in problem solving and viewed policing differently than other officers in their agency. Their training and regular interaction with crime analytic technologies seemed directly connected to their positive view and comprehensive understanding about how information technologies and crime analysis could assist them in preventing and reducing crime as well as resolving underlying problems and environmental factors contributing to crime. One officer stated that "[using crime analysis to solve problems] is really the way of the future. It is not about getting more people or resources, but we have to be smarter and use what we have in a more intelligent way."

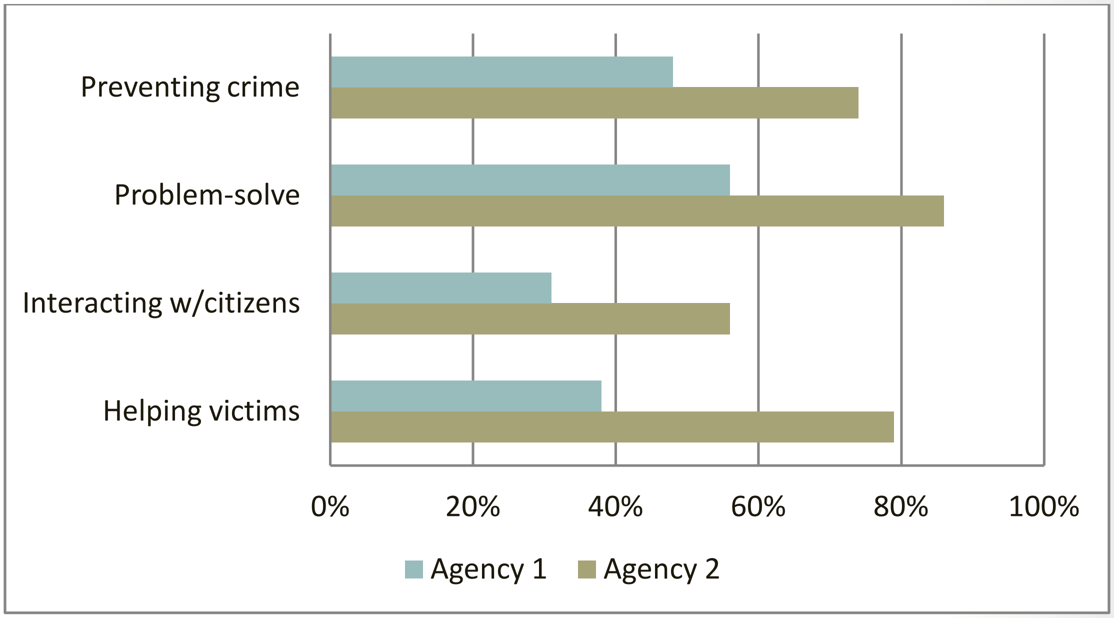
However, it was also evident that LPR and other information technologies were not necessarily used strategically in ways that might make the police more effective. In Agency 1, for example, the assignment of LPR was highly discretionary and officers were not necessarily deployed to specific "hot streets" of stolen automobiles. Further, the use of LInX was also highly variable across officers, depending on their access to the technology and their knowledge on how to use it (and what it could be used for). There are few impact evaluations to guide police strategic thinking in this area. Only two studies exist on the effectiveness of LPR at hot spots of crime (see Koper et al., 2013; Lum et al., 2011; Taylor et al., 2012); they show either little to no impact on crime reduction, prevention, or deterrence. There has not been an evaluation on the impact of LInX or LPR technology on crime detection, reduction, or deterrence.[45] One patrol commander in Agency 2 also suggested the need for information sharing to be improved between shifts, which he currently felt "worked as two separate departments." Analysts in Agency 2 listed a number of requests they have received from detectives, including requests to search for vehicles, names, criminal histories, witnesses, arrest information, or partial descriptors (scars, nick names, tattoos, family connections) to help solve cases. However, they acknowledged that it is less often the case that they are asked about trends, patterns, and how to use analysis proactively (to prevent crime).

Thus, despite some optimism, it was clear that officers, detectives, and commanders were much less likely to view technology as effective in terms of its

[45] The principal Investigators are now conducting a study evaluating the investigative and patrol effectiveness of LPR on case closure and problem solving under a National Institute of Justice Grant, 2013-IJ-CX-0017.

ability to prevent and reduce crime (as opposed to clear cases or investigate crime). In some interviews, the issue of this type of effectiveness was not even raised by officers. There were some agency-level differences that appeared in the survey among officers, however, that were not as prominent in the interviews. For example, as Figure 6-j indicates, patrol officers in Agency 2 were more likely to agree or strongly agree that technology improved their effectiveness.

Figure 6-j. Percentage of officers who agreed or strongly agreed that technology could help them with proactive or community-oriented tasks



It was also evident that higher ranked commanders were more likely to have this view of technology and its effectiveness than lower ranked officers. This was consistent with our survey findings in both agencies. When personnel were asked whether "Information technologies and crime analysis help me understand and respond effectively to crime problems," second-line supervisors and above significantly differed from rank and file officers in both agencies (with higher levels of agreement about this statement).[46]

[46] In Agency 1, agreement scores for rank and file, first-line supervisors and second-line and above commanders were 2.60, 2.65 and 2.98, respectively, with significant differences between second-line and above commanders and rank and file. In Agency 1, agreement scores for rank and file, first-line supervisors and second-line and above commanders were 2.98, 2.97 and 3.33, respectively, also with significant differences between second-line and above commanders and rank and file.

Some were less optimistic about technology making law enforcement more effective in preventing, reducing, or controlling crime.

While at the command level in both agencies there was a much better understanding of how crime analytic and information technologies could help agencies identify places and people for purposes of proactive problem solving or crime prevention, some also expressed skepticism. When the team asked one commander how optimistic he was about officers on the street understanding the value of crime analysis for crime prevention and using it towards those goals, he stated that “the number one barrier to this approach were people’s attitudes, especially those who fight the system or think that [the new records management system] is garbage.” The same high-level official was unsure whether information technologies were actually connected with crime reduction or case clearances. Officers, analysts, and detectives were also reluctant to directly link crime reductions with the technology.

Some of the same officers who praised LPRs for being extremely effective questioned their effectiveness after discovering how much each LPR unit cost. They acknowledged that the “hits” (i.e., positive identification, arrest of suspect, etc.) with LPR and also LInX were rare, and they were uncertain whether getting those hits translated into effectiveness or cost-effectiveness. One officer in Agency 1 replied that he might only get one hit every three months or so using LPR. Another, when asked about its effectiveness, stated: “It is more effective in that you can run more stuff.” But in the same group, when we ask if LPRs were worth the cost ($20,000 – $25,000 apiece), we heard: “If you link it to DMV [motor vehicle records] and to NCIC [criminal history records] then it might be worth twenty-five thousand. Right now, I get like one good hit like every three months.” Yet another officer stated that he “drives all the time with it, and in the last two months got one hit—one legit stolen vehicle.” He continued: “My point is that it can only access stolen tags. For twenty-five grand, the thing’s trash.” However, he also added “if we could get information on warrants, suspended drivers, sex offenders, stolen tags … we could get many more arrests for people that were wanted.” Officers, therefore, were not only concerned with more quickly solving crimes, but also with the cost-effectiveness of technology in helping them to do so.

Another officer remarked that “[technology] does not change individual capabilities or my job, which is to be a problem solver and to give aid and render care.” The same officer also suggested that technology “might take away from these things, because when you give officers more and more responsibility… some are unable to keep up." An officer in Agency 2 said, "There is no substitute to good police work and a certain amount of being in the right place at the right time." Some officers argued that certain gains in efficiency may result in loss of other skills of officers. Other detectives from Agency 2 who felt crime analytic technologies and personnel were very valuable to them indicated that traditional detective work (and detectives) was still needed to solve cases. One detective in Agency 2 stated that "although analysts could do some things, you still needed detectives to make the connection of the abstract pieces of information [in an investigation]."

With regard to crime analytic technology, patrol officers in Agency 2 pointed out that sometimes crime analysis forced them to "fight dots with dots" or engage, as mentioned in Section 6.6-, in "whack-a-mole" policing. They gave the example of field interview reports. Officers say that once hot spots are established through crime analysis, they are required to go to the hot spots and conduct field interview reports, with little understanding as to why. One officer stated, "Crime analysis just tells us what we already know." Another stated, "We know where crimes are—don't need a computer to tell us or Compstat meetings to tell us where they are." Another detective stated, "You can tell at the beginning whether a case can be solved—do you have witnesses, DNA, etc.? Solving cases depends on the crime" (as opposed to technology or crime analysis).

One patrol officer in Agency 2 said that using crime analysis to guide their patrol efforts "wasn't worth the effort," but also acknowledged that they don't know the results of their efforts, nor do they get feedback. One example given was the use of truancy crackdowns in places with high residential burglary. One officer said that he did not understand why this would be effective. Some first- and second-line supervisors from Agency 2 also questioned the effectiveness of using crime analysis, as they felt that hot spots would only temporarily disappear but would pop back up once enforcement abated. One new officer we interviewed simply stated that he was most concerned with addressing his calls for service, not with technology in the agency and how it could assist him.

Officers in both agencies also recognized the limitations of technology in achieving law enforcement goals. A detective from Agency 1 remarked that the data could only contribute to improving investigative effectiveness if the data entered were reliable and not missing. He remarked that "supervisors are just looking at reports to see that they meet requirements for approval. They are not looking to see if there are phone numbers put in there; not looking to the quality of the narratives … if computers say it is good, it must be good. For us we have to contact victims all of the time—like your car has been recovered and [information technology systems] helps out to reach out to them." Another patrol officer in Agency 1 stated that "[LPR] is only as good as what other officers have put in."

Finally, some argued that technology might reduce their effectiveness.

Some officers associated technology with increasing officer distraction, reducing officer situational awareness, or reducing the amount of time doing "real police work." While these issues were covered in Section 6.5, this finding is worth noting here. Officers interpret "effectiveness" not in reference to their agency or even their district's effectiveness in reducing crime, but in their individual effectiveness in carrying out their duties as defined by their general orders and their perception of their roles as officers. For example, officers often remarked that the time working on technology takes them away from doing other things. An officer in Agency 1 stated that he used to be able to do 10 tickets in the same time it now takes him to do seven.

Officers also suggested that technology (especially mobile computing technology and remote reporting) could reduce situational awareness and alertness, which might also reduce their effectiveness. One officer remarked that "ever since I have been on, you learned your area, you knew roads, road names, etc. Now we have GPS in the car. Before you had to be more aware of exactly where you are. Now, I think that officers have to almost force themselves to have to think 'this computer is not here.'" Another officer stated that "officer safety issues with so much technology is bad" and that it "reduces situational awareness." He remarked that he has had "people sneak up on me while I'm typing." The impact of report writing technology on situational awareness could be even more acute if systems were not user friendly or the implementation of that system comes with new and unfamiliar reporting requirements. Other officers mentioned allocating a block of time just to write reports back at the station house in order to manage the new information management system and write reports in a safe environment. This suggests that the assumption that remote automated reporting may keep officers in the field longer and increase their visibility may not be accurate.

Summary

Overall, our interviews reveal a disconnect between technology and effectiveness of crime prevention and reduction. Instead, effectiveness is associated with efficiency and effectiveness related to case closure. The value placed on technology in terms of speedy case closure and successful arrest of individuals emphasizes the lens through which law enforcement agents view "effectiveness." Although numerous innovations in policing have tried to move police towards valuing outcomes such as crime prevention and reduction (i.e., community-oriented, problem-solving, intelligence-led, predictive, or evidence-based policing), this interpretation of effectiveness as measured by case closure and arrest is still strongly evident.

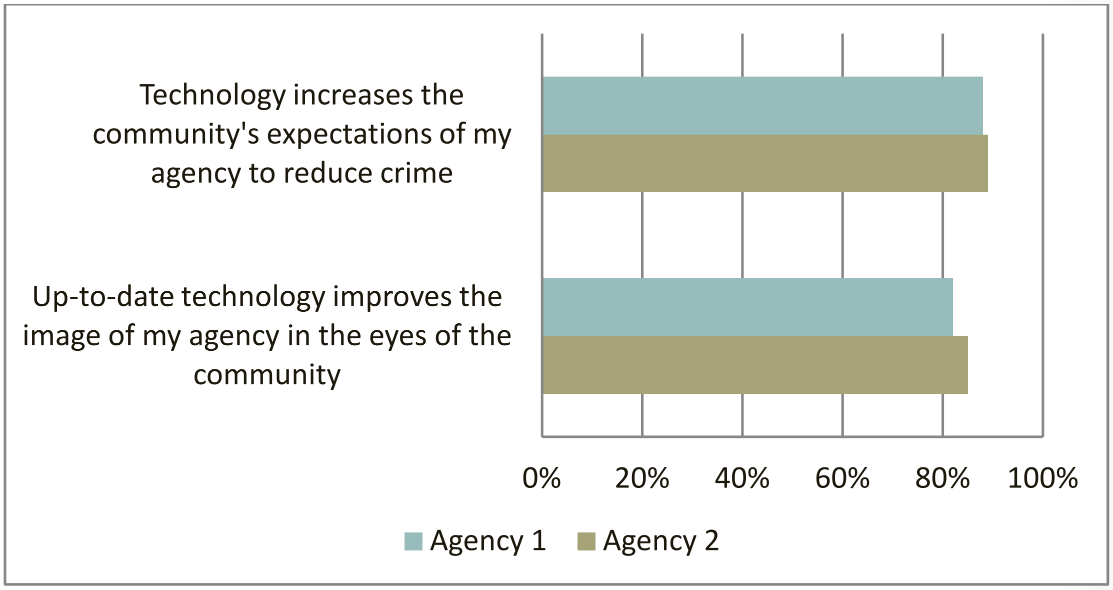
In order for agencies to associate effectiveness with crime prevention and reduction and with citizen satisfaction (as opposed to arrest or efficiency), greater emphasis by the agency in training and organizational norms has to be placed on these performance measures as well as changing deployment practices. This was emphasized by Chan et al. (2001) in their study:

> If police agencies are to get a better return on their investment in IT, there needs to be a conscious and sustained effort to change the organisational settings into which that technology is being introduced. Effective implementation of intelligence-driven patrolling, for example, requires not only information systems that can provide data on hot spots and hot times, but also analysts capable of interpreting this information and, most importantly, work allocation systems that will deploy patrols accordingly. (Chan et al., 2001: p. 116)

6.8 Impact of Technology on Police-Citizen Communication and Police Legitimacy

To this point, much of this report has focused on technology's implications *internally* on police organizations and their employees, but technology can also influence police-community relations and perceptions of police legitimacy—that is the police agency's relationship with its *external* constituents. As Peter Manning notes, "the technology of an organization speaks to the socially constructed environment, the *external realities* in which the organization operates" (Manning 2013,). This function of technology was acknowledged by respondents to our survey in both agencies, particularly higher ranking officers (second-line officers and above), who could expect to be held accountable for their agency's standing within the broader community (see Figure 6-k). A very high proportion of these officers acknowledged that technology both increased public expectations about an agency's crime-fighting capacity and that the implementation of the latest technology contributed to a favorable police image.

Figure 6-k. Percentage of second-line officers and above who agreed or strongly agreed that technology has an impact on community expectations and agency image



Technology's benefits to the image of the police can be realized in a number of different ways. For example, technology can be used to communicate information to the public about what the department is doing, including how well it is accomplishing its mission. Technology, such as a tip line, can also be used by community members to provide departments with input in the form of crime information or expressions of broader needs or priorities. Moreover, when it comes to strengthening or weakening legitimacy or public support for the police, technologies can play a key role (Neyroud and Disley 2008). For example, should a department use its license plate recognition technology in ways that are deemed inappropriate by its constituents (such as checking passing vehicles for outstanding parking tickets or fines), then it might risk losing some public support (Merola, Lum, Cave, and Hibdon, forthcoming).

Since we only had limited opportunities to observe police interactions with the public and did not interview local residents about their views of the police, our analysis of this aspect of police technology is based solely on interviews with officers and civilians within each agency and their general impressions of technology's impact on the public. As a consequence, our findings are more tentative than those on the other nine themes in our study. In the course of our interviews, we asked respondents how the information, analytic, and surveillance technologies in their agencies, and technology in general, influenced police-community relations both in terms of public perceptions and the nature of police-citizen interactions.

Based on what we heard and observed, a key theme in each agency, though particularly in Agency 1, was that the departments focused more attention on technology's potential for shaping internal structures and operations than on its potential impacts on external constituents. This is not to suggest that the public response to technology was viewed as unimportant but that this did not amount to a pressing issue. This assessment was illustrated by some respondents indicating their intention to try and use technology in the future (rather than immediately) to do more to enhance police-community relations, the absence of any kind of systematic approach to publicizing how and why new technologies were being used in certain ways in the course of the agency's daily work, and by the generally ad hoc nature of officers' responses to citizens' inquiries about some of their agency's technological capabilities. Several more specific themes are discussed below.

Technology was used for developing police-citizen relations, but this domain of technology use was underdeveloped.

Just as information and analytic technologies can provide useful knowledge to those working within police organizations, they can do the same for local residents and key stakeholders in the community. In addition to the possible crime prevention benefits of sharing crime-related information with the public (e.g., crime suspects wanted by the police), making this and other information readily available can also be regarded as providing good service to an agency's "consumers" (Chan et al., 2001: 65). One of the clearest examples of using technology within the context of police-community relations was giving members of the public access to crime maps and statistics. In this regard Agency 2 was more advanced than Agency 1. Not only was its website technology more sophisticated and user friendly, but those we spoke to were more likely to mention this feature of how the department used its technology to communicate with its publics than those in Agency 1. In Agency 2, community members could go to a website and enter search criteria in order to see crime locations in their neighborhood, and the department made concerted attempts to make the public aware of this capability. A similar service was available in Agency 1, but the website was more cumbersome and difficult to navigate and was rarely referenced by those with whom we spoke.

A high-ranking officer in Agency 2 told us how the department used online crime mapping, offender watch, and social media to try to connect the agency with its communities. He also told us that crime analysis and data were shared regularly at monthly community meetings attended by the various assistant chiefs. Another respondent in Agency 2 explained how the department had sought to increase data flow to its citizens by working with a vendor to provide an online mapping tool. To support this venture, the crime analysis unit had trained patrol officers on how to brief people in the field using their mobile computer terminals so they could show citizens how to access the agency's online mapping technology on their own. Making this crime mapping feature available to the public was also impressed upon sergeants. In one of our focus groups, a sergeant mentioned that at the community meeting he was attending that night, he was supposed to tell people about the mapping program. He added emphatically that people "use it," and that those residents attending the meeting fully expected him "to show them the dots."

In contrast, Agency 1's Chief acknowledged that new technologies, such as the RMS, could be used to help build community-oriented policing, but in this regard the department could be doing better. Indeed, on our survey, only 22% of supervisors and commanders reported using IT and crime analysis to share information with community leaders or business owners "often" (17%) or "very often" (5%).[47] Similarly a civilian very familiar with crime analysis and information technology in the department said that he hoped to use the RMS to produce "more public products" drawn directly from this data. This suggests that the department could be doing more to use its technology to enhance police-community relations. Respondents in Agency 1 also seemed to feel that how crime information was presented to community members depended largely on the style of the individual officer. So, for example, in one focus group we heard that different commanders had different strategies for how they used technology in relation to the public.

In Agency 2, the potential for using technology to enhance police community relations was also mentioned as part of some high ranking respondents' vision for future reforms. One upper-level manager who wanted to implement a more sophisticated automated case file system for detectives noted that an additional benefit to efficiency would be customer service. This respondent's vision was for an automated case file system that would be designed to help detectives access case information more readily and thus improve their ability to respond more quickly to

[47] The corresponding figures for Agency 2 were about twice as high (26% reported "often" and 15% "very often").

follow-up inquiries from victims. It would also help ensure that any detective, not just the one assigned to the case, could give a victim feedback on their case, presumably reducing delays should the assigned detective not be available. Another respondent said he would like to see all patrol officers make their email addresses available to the public. This would include setting an "out-of-office" reply on their days off, which would help prevent calls or issues with the community "falling through the cracks." He gave the example of a robbery, where the citizen could email the officer with a list of stolen items and their serial numbers. Should the citizen forget an item, he or she could go back to his original, which would be on record. He said he experienced some resistance to this idea but was unsympathetic. His response was, "You work 11.42 hours, you have time to check email."

There are diverse opinions on whether technology improves or undermines police-community interactions.

We asked respondents how they felt technology affected their actual interactions with community members, if at all. Here, there was a fair amount of disagreement in both agencies, a finding that was also captured in our survey. In Agency 1, frustrations with the new RMS shaped some of the comments we heard, particularly from those working the street. For some, the fact that data entry was so time consuming and tedious meant that it reduced the amount of time available for meaningful face-to-face interactions with members of the public. Other officers in Agency 1 felt that the new RMS improved their interactions, as they had access to information that they could now provide to people who requested it. For instance, in one of our focus groups with patrol officers, we heard, "Now you have a computer … everything is there … now when someone asks you a question, you can go in there, look at it, and give them a proper answer." Despite this particular patrol officer's more positive assessment of technology's effect on police-citizen interactions, the high level of frustration with the new RMS in Agency 1 helps explain why line officers were generally negative about this aspect of technology, and more so than line officers in Agency 2. In our survey, only 34% of line-level officers in Agency 1 (and 30% of first-line officers) agreed or strongly agreed that "Information technologies improve the way I interact and communicate with citizens." In comparison, second-line officers and above who were not the RMS' primary users were much more positive, with 65% agreeing or strongly agreeing with this statement (a finding that was statistically significant). Line-level officers in Agency 2 were also more positive about this aspect of technology than line officers in Agency 1 (54% agreeing or strongly agreeing), namely, that it gave officers better and more accurate information to share with members of the public (as we heard in one of our focus groups). But even without the problems of a new RMS, they did not assign a great deal of value to technology's capacity to improve police-citizen interactions (the average level of agreement for this group on the 4-point scale[48] was 2.58). We also heard that technology, such as crime analysis, could be used to "break the ice" with community members to open up discussions about specific crime patterns or problems.

Notwithstanding some of the positive comments about technology providing patrol officers with the ability to easily share more accurate information with members of the public, some expressed concern that there was now a generation of officers within the department that was so driven by technology that the officers had "fewer social skills" (a statement we heard from a focus group of commanders in Agency 2). A similar concern was voiced by a patrol officer in Agency 1, who said that data entry "definitely takes longer" and that officers could be so distracted by their cell phones and MDTs that they did not get "enough human interaction." He added that this was detrimental to good police work, as you "learn a lot about yourself" when you had to deal with difficult or stressful situations that "give you a lump in your throat" (such as chases or fights). He concluded, "Just being proficient with a computer does not prepare you for the nitty-gritty part of the job." As others have observed, how much IT has supplanted the traditional ways of officers interacting with people on their beats to glean information has not been systematically studied. Future studies might want to explore the "extent to which street-level officers, like the general public, are investing more and more time in their computer screens and less in face-to-face contact with people" and whether this affects the quality of police-community encounters (Mastrofski and Willis, 2010: 89). Our fieldwork suggests this is an important issue over which, if these two sites are any indication, there is considerable disagreement.

There was uncertainty and concern about the impact of technology on police legitimacy and public support of the police, particularly in regard to surveillance technologies like LPR.

Finally, we were interested in police officers' perceptions of how they thought the community viewed technology in their agencies. Unsurprisingly given the potential for LPR technology to record and store vast amounts of information on vehicle use by people who have not committed crimes, much of what we heard in Agency 1 about the potential reaction of the public to uses of technology focused on

[48] 1 = strongly disagree, 2 = disagree, 3 = agree, 4 = strongly agree

LPR specifically. In Agency 2, we heard more about how technology could generate unrealistic expectations about what the police could accomplish, particularly in regard to DNA analysis.

Concerns over LPR and privacy were the basis of Agency 1's efforts to construct a comprehensive policy on how information on vehicles was to be collected, stored, and used. In comparison, significantly less attention was given to how officers should address inquiries about how LPR units were being used in the field. In fact, we heard that there was not a consistent policy on this, nor had Agency 1 provided press releases on LPR (or the RMS, for that matter). As a consequence, it was up to individual patrol officers to figure out how best to respond to citizens' questions and concerns when in the field, and there did seem to be some general uneasiness among those familiar with LPR regarding how to do this. One respondent, for example, told us that Agency 1's perceptions of the community's reaction to LPR use, reinforced through "some media outlets" portraying LPR as "Big Brother" watching, had largely limited its use within Agency 1 to stolen vehicles and AMBER Alerts.[49]

Concern for this kind of public reaction to LPR use can help explain why some patrol officers assigned to LPR units responded to citizen inquires about the cameras on their car with an ad hoc mixture of humor and caution. They said their LPRs were objects of curiosity, and they were often asked about them while they were out on patrol. One LPR officer said he told children who asked that his LPR camera took pictures of them, and if they were bad kids he had "their picture" and could "find them." Another LPR officer said jokingly to those who asked that it was "face recognition software." Other officers did more to anticipate adverse reactions by addressing questions about "Big Brother" directly. One officer said he told people "exactly" what it was and that it merely automated tasks that officers have always done, such as recording and checking license plates. Another LPR officer told us that he reminds people who ask about this technology on his cruiser that a lot of people are already collecting their data. In addition to letting people know that the gathering of information with an LPR was consistent with technology more generally, he would also "sell" the benefits of the LPR to them by underscoring its crime-related and citizen-service functions: "It is looking for AMBER Alerts; it is looking for people who are wanted and associated with vehicles and stuff." He

[49] According to the Office of Justice Programs, the AMBER Alert program is "a voluntary partnership between law-enforcement agencies, broadcasters, transportation agencies, and the wireless industry, to activate an urgent bulletin in the most serious child-abduction cases." See http://www.amberalert.gov/.

added, "I don't get in the weeds and tell 'em, 'We can mine this data; we can find out who's doing what,'" before concluding, "It is basically how you present it to people." Others in the LPR group generally agreed with one of their member's statements that saying "I am searching for stolen vehicles" is a good way to satisfy people who are curious about LPR.

LPR technology's relationship to citizen's concerns about privacy also arose in our focus groups with detectives. Part of the discussion here moved toward what kinds of data can or cannot be linked with other information by detectives in the course of their daily work. One detective noted that it was permissible to scan a license plate, but "soon as a tag is tied to a person, you have now created a government record for no reason at all" [i.e., no crime had been committed]. His comments suggested that he was very sensitive to the legal and moral implications of linking surveillance technology and electronic databases to create a detailed profile of a person, including any criminal violations they might have. We also heard from a middle manager who told us that at one of the monthly community advisory board meetings he regularly attended, one attendee expressed privacy concerns and was resistant to LPR use. To put the member's mind at ease, he told him that they were not collecting anything and that they let the stolen vehicle "hot sheet" dictate how the LPR was used. Since this time he said he has not received any more "negative feedback."

Since Agency 2 did not have LPR, we heard much less about privacy issues. Instead we heard about the "CSI effect," or the unrealistic expectations that technology could create in the minds of the public. Some of the detectives told us that people thought they could lift fingerprints off almost any kind of material and that they could be easily traced. One went so far as to mention that she will actually demonstrate to a citizen how difficult it is to retrieve a usable thumb print by pushing her thumb down on a car hood, covering it with powder, and then showing that it left no print. Patrol officers also talked about this aspect of forensic technology. They told us that community members expected them to be able to get fingerprints and biological evidence "off almost everything." Whether or not this is a trend that is affecting the way the public conceives of police performance and decision making is an important topic for future exploration. While we heard about this link between technology and increased public expectations for reducing crime from various ranks and assignments in the department, our survey revealed that higher ranking officers (second line and above) were particularly likely to think of technology in these terms. In Agency 1, for example, 88% of second-line officers and above agreed or strongly agreed that technology increased public expectations compared to 75% of line officers (a difference that was statistically significant). The corresponding numbers in Agency 2, although not significant, were similar: 89% versus 83%, respectively.

Summary

In sum, there was broad agreement at the sites we visited that information and analytic technologies were useful tools for sharing crime data with the public and enhancing the ability of police to respond to citizens' requests for information and assistance both in terms of speed and accuracy. Consequently, both sites used technology, particularly the web, to communicate with their outside constituents. At the same time, there was less consensus on whether technology improved or undermined interactions with the public in the field. Some command staff and officers felt that technology reduced opportunities for valuable "face time" with local residents and hindered the development of important social and craft skills, while others felt this was contingent upon the personal qualities of individual officers. As for legitimacy, very few respondents mentioned that their department made concerted efforts to publicize the use of cutting-edge technologies to fight crime and enhance their agency's status in the eyes of the public. Even in Agency 2, which had made significant efforts to make its constituents aware of its community crime mapping tool, we did not hear that increasing public support through this technology was a key goal. What seemed more important was meeting increasingly tech-savvy citizens' demands for access to information and doing so efficiently. When there was some risk that technology could harm legitimacy, such as by raising privacy concerns, there was understandable caution about how the technology should be presented to outsiders. As information, analytic, and surveillance technologies continue to develop as important features of police work, our fieldwork suggests that they will reveal a rich set of research opportunities for examining their effects on police-citizen interactions, police-community relations, and police legitimacy.

6.9 Impact of Technology on Job Satisfaction

Finally, we considered how technology impacts officers' job satisfaction. This measure can overlap with both efficiency and effectiveness in that technology might improve job satisfaction to the extent that it makes police personnel more productive and effective. However, we also focused on whether technology contributes to other aspects of job satisfaction. For example, does it enable them to be more creative and innovative in their work? Do they enjoy their job more when new technology is introduced? Or, in contrast, does it reduce officers' job satisfaction, perhaps by creating new demands, taking time away from tasks they enjoy, creating stress, and/or reducing their sense of autonomy and discretion?

Again, as with the other ways technology might impact policing, we discovered a number of contradictions from our discussions with officers regarding a relationship between job satisfaction and technology. Despite major complaints about their jobs, many officers wanted to be satisfied with their profession and enjoy being law enforcement officers. Consistent with other findings, we found officers were most satisfied with technology when it made their jobs more rewarding, which they interpreted as "catching the bad guys." They also seemed more satisfied when technologies helped to increase their efficiency, gave them new skills, or improved their safety. Further, officers were more likely to associate job dissatisfaction in reference to aspects of their organizations, not technology *per se*.

Technology can make officers' and supervisors' jobs more rewarding, especially when it was associated with "catching the bad guys."

Law enforcement officers from both agencies clearly felt their job satisfaction increased when they solved crimes or arrested suspects. Thus, when technology assisted with this process, it was viewed as rewarding. For example, when speaking to officers using LPR technology in Agency 1, they felt satisfied when LPR found a "hit" (the system detected a stolen or wanted license plate or vehicle). "Recovering a stolen car can often get officers excited about the technology and makes them want to use it," one officer stated, although he also recognized that the novelty of the LPR technology could wane. Another officer in Agency 1 said that it allowed them to have access to real-time information, especially about the history of an individual that they have stopped. He stated "It makes our job easier— before you would have never had that kind of information. Now you can ask, 'you have been warned before, what are you doing here again?'" Agency 2 patrol officers agreed, stating that "what gives them satisfaction is catching the bad guys. Technology helps to find bad guys sometimes, and computers are faster."

The connection between job satisfaction and apprehending offenders continues to indicate that police agencies value arrest and apprehension over prevention or crime reduction. Indeed, technologies more likely to be useful to prevention and crime reduction (analytic and records management technologies) that were not directly linked with apprehending offenders were not as quickly associated with job satisfaction (even though these might play important roles in apprehending offenders). For instance, some officers in Agency 2, which had a highly developed crime analytic unit, argued that they were not sure how analysis technology improved their job satisfaction. Some officers the team spoke to did not regularly engage with the crime analysis unit, and others felt the analysts just gave them dots to “put cops on dots.”

On the other hand, detective units in both agencies clearly seemed to connect their satisfaction with their job with crime analytic and other information technologies. Being able to find suspects faster, search for partial and incomplete pieces of information more successfully, or close cases more quickly were viewed as positive outcomes of technological advances. This qualitative finding was aligned with our survey results. Detectives in both agencies significantly differed from patrol officers with regard to disagreeing that information technologies take them away from aspects of policing they enjoy. The differences between perceptions of job satisfaction and technology between detectives and officers was especially notable in Agency 1, where a greater percentage of detectives were more likely to say that “technology makes their work interesting” or “enhances their job satisfaction.” In comparison, however, Agency 2 had much stronger levels of agreement about these items, and no significant differences across ranks or units.

Technology can also improve job satisfaction if it increases efficiency, stimulates officers’ learning and advancement, or is seen as improving officer safety.

As discussed in the section on efficiency (section 6.6), officers valued technology for efficiency (much more so rather than effectiveness), and many linked that efficiency to job satisfaction. One officer in Agency 2 stated that technology had greatly improved information dissemination in the agency and reduced duplication of efforts and reports. He is now aware of activity that occurs on other shifts, which he finds useful. Another patrol officer in Agency 2 (and other officers in the focus group) concurred, saying that the ability to cross-reference information has a big impact on policing. “When you have a suspect in the back of the car who gives a false name,” he stated, “we can look him up to see if the picture from [the RMS] matches the person.”

Officers in Agency 2 were comfortable with using certain information technology systems, and felt technologies did enhance their work, improve officer safety, and help identify people. Officers from this agency were not negative about technology, stating that they “want to work smarter.” or that “technology makes the job easier.” Some officers in both agencies suggested that people who resisted learning about technology were “slackers” or “didn’t want to learn.” Some officers even felt dependent on technology and felt things go into chaos when technology goes down.

A few officers associated job satisfaction with technology in terms of technology providing them with the opportunity to learn and develop new skills and knowledge. One officer stated that her job satisfaction has improved with technologies because every time she learns something new, she “has another tool to address crime issues.” A number of officers talked about the need to improve training and access to different systems, as well as making it easier to log into different systems (suggesting their willingness to use technology if taught).

When speaking to a specialized unit in Agency 2 that uses products of crime analysis technologies, the research team found a noticeable level of satisfaction with being officers in this unit. Many spoke of initially not wanting to be a part of a problem-solving unit, or had a hard time at first not focusing on arresting people. However, most (if not all) spoke positively about learning how to prevent crime and problem solve using crime analytic tools, rather than just reacting to crime and arresting individuals.

Technology also was associated with job satisfaction if it was seen as improving officer safety. However, there were conflicting views when discussing officer safety and technology. For example, one officer in Agency 1 remarked how mobile computer units reduce radio traffic, which can improve officer safety because it keeps the radio frequency clear for other officers who may need assistance. Others implied safety benefits when discussing how information technologies could help them anticipate the risk they might encounter before responding to a call for service or stopping a vehicle. At the same time, officers, supervisors, and command staff from both agencies acknowledged that some technologies could distract officers and reduce situational awareness. This was mentioned when officers of all ranks discussed mobile computer units and mobile telephone technologies.

Some did not associate their lack of job satisfaction with technology per se, but rather with organizational aspects surrounding technology.

Although there were benefits and frustrations associated with technology, law enforcement personnel whom we interviewed did not necessarily associate technology directly with job dissatisfaction. Instead, officers often blamed organizational aspects that were connected with technology as the source of their general dissatisfaction. For example, one officer in Agency 1 stated, "Now it has been two years [since implementing the new RMS system]; it is a pain in the ass, but I don't think it affects us that much. My dissatisfaction with some aspects of this job has nothing to do with tech—it is with who runs this department and how it is run." When we asked crime analysts in Agency 2 about their use of analytic technology and their job satisfaction, they focused less on the technology itself and more on being frustrated, overworked, and underappreciated by some units and ranks (especially the rank and file), who they felt were not supportive of them (despite the strong support by the agency's leadership).

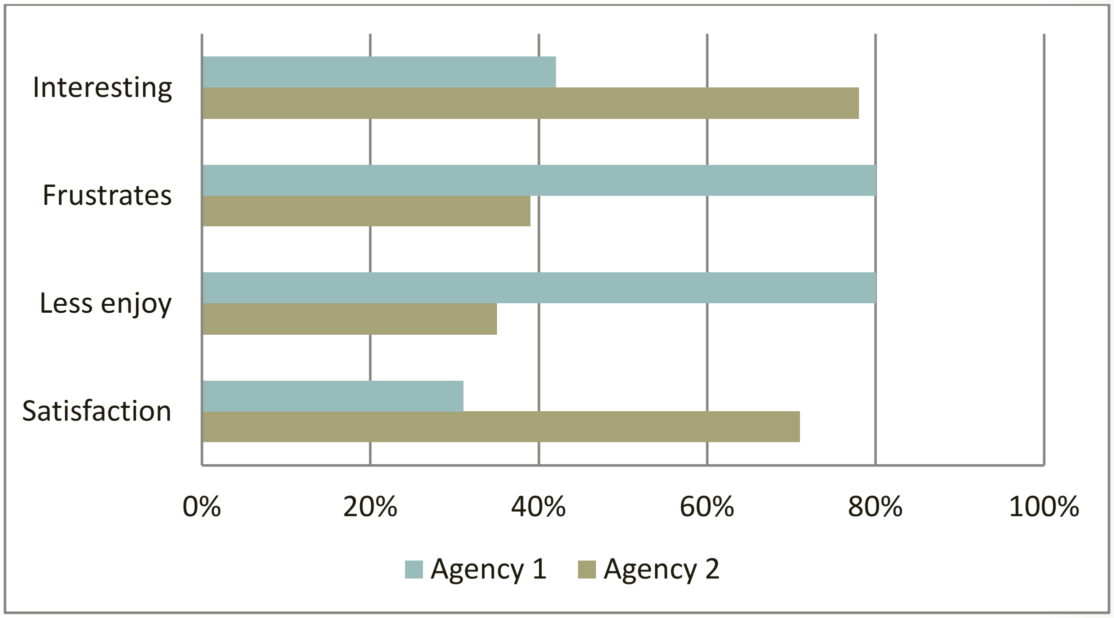
When talking to a group of first-line supervisors in Agency 2, one sergeant stated that he was "not necessarily less satisfied [because of technology], but there is more frustration. I love my job and love my officers, but I'm more frustrated now than in the past. Technology isn't the reason for frustration; it is the people making the decisions." Another stated that the issue was not analytic technology that created series for deployment, but rather the communication between the administration and patrol. He argued that "communication is a give and take thing. I appreciate when the administration comes to me to let me know about [a crime series using analytic technologies]. But they don't listen to us when we say this is a one-time thing," suggesting that their experience was also a valued source of knowledge in addition to analysis.

Yet others only became dissatisfied when they viewed their agency in comparison with others in terms of technological advancement. One officer from Agency 1 said he called an officer from a neighboring jurisdiction for help with a case of a missing woman. He noticed that the officer had much better technology to share information (like a photograph) with others in his agency, which made him realize how behind his agency was.

The strong link between organizational aspects and job satisfaction, as opposed to technology and job satisfaction, also emerged in contradictions about feelings about the job despite technological challenges. For example, one officer bluntly said, "I hate [the new RMS system], but I really enjoy coming to work." Another officer simply stated that independent of technology, he was "just happy to have his job."

The survey findings reinforced that the impact of technology on job satisfaction may be mediated by aspects of the organization. Across all of our job satisfaction questions, Agency 2 had greater numbers of survey participants agree that technology was connected to job satisfaction (from 55% to 79% in agreement across all indicators, ranks, and assignments). However, Agency 1 had much lower levels of agreement (19% to 66%), with the highest levels of connection between job satisfaction and technology in the highest ranks or detective units and other assignments (as opposed to patrol assignments). When examining patrol officers (Figure 6-l), the survey found that patrol officers in Agency 1 were more likely to view technology as frustrating and something that made their jobs less enjoyable, while officers in Agency 2 indicated much more satisfaction with technology, and that it made their jobs more interesting.

Figure 6-l. Percentage of patrol officers that agreed or strongly agreed with how technology made them feel about their jobs



Summary

Technology can be associated with job satisfaction depending on the function of the technology, and officer's rank and assignment, as well as the view that officers have of their organization more generally. However there can also be great levels of variation across agencies with regard to the connection between job satisfaction and technology. This complex relationship between job satisfaction and technology, which is impacted by other factors, was best summed up by an officer in Agency 1 who stated, "it is taking more of our time, which is keeping us from doing more of what we want to do—going out and being cops."

7. Agency 3 and 4: Information Technologies, In-Car Video and DNA

This section discusses the fieldwork conducted (primarily by PERF staff) in Agencies 3 and 4. As discussed in Section 4, project staff examined the uses and impacts of IT in these agencies with an emphasis on mobile computing (as in Agencies 1 and 2). In addition, they also studied issues surrounding forensics technology, particularly DNA testing capabilities, and in-car video/audio cameras. Agency 3 is a large suburban agency that has had its own forensics lab with DNA testing capability for over a decade. The agency was also in the process of adopting in-car cameras at the time of the study. Agency 4 is a large urban police force that was selected for its extensive and long-running use of in-car cameras.

Project staff explored the key study themes in these agencies using the same survey and interview/focus group instruments used for the fieldwork in Agencies 1 and 2. The case studies in Agencies 3 and 4 yielded many findings and themes similar to those from the studies in Agencies 1 and 2. Complexities that limited the benefits of technology in Agencies 3 and 4 included technical (functionality) problems, dissatisfaction with technology implementation among agency staff (e.g., due to limited consultation with and training for line-level officers), new demands and burdens (and sometimes inefficiencies) stemming from technology, mistrust about the purposes of new technology, misconceptions about technological capabilities, shortcomings in the strategic uses of technology, and other unintended consequences (e.g., changes in community expectations of police). The work in Agencies 3 and 4 helped to strengthen the basis for our generalizations about the uses and effects of IT, particularly mobile computing, in police agencies. At the same time, it also illustrated how the complexities and contradictions of technological change apply to other surveillance and investigative technologies (namely, in-car cameras and forensics technology) not studied in Agencies 1 and 2.

The issues are explored in more depth in the subsections below. Insights from these case studies are also integrated with findings from Agencies 1 and 2 in the discussion of study conclusions in Section 11.

The case study report for Agencies 3 and 4 was written by Daniel Woods for the PERF research team.

7.1 History of technology in the organization

The crime lab of Agency 3 was opened and accredited in 2002 with a staff of two. Since then it has expanded to nearly 40 staff (between sworn officers and trained civilian forensic specialists). Initially, not every unit within the crime lab was accredited; however, Agency 3 adopted updated standards and was fully accredited in 2012. At the outset of this study, the crime lab units were spread out within the main police headquarters, but have since consolidated within one larger space when headquarters was moved to a larger building. In four years, the unit reduced the backlog of DNA cases from over 400 to fewer than 50. Since its beginning, the lab has also expanded to include state-of-the-art equipment in order to sequence more samples of DNA (using smaller specimens), scan and retrieve more information from hard drives,[50] obtain more detailed scans of latent prints (including better algorithms for matching prints to suspects), and increase their ability to identify the quantity and purity of illicit substances. Since this study began, the agency moved its headquarters into a much larger space with an entire floor devoted to all of the crime lab units. In addition to the new space, the lab technicians and scientists will have dedicated work space and new equipment.

In addition to the crime lab, Agency 3 also received additional technologies which make them a good comparison to Agency 4. These technologies included LPR, electronic ticketing (eTix), and in-car cameras. Although some of these technologies are not necessarily new to the department, greater implementation of the technology is. Agency 3 has experienced implementation delays due to factors such as software/hardware problems, compatibility, and negotiations with the officers' union (i.e., the Fraternal Order of Police, or FOP).

Agency 4 began using in-car cameras in 1999 after the officer-involved shooting deaths of two civilians. This agency performed a pilot test, rotating cameras among each of their districts. After the pilot program, Agency 4 purchased the VHS system for its patrol fleet. Fewer than 10 years later, Agency 4 upgraded to

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[50] The amount of hard drives that the unit mirrors/copies has increased dramatically over the years, as the number of hard drives an individual possesses has increased, including laptops and desktop computers, external hard drives, smart phone electronic storage, and even cloud drives.

a digital system to increase efficiency and modernize. The previous system required thousands of tapes and took a substantial amount of time to generate copies. In addition, the VHS tapes (with the system stored in the truck of the cruiser) often melted from extreme summer temperatures. The move to digital cameras allows Agency 4 to produce DVDs (as needed) of camera footage in a timely manner. In addition, the new system has allowed supervisors to access video footage from their desktops.[51] Both the old and more recent in-car systems have been a part of Agency 4 for so long that there are few patrol officers who remember a time when there was not a form of video surveillance included in their vehicle.

Both Agency 3 and Agency 4 have had relatively recent changes (in the past 10 years) to their report writing and RMS systems. Agency 3 made the move to a newer system in order to facilitate a paperless system. However, the “new” system and their report writing software could not communicate with each other. As a result, by one sergeant’s reckoning, the yearly paper budget for one year had been used up in three months. Reports had to be printed in multiple copies and sent to various offices, including the District Attorney’s office and the agency’s records department. Agency 4 adopted a system that was utilized by the jurisdiction’s fire department in an effort to provide interagency support for incidents where fire and police response was needed and both agencies could share information quickly.

With regards to adoption and implementation, Agency 3 followed two different processes depending on whether the technology was related to the crime lab or the police department in general. In order to maintain/obtain crime lab accreditation, the requirements for Agency 3 were very straightforward. However, with the additional gain in lab space, Agency 3 also added more (updated) equipment. With regard to the crime lab, there appears to be a lot more vendor support available. For example, the fingerprint analysts have access to a vendor representative who frequently asks if there are problems with the existing systems and what changes would they like to see in future updates. This vendor also sponsors agency representatives to come to yearly conferences where they receive feedback and address their concerns while showing what new products they are working on. Also, the techs have access to a blog where they can post comments to other system users around the country where they can troubleshoot with others.

[51] Supervisors with iPads have been able to access footage from almost anywhere, providing them with (in some cases) real-time information when they are called from home to an emerging critical incident.

With regards to Agency 3 and 4's respective RMS systems, the agencies followed a relatively standard process of vetting vendors (i.e. advertising RFPs for new vendors). Each agency utilized a committee of personnel at various ranks to utilize the new system and make recommendations before proceeding further with acquisition and implementation. However, at least from the patrol officer standpoint, this process happens "behind the scenes." Many patrol officers indicated they were told a new system would be put in place and they would be trained on the new system.

For other technologies, e.g. in-car cameras, implementation with Agency 4 was much smoother than Agency 3, mostly due to "cultural" rather than technological reasons. Agency 4 has had a much longer relationship with the technology and rather than adopting something new, they were replacing outdated equipment. Agency 3, however, had a more drawn out process centering on negotiations with the FOP. Agency 3 had attempted to install in-car cameras into patrol cars earlier, but had to abandon it due to an impasse in negotiations with the FOP regarding the use of audio recording. The issue was tabled for years before reemerging. Agency 3 obtained in-car cameras, but had to install them on a reverse-seniority system whereby new officers would receive a vehicle with a camera. In addition, some officers volunteered and in some cases, if an officer was eligible for a take-home car, often it was one with a camera in it.

Both Agency 3 and 4 have adopted high-tech equipment and software. Each agency has had its own implementation challenges regarding police-specific technology related either to police culture or technological issues. The following sections contrast results obtained from an agency-wide officer survey with responses in interviews and focus groups.

7.2 Impact on police culture

Survey responses indicated that both agencies did not implement technology very well, with respondents from Agency 4 having a more negative view (see Chapter 5 and Appendix C).[52] These responses were largely mirrored in the smaller group settings. In general, officers were not satisfied with the way new technology is

[52] Survey results from Agencies 3 and 4 should be viewed with added caution given the relatively low response rates in those agencies (see Sections 4 and 5). As discussed in this section, however, many responses in the interviews and focus groups mirrored those in the survey.

implemented. This dissatisfaction is more apparent from line-level officers. Officers in both agencies provided similar responses in terms of technology acquisition and implementation. At the line-level, these officers generally have to be receptive to the new technology because they are told they have to. Many officers feel as if they did not have a say in the decision-making.[53] Each Agency's personnel offered similar reasons for why this may be the case. Some officers felt that there were legal pressures to adopt certain technologies, including crime reporting requirements to each agency's respective state or the adoption of a new system that was related to the agency's desire to be on the "bleeding" edge of technology.

Personnel in both agencies were also less likely to feel like they were in a position to give feedback on how the technology was working. However, they were more likely to say they had access to support if they were experiencing problems. This was more apparent for officers in Agency 3.[54] Personnel frustrations are, in part, due to the perceived lack of preparation and familiarization with new technology. As law enforcement agencies find themselves with shrinking budgets, intensive training for all personnel is often not an option. Officers in both agencies were under the impression that training for new systems or technology was meant to be longer, but was often shortened to accommodate budget requirements and staffing requirements. They do realize there are some complicated logistics involved in training an entire force, but they feel they only get cursory coverage. Officers in Agency 4 indicated they were told to go out and "play with it." Although many officers in the survey indicated they liked experimenting with new technology, most officers in the focus groups indicated they lacked the time to do so. Oftentimes, a smaller number of officers in each department would get a more intense training and then provide "training" for fellow officers and serve as a resource when there was a need for trouble shooting. In Agency 3, the training on the use of the new technology was out of sync with the actual rollout. As such, by the time the officers were in a position to use the new systems and technology, they were in need of a refresher. If the "trained" officer was available, it did make things easier for them, but this was often hit or miss.[55] In general officers in each department are very

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[53] 12% of line officers in Agency 3 and 6% of line officers in Agency 4 agreed with the statement: "Before implementing a new technology, command staff work hard to get input from employees." For 2nd-line supervisors, agreement only increased to 24% for Agency 3 and 27% for Agency 4.

[54] Recall, Agency 1 formed a users-group to get feedback on their new RMS system. This system was not in place in either Agency 3 or 4.

[55] Agency 3 had the benefit of having a "handful" of very tech-savvy officers who were very able to diagnose problems and provide solutions. This was most apparent with one officer in particular. He was mentioned by name in more than one focus group.

adaptable. There may be specific issues with each technology, but in the end, they get through them. However, one issue that generally remains is the disconnect between line-officers and second level supervisors (which will be discussed in the next section).

Regarding specific technology, like in-car cameras, there were fewer receptivity issues in Agency 4 since they had been using them for a much longer period of time. Although, at least some officers viewed the change from analog to digital not as an innovative upgrade, but a necessary change because the old system was not made any more, most viewed it as a logical change. However, because in-car cameras are a relatively new phenomenon in Agency 3, there are certain misunderstandings about the technology that interfere with its acceptance. Most notably, many officers are unclear when their cameras (and therefore microphones) are on and whether and when they can be turned off. One officer in Agency 3 indicated there were some officers who would move away from him because they knew he was "mic'd up." Other officers who utilized the technology merely made it a part of their routine to indicate to a fellow officer when his/her microphone was on and turn it off if there needed to be a private conversation. It is highly likely that these specific misconceptions will alleviate over time as agency personnel become more accustomed to the technology.

Specifically focusing on Agency 3 and their crime lab, there are some unique cultural issues, mostly centered on what the lab can and cannot do. By and large, crime lab technicians and scientists are very receptive to the technology they acquire. In addition, the agency as a whole benefits greatly from the expanded resources. However, the impact of the "CSI Effect" has necessitated some "expectation management" between the crime lab and other agency personnel in addition to the expectations of prosecutors (and even defense attorneys). Some crime lab personnel indicated that often detectives will ask the crime lab to perform every conceivable test they could. In essence, the crime lab has had to do some campaigning in order to demonstrate their capabilities and what tests are most appropriate for each type of crime scene (evidence). Finally, the crime lab has had to point out to some (often younger officers) that you do not need to have a suspect in mind in order to perform a DNA test.

In general, officers in each agency would likely be more receptive if they knew about the relative importance and function of newly acquired or updated technology. Although higher ranked officers were more likely to say they were receptive and felt the department did a better job at explaining the benefits, similar to line-level officers, many were left wondering why certain technology was changed in the first place. With new technology, there are often misconceptions about the true purpose or utility. Higher ranked officers are generally closer to the decision making process and often viewed the upgrades and acquisitions as a benefit. However, like the survey results indicated, they were often likely to feel like they had to adapt to the new way of doing things.

All in all, the impact of new technology on police culture was a function of how the agency introduced it. Personnel in Agency 3, in both the survey and focus groups, thought the agency did a better job in implementation than the officers in Agency 4; however, they still felt “out of the loop.” New technology and even updates to existing technology often impacts police organizational structure in addition to police culture.

7.3 Impact on police organizational units, hierarchy and structure

Line officers and 1st line supervisors in both Agency 3 and 4 indicated, in general, that there was a disconnect between older (higher ranked) officers and those officers at the line-level. One officer in Agency 4 (with agreement from colleagues) said, in essence, that any lieutenant or higher ranked officer who had been off the street for at least 10 years did not know what it was like to be a patrol officer. Although this was specific to Agency 4, to a certain extent this sentiment also applies to Agency 3.

In general, in each agency, when a new technology or system is adopted, it is in concert with existing systems, rather than a replacement. Thus, officers have to learn and remember another log-in/password combination. The officers in each agency indicated they had more than a dozen to remember, whether they were related to specific databases or specific technologies in their vehicle. Historically, officers who have been out of the field for more than 10 years have not had to fill out a report on a computer. Older patrol officers, however, have had to adapt to new systems. Many older officers, in both agencies, have said there was a learning curve involved in figuring out the new systems. Younger officers, especially in Agency 4, are less likely to have utilized a paper report. Both agencies utilize NIBRS reporting, which captures more details about crime incidents. Each agency’s reporting software accommodates these additions, but the at the expense of creating lengthier reports, which led one officer in Agency 4 to describe the situation as having to “fill in all of the boxes, but kept us from doing real police work.” This sentiment was mirrored in Agency 3 as well.

Although most officers viewed an age-divide in the uptake of new technology, they did not always view this as most beneficial for younger officers. Officers in Agency 3 felt that the youngest officers, who were used to intuitive iPhone interfaces, had trouble interacting with less intuitive systems they used in their police work. In addition, older officers might feel more frustration when the technology broke down, but were better able to switch gears and go back to the old way of doing things. Younger officers, without that experience, were least adaptable. One sergeant in Agency 3 indicated he required officers to get from two points in his/her patrol area using only a map.

Regarding in-car cameras, in Agency 3, since most officers have not had cameras in the car, there is largely a feeling that the cameras are a form of Big Brother. Officers in Agency 3 do understand that more cameras are going to roll out within the agency and they say they will adapt when that happens. However, they largely view the benefits of the camera system as secondary to “keeping tabs on them.”[56] This sentiment is mirrored in Agency 4, where supervisors can access the digital video footage from their iPads.

The deep integration of in-car cameras in Agency 4 did lead to the creation of a specific unit to handle all of the footage. The switch from analog (VHS tapes) to digital dramatically reduced the space requirements of the unit and increased their efficiency. The unit director provided us with a tour, including their server room. Without needing space for VHS tapes and with improved server capacity, their server room now has much more space available to grow. Making copies of videos is a much more streamlined process. This unit has also been innovative. They have used video footage to generate instructional videos or the agency equivalent of a PSA for safety reminders.

[56] This has largely been the reaction of officers to technological change. With the advent of the two-way radio, officers felt they had less autonomy and their supervisors were keeping track of them.

7.4 Impact on internal accountability and management systems

Officer survey responses indicate a general view that they are expected to utilize technology to address crime problems. At the same time, they generally viewed technology also as a means to assess their individual performance as well as their agency's performance. Officers in Agency 4 often expressed the view that technology was a means for their supervisors to keep track of their activities, rather than their unit's activities. Interestingly, the officer level surveys seemed to indicate that compared to Agency 3, officers in Agency 4 seemed less likely to report that technology was used for internal accountability (compare, for example, Tables 4s for Agency 3 and 4 in Appendix C).

As mentioned in the previous section, officers generally viewed the move from paper to electronic reporting, with the NIBRS requirements as moving towards filling in boxes rather than "real police work." Officers in Agency 3 indicated that, depending on the officer, a lot of time is spent making sure their reports are filled in correctly. This back-and-forth between an officer and his/her sergeant is largely dependent on the sergeant. Officers in Agency 3 indicated some sergeants have more stringent standards than others. The increased collection of data over the years has also turned patrol work into almost an accounting-based system. When many of the day-to-day activities of police officers get quantified, these activities become metrics by which to base how well an officer is performing.

Officers in Agency 4 indicated the in-car camera systems have become a means for internal accountability. The camera system is meant to be a means of resolving citizen complaints, in addition to enhancing officer safety. However, officers indicated that the audio/video footage was often used to hold officers accountable for procedural violations. If, after a citizen complaint had been filed, an officer was documented violating policy, that officer would receive sanctions for it. By and large, officers were less bothered by the system itself, but often worried what would happen if a complaint was filed. One sergeant indicated that probably every officer in route to the focus group had violated policy in some fashion.[57]

In-car video is primarily a means to resolve citizen complaints efficiently. This system has the benefit of providing transparency to the public while maintaining

[57] Often stories like this can appear as "urban myth" where an officer knows of an officer who experienced this; however, we did hear of incidents where upper level command staff intervened in cases where an officer was disciplined for things said on video (but out of hearing of the general public).

officer accountability within the organization. We asked officers if they had ever benefitted from the use of in-car camera. In general, at best the officers knew of someone who had, but had not directly benefitted. Part of this phenomenon is due to the fact that officers are generally not told if a complaint gets filed against them and if the video quickly absolved the officer of any wrong-doing. Officers indicated they never heard about dismissed or unfounded claims. Although officers, in general, might not need to know when a complaint does not go forward, at the present, officers are only aware when things go wrong. This lack of knowledge feeds into the sense that the "real" purpose of the camera system is to keep tabs on their behavior.

Information technology, in Agency 3 and 4, has the capacity of providing accountability from an accounting-based standpoint in terms of officer performance. In a sense, this provides a level playing field because agency personnel know what metrics are important. Officer monitoring systems (such as in-car cameras) provide an additional means to monitor officer behavior. However, this potential of this system could be enhanced through feedback to officers when things go "well." Including this feedback to officers could be a step towards changing officers' views that the system is mean to keep them in line.

7.5 Impact on individual police/supervisor discretion and decision making

From the survey, among the choices of how officers use technology, officers from Agency 3 and 4 more often indicated they used technology to locate suspects, wanted persons, and other persons of interest rather than use technology to problem-solve (see Section 5 and Appendix C). Interestingly officers in Agency 3 indicated that the most likely use of information technology was to gather information on an address or person while in a route to a call.

Our interviews indicated that officers in both agencies conveyed their general excitement at the amount of information available to them to guide their decision making. Each officer had a favorite information database. They were also impressed that driver records included pictures. This was seen as a great asset when conducting a field interview in which they needed to determine the identity of the person with whom they had contact. Some supervisors used technology regularly to determine where their officers should patrol and what types of incidents needed addressing. Information technology was seen as a potential means to guide activities, at least in terms of where, but largely officers did not see technology as a constraint on their discretion.

With technology providing feedback on officer activities, guiding deployment, and providing direct monitoring of officer behavior, it would be easy to assume this would limit officer discretion. One would think officers should feel more constrained. However, both the survey results and the qualitative interviews do not support this claim. The survey provided an interesting contrast. Officers in both agencies (at all levels of supervision) indicated information technology helped them engage in “proactive, self-initiated” activities, yet they also indicated they relied on their own experience (rather than technology) when making decisions about crime problems (79% to 88% of patrol officers agreed with this statement and only 14% to 18% reported using information technology often or very often to determine how to respond to crime problems). Information technology sometimes was used to determine where one should focus (20% to 30% of patrol officers used information technology often or very often to determine where to patrol between calls), but in the end, the “what” to do was still driven by the individual officer (often at the direction of a supervisor).

Because Agency 4 has had more experience with in-car cameras, we asked agency personnel if this affected their discretion. The camera system, once turned on, creates a buffer. When the system is activated the system tacks a previous time period onto the ongoing footage to see what happened before the system was engaged. We thought this could affect discretion if, for example, an officer was on the phone immediately prior to engaging a member of the public. Officers in Agency 4 acknowledged this might be a possibility, but largely dismissed it. They often said they were not thinking about whether the camera was on. Ultimately, they said they always retained discretion. The addition of the camera system was merely another element guiding the individual officer’s decision to act in one instance and not in another. They also noted that the camera provides a narrow view out the front of the car and, therefore, only provided a limited account of what was going on. As such, the officer was still in the best position to determine what action to take.

Information technology largely provides a department with a means to focus resources and direct activities, but in the view of the officers involved it does not tell them what to do. Officers still relied on their own experience, but recognized the benefit of having information at their disposal. Because officers can rely on their own experience, enhanced with information, ultimately their discretion remained unaffected.

7.6 Impact on police processes, efficiencies and daily business and work

Based on the survey responses, officers in Agency 3 felt information technology helped them be productive in their daily work and, in general, felt it was easy to use; however, many survey respondents felt information technology created extra work. Officers in Agency 4 did not feel information technology was easy to use and the majority of respondents felt the technology Agency 4 used created extra work.

Most survey respondents from Agency 3 and 4 indicated information technology made them more effective in locating persons of interest and responding effectively to crime problems. When technology works well, a department is provided with up-to-date information on crime problems related to hot spots and chronic offenders. With this knowledge, a department knows where to be in order to maximize their crime deterrent effect. Although the communities served by Agency 3 and Agency 4 are not put at risk through these inefficiencies, crime control efforts could be enhanced further by addressing these deficiencies.

Officers in Agency 3 indicated information technology provided input on where the officers should be; however, they often relied on their own intuition and experience on where crime would likely go after they conducted their operations. Although information technology plays an important role in quantifying the problem and localizing it, officers felt there would always be the human element. As one officer said, “a good officer will know where to go.”

With each element of technology (whether hardware or software), there is a corresponding additional element of logging on to a new system. In part, this is because each individual system is a proprietary stand-alone system. Officers, in both agencies, indicated it could take at least 30 minutes to log on to the various systems, but up to an hour to get from roll-call to being out on the street. Officers have to log on to each system and hope each system works. Each piece of hardware needs to sync up in order to function properly (especially in the case of the in-car camera systems). If it does not, the officer is delayed and has to obtain a replacement. In Agency 3, the in-car camera system utilizes a wireless connection to upload the previous shift's audio/video footage, which needs a dedicated connection. Officers will start their cars and then attend roll call. Their vehicles have to remain running because if the car is off, any electronic device draining the battery will be shut off. As a result, there is a sizeable expenditure in fuel for the sole purpose of uploading data from the camera system.

Personnel in both agencies indicated the electronic reporting system was a fairly tedious process. Each system had numerous tabs to navigate and generally took more time to process than previous paper reports. However, most officers have come to view this as merely an aspect of their work. In essence, they have acclimated to the system. There are times when the system goes down. One officer (in Agency 4) captured the sentiment shared by many officers. This officer indicated they system was great when it worked (which was most of the time), but when it did not, it created many headaches. Agency 3's "paperless" system has created a lot of duplication because each report has to actually be printed (as mentioned previously).

One major aspect having an impact on efficiency was connectivity. Both agencies experienced gaps in connectivity which influenced the adequate functioning of their systems. Although this impacted officers in Agency 3, personnel in Agency 4 seemed to have more intense negative experiences with technology due to wireless connectivity. Recall earlier one officer indicated higher level supervisors did not know what it was like to be an officer on the street at present. During interviews with 2nd level supervisors, they indicated their officers often hung out in the district parking lots writing reports when they wanted them out on the streets doing patrol work. Through the focus groups with patrol officers, we learned that officers often wait until the end of their shift to write the reports so they could sit in a location where they had a dedicated wireless signal. Nearly every officer indicated he or she had lost a report because it was started during some downtime. During that downtime, the officer received a call or witnessed a crime and had to disengage from report writing and in the process of handling the call for service lost connection and as a result lost all of their progress. The officers also joked (albeit in a serious way) there were areas of the jurisdiction where they would not be able to utilize their electronic ticketing because there was not a strong enough signal to use it.

Agency 3's crime lab presents a different story. The technological advances in the past decade have allowed the lab to process samples quicker and utilize smaller specimens (in the case of DNA results). The fingerprint identification system has increasingly finer resolution. The electronic crimes unit can mirror hard drives from computers and smart phones more quickly. Advances in technology have, in a way, made things more efficient; however, it cannot replace the importance of the staff involved.

One member of the crime lab indicated the main reason Agency 3 reduced its backlog of forensic cases was due to hiring more technicians and scientists while outsourcing some of the backlog to other labs. However, with the backlog under control, they have instituted a hierarchy for handling cases where the most serious new cases get priority and other cases are handled in due time. The forensic side of the crime lab is presented with a particular equilibrium. Because of their successes, and the fact that they can handle smaller samples, they have seen an increase in the number and types of cases they are called upon to handle. Being able to handle more cases has meant more cases come their way.

The fingerprint identification system utilizes elaborate algorithms to match latent prints to the known offenders. However, the system cannot make fine grained judgments about what constitutes a match. It takes a technician looking at the image screen to make that judgment. When asked if new technology increased one technician's efficiency the response was negative. In the end, the technician's job was easier because of better resolution, but the actual mechanics of the job remained the same.

The process by which sworn officers engage the crime lab has resulted in some inefficiencies as well.[58] Each unit of the crime lab maintains its own request form, which generate their own tracking numbers. Therefore it makes it difficult to organize if a request is made on the wrong form, or if multiple forms are floating through the process. In addition, some, generally younger, officers and detectives will follow what has been colloquially called the "shotgun approach to investigations" and will ask for every conceivable test. Crime lab staff have to contact the particular officer/detective and go over each test including; what will be gained by the test, whether the test is appropriate, and the cost relative to the return. In the case of property crime, it is unlikely the department will perform $10,000 in tests for a crime involving $100 of property. Crime lab staffers also regularly meet with prosecutors to walk them through the tests which will result in the most probative value. As mentioned previously, some sworn personnel are unsure when they should ask for a particular test. In the case of DNA analysis, some officers have the mistaken belief there needs to be a suspect before they can ask for

[58] These inefficiencies have likely been addressed at the time of this report.

a test. Although this is not a reflection on the efficiency of the crime lab, this situation does result in a longer identification process overall. In an interview, the crime lab director indicated the desire to generate suspects more quickly in order to take these offenders off the streets earlier. Overall there is likely a societal cost savings if this can be accomplished, as offenders are likely to keep committing crime as long as they are on the streets.

Technology has the capacity to provide more information, more efficiently, and allow personnel to complete tasks more quickly. However, this scenario requires optimal execution. Police departments are often faced with needing different technologies at different times. As such, these separate pieces are often provided by separate vendors. In this case, it is difficult to get the individual aspects of an agency's systems to talk to one another. In addition, there are hurdles related to something as simple as a dedicated wireless connection. Although not part of the technology itself, lack of connectivity creates difficulty for a department by increasing off-street time of patrol officers as they troubleshoot their information technology issues.

7.7 Impact on police-citizen communication, police legitimacy, and job satisfaction

Survey respondents indicated having up-to-date technology improved the image of the department in the eyes of the community, but did not necessarily make the department more transparent. The use of in-car cameras has been seen by some officers, especially in Agency 4, as a means of holding the department more accountable to the community. When a police-citizen encounter occurs, the officer and citizen are aware of the recording. In addition, the public at large are aware that the police are using recording devices.[59] In-car cameras are not necessarily legitimacy enhancing elements in and of themselves, but provide a legitimacy safeguard when things do go wrong between an officer and suspect.

Officers in both agencies related that because there was the expectation (in the public's eye) that events would be recorded, they felt there was less trust in the officer's word. Technology does not always work as planned. Officers in both agencies mentioned having their word questioned if there was a lack of video

[59] One officer in Agency 3 indicated the department should be recording since most people on the street were recording them.

footage, or if the audio cut out. Officers mentioned the audio sometimes cuts out (due to distance from the vehicle or if they walk too far into an older building). The video footage does not provide an indication between the situations where an officer intentionally cuts off the microphone versus ones where the microphone cuts out on its own. Officers, especially in Agency 4, indicated that when there is a technological failure, they feel it is taken as a sign they have done something wrong.[60] As mentioned previously, many officers, especially in Agency 4, felt that the camera system was a tool for higher level command staff to find policy violations independent of any actual citizen complaint.

The failure on the part of technology, as well as the various processes related to technologies' use has direct implications for job satisfaction. One officer in Agency 4 indicated the officers were "drowning in [their] processes." This officer meant that as the agency acquired new technology, there was not an effort to phase out the old. Also, line-level officers in both agencies indicated they felt "out of the loop" with regard to new technology (why it was useful, why a change was needed, what technology to actually get, etc.). Many officers also felt that more training on how to use new gear and information systems would benefit them greatly. However, no one interviewed indicated technological issues would keep them from remaining police officers.

[60] One officer in Agency 4 indicated that if there was a technical failure, the officer was supposed to correct it by obtaining new equipment. However, sometimes the technical failure was discovered in the context of a foot pursuit and there was no opportunity to correct the problem.

8. Trend Analysis of the Impact of Technology on Crime in Agency 1

In Sections 8 and 9, we describe two sets of analyses that the George Mason team conducted in Agency 1. In this section we provide results of a trend analysis of the general impact of technology on crime. In Section 9, we describe a randomized controlled experiment that examined the use of mobile technologies in crime hot spots.

Agency 1's implementation of its new RMS in early 2010 and its expansion of LPR deployment in early 2011 provide an opportunity to investigate whether these technologies have had discernible impacts on the agency's effectiveness in reducing crime. To that end, we sought to examine pre-post trends in Agency 1's offense reports and arrests to determine whether these technological changes have been associated with reductions in crime and/or improvements in case clearance rates. We hypothesized that the implementation of the new RMS might improve Agency 1's ability to solve and prevent a variety of crimes. At the same time, the expansion of Agency 1's LPR deployment might have increased the apprehension of auto thieves and reduced auto theft, while possibly producing deterrence and incapacitation effects for other types of crime as well (e.g., see Koper et al., 2013).

8.1 Data and Methods

Our ability to examine these issues was limited. Sources in Agency 1 informed us that crime and arrest data compiled prior to the new RMS are not strictly comparable to those that the agency currently produces. This precluded us from doing a rigorous pre-post time series analysis of trends in crime, case clearances, or police proactivity.[61] However, Agency 1 was able to provide the research team with annual UCR Part I crime and arrest counts for several years that were standardized to be comparable for years before and after the implementation

[61] We considered measuring police proactivity using UCR part II arrests for offenses like DUI or disorderly conduct (e.g., see Sampson and Cohen, 1988)

of the RMS. The agency also provided quarterly counts of these crimes and arrests for the first three quarters of 2012 (January-September).

With the exception of rape (which was excluded from the analysis due to low counts),[62] we examined trends in the annual counts of these crimes from 2007 through 2012.[63] We thus compared the three years before the RMS (2007-2009) to the three years following RMS implementation (2010-2012) and the four years before LPR expansion (2007-2010) to the two years following LPR expansion. Note that we estimated the annual counts of these crimes in 2012 based on the numbers that occurred during the first three quarters of the year; the counts for that year should therefore be treated cautiously.[64]

We did not have specific figures on the numbers of these crimes that were solved, so it was not possible to calculate true clearance rates. However, we approximated the annual clearance rate for each crime type based on the annual ratio of arrests to crimes for that crime type (as done by many others in deterrence studies and analyses of trends in clearance rates). This approximation assumes that most arrests in a given year were associated with offenses that occurred in that year and that the error in this measure is distributed equally across years. The calculations for 2012 are based on crimes and arrests that occurred from January through September of that year.

We caution readers that this analysis is a tentative, descriptive examination of whether there were obvious and consistent improvements across major crime types in crime levels and clearance rates in Agency 1's jurisdiction following the implementation of its RMS and the expansion of its LPR capabilities. Due to the data limitations discussed above, we could not conduct a formal assessment of whether there were statistically significant changes in crime or clearance rate trends. We also did not compare Agency 1's jurisdiction to others, given the limitations to the analysis and the mixed findings presented below from the pre-post analyses. The results below should be viewed as suggestive but not definitive.

[62] Agency 1 received fewer than 100 reports of rape annually during most of the years analyzed.
[63] We analyzed the annual numbers of these offenses rather than their annual rates because the population of Agency 1's jurisdiction changed relatively little during this time frame.
[64] For each crime type, we summed the number of crimes during the first three quarters of the year and multiplied this number by (12/9) to estimate the number that occurred for the full year. This calculation assumes that these crimes occurred at the same rate during the final quarter of 2012 as they did during the earlier portion of the year.

8.2 Results

Trends in the annual number of each offense are presented in Figures 8-a, 8-b, and 8-c. Overall, the trends show no consistent pattern of crime dropping after the implementation of the RMS or the expansion of LPR. Robberies dropped from approximately 600 in 2007 to under 400 in 2009 (pre-RMS), but then held steady in 2010 and rose somewhat in 2011 before dropping again to below 340 (estimated) in 2012. Aggravated assaults, in contrast, were higher from 2010 through 2012 (ranging from about 380 to 450 per year) than prior to 2010 (when they ranged from 309 to 386 per year). Burglary, auto theft, and larceny all declined after the implementation of the RMS in 2010. However, the drop in auto theft appears to have been the continuation of a trend that preceded the RMS, and the rate of decline seems to have slowed after the RMS and LPR expansion. More specifically, auto thefts dropped from 1,459 in 2007 to 1,096 in 2009, a decline of 25%. They declined at a slower rate of 20% between 2009 and 2011, and then leveled off (dropping only 2%) from 2011 to 2012. After dropping in 2010 and 2011, burglary appeared to be moving upward again in 2012, though we estimated that it remained lower (below 1,100) than prior to 2010 (when there were about 1,400 per year). Finally, larcenies dropped in 2010 after having risen during 2008 and 2009, but remained somewhat higher (at 14,463) than during 2007 (when they numbered 14,244). Larcenies then dropped further to an estimated 12,900 in 2012. In sum, the evidence is perhaps strongest for declines in burglary and larceny following the implementation of the RMS in 2010, though the post-RMS trend for burglary has not been entirely consistent.

Figure 8-a. Robbery and aggravated assault trends for Agency 1 (2007–2012)

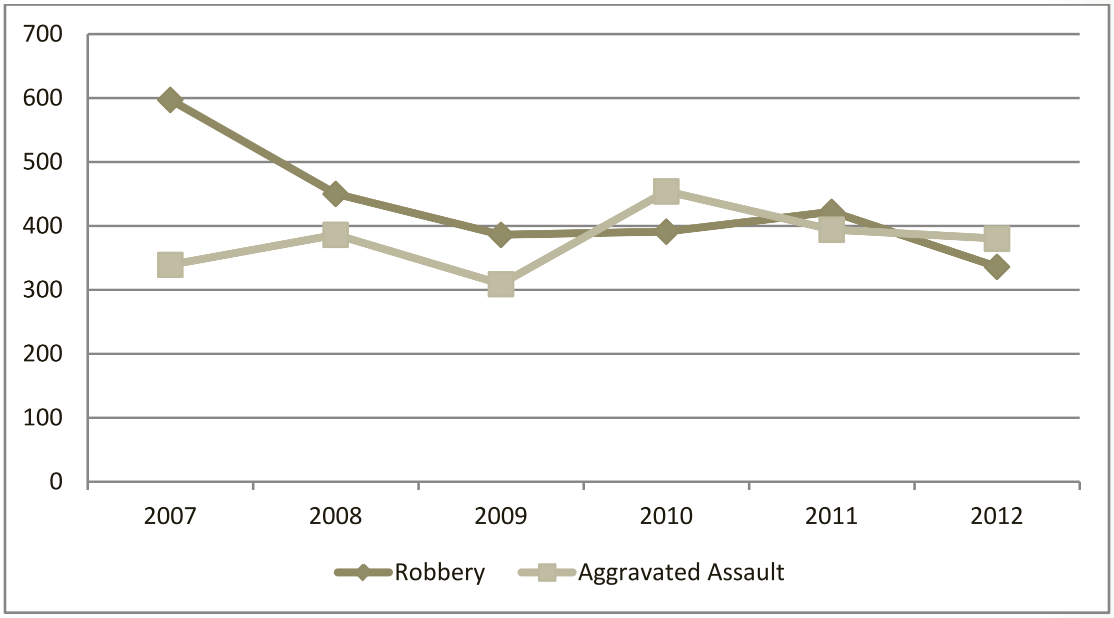

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Figure 8-b. Burglary and motor vehicle theft trends for Agency 1 (2007–2012)

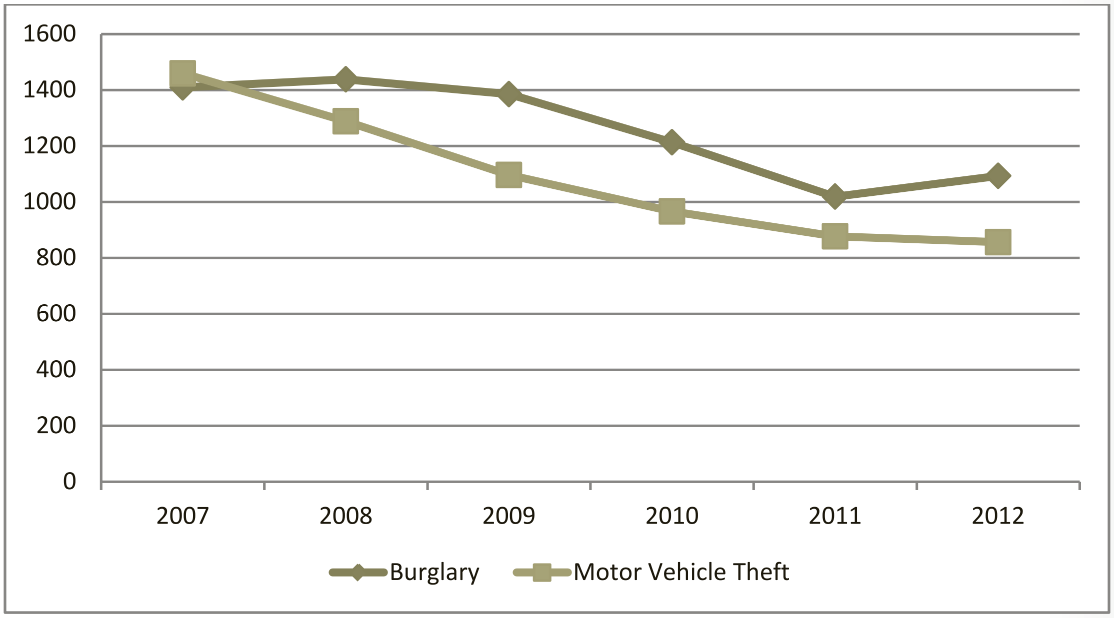
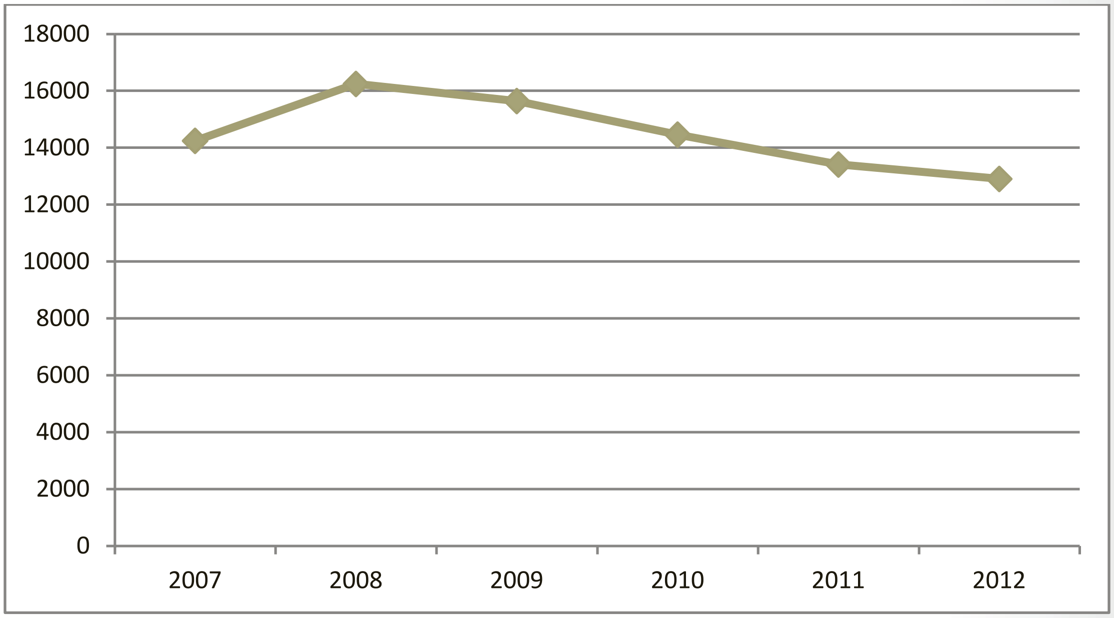


Figure 8-c. Larceny trends for Agency 1 (2007–2012)



Trends in clearance rates, as approximated by the annual ratios of arrests to crimes, were also mixed across crime types (see Figures 8-d and 8-e). The most pronounced changes were associated with robbery and aggravated assault, and these trends went in opposite directions. The annual ratio of arrests to crimes for robbery increased by one third from 2009 to 2010 (rising from .48 to .64) and remained at a higher level afterwards despite declining somewhat in 2012. This may suggest that the RMS helped to improve clearances of robberies, but if true, this does not appear to have reduced the number of robberies in 2010 and 2011 (see above). The ratio of arrests to crimes for aggravated assaults, on the other hand, dropped considerably in 2010 (falling from the range of 1.2 to 1.5 before 2010 to the range of .88 to 1 after 2009) and remained lower through 2012. This suggests that clearances for aggravated assaults worsened after 2009 as these crimes were increasing.[65]

[65] Note that the ratio of arrests to crimes for aggravated assaults was considerably higher than that for other offenses during this time period. Indeed, arrests for these crimes outnumbered the actual offenses for a number of years examined. This suggests that true clearances for these offenses are likely high relative to those for other offenses (in general, aggravated assaults are more likely than crimes like robbery to involve victims and offenders who are acquainted with one another—see Rand, 2009; Roberts, 2008). It may also suggest that some arrests for aggravated assault are later downgraded to lesser forms of assault.

Patterns for other crimes were mixed or less pronounced. The clearance ratio for larceny improved somewhat in 2010 and 2011, but it declined somewhat in 2012 to a value (.28) that was very similar to its value in 2009 (.27). The burglary ratio worsened considerably in 2010 and then rebounded by 2012 to its pre-RMS level. Finally, the arrest to crimes ratio varied inconsistently for auto theft, increasing in 2010 and then declining in 2011 as LPRs were being expanded. Tentative figures for 2012 suggest that the ratio improved to .19, which was 45% to 73% higher than its levels from 2007 to 2009 (.11 to .13). However, our focus groups with LPR officers in Agency 1 (see Section 6) suggest that this improvement may have been due to other factors, as the LPR officers seem to get few hits with the devices.

Figure 8-d. Ratio of arrests to crimes for selected offenses in Agency 1 (2007–2012)

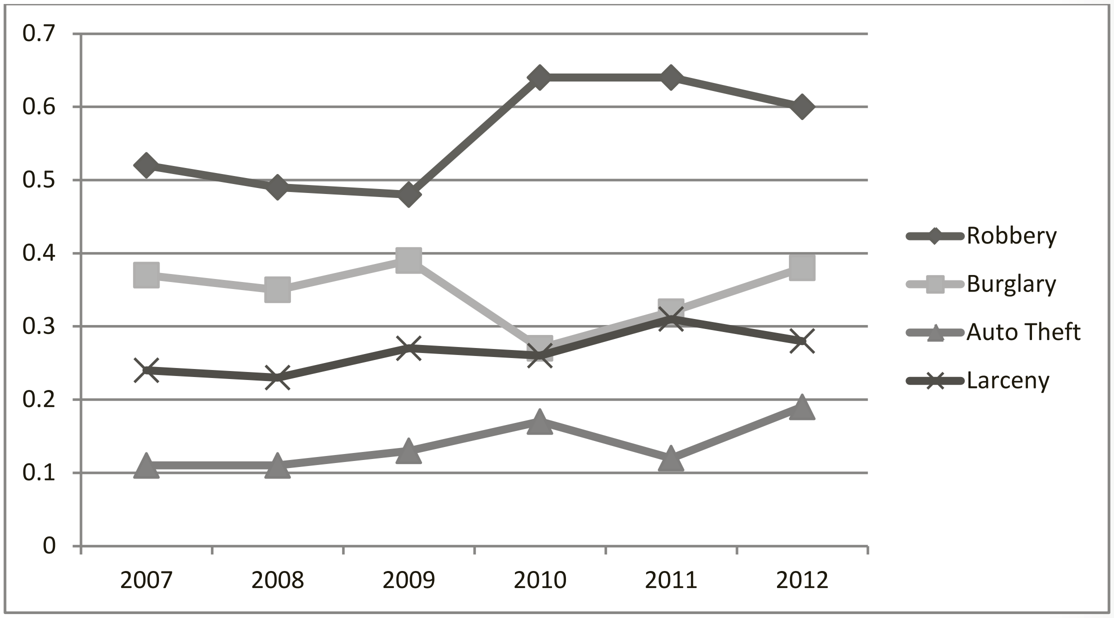
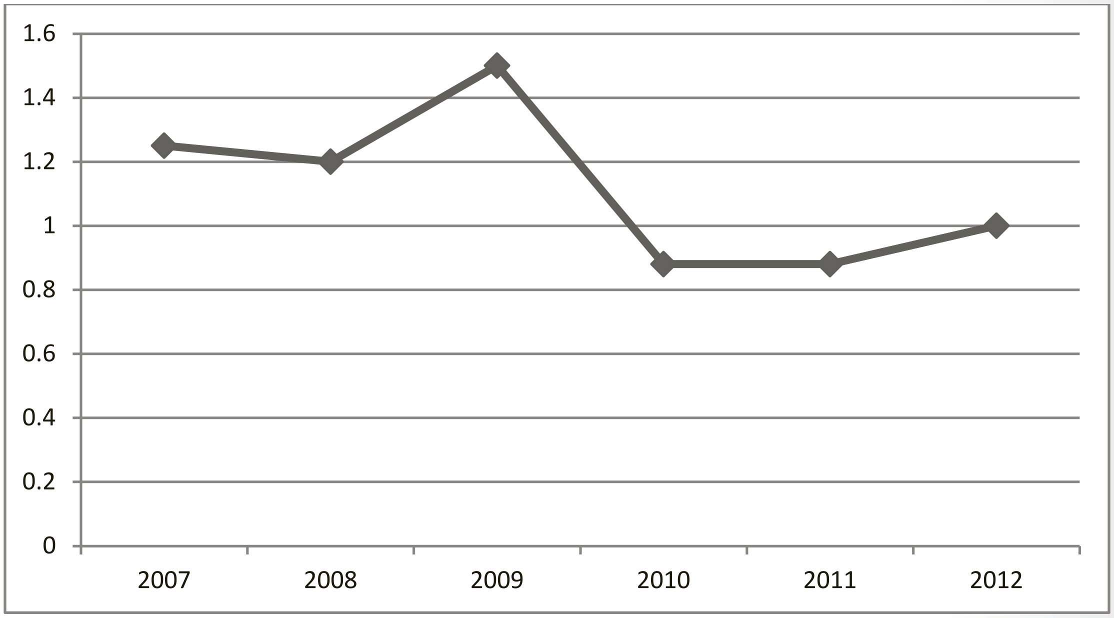


Figure 8-e. Ratio of arrests to crimes for aggravated assault in Agency 1 (2007–2012)



8.3 Discussion

In summary, our tentative examination of trends in Agency 1's crime reports and case clearances reveal little consistent evidence that the implementation of Agency 1's RMS or the expansion of its LPR deployment reduced crime or improved case clearances during the first few years following these changes. Trends in crime and clearances were inconsistent across different types of offenses. In addition, crime and clearance trends for the same crime type were typically inconsistent.[66]

As discussed elsewhere in this report, better information systems have the potential to enhance police effectiveness in a number of ways—e.g., improving agency management and criminal investigations, increasing the likelihood of detecting wanted persons in field encounters, and encouraging more proactive contacts and problem solving among officers. However, the officer survey and focus groups suggest that these potential benefits have likely been offset in Agency 1, at

[66] While we might expect the impacts of LPR to be greatest for auto theft, we do not have clear rationales for believing that the RMS would affect some types of crime more than others or that the LPR deployment would have differential effects on different types of non-auto crime. Consequently, we have focused on overall patterns in the data and looked for consistency in trends across crime types.

least in the short run, by the difficulties of using the RMS and meeting the new reporting requirements that came with the system's implementation. If anything, these problems seem to have reduced officers' time for proactive work, potentially undermining Agency 1's performance. Further, we did not find widespread indications that officers are using the RMS in strategic ways.

Expected and desired changes stemming from the RMs might still occur gradually over time as command staff and officers acclimate to the system and as the data contained in the system grow in volume and improve in quality. Indeed, one might hypothesize that this type of technological change has no effect or even adverse effects on agency productivity and performance in the short run, followed by a gradual improvement over time.

In a similar manner, the expanded use of LPR also has the potential to improve Agency 1's effectiveness, particularly with respect to reducing auto theft. However, the number of LPRs in use by Agency 1 may not be large enough to have produced demonstrable effects relative to the population, geographic size, and crime levels of Agency 1's jurisdiction. And although Agency 1 has learned to use LPR to assist in criminal investigations (by canvassing areas near crime scenes), the agency has not generally deployed its LPRs in a highly strategic or evidence-based manner (e.g., systematic deployment to hot spots). As with the RMS, officers and commanders may learn over time to utilize LPRs in more strategic and effective ways that produce clearer results.

9. Examining Mobile Technology Use and Impacts in the Context of Hot Spots Policing: Results from a Field Experiment in Agency 1

9.1 Introduction: Using Mobile Technology in "Hot Spots"

To further understand the impact and effectiveness of the use of technology in the field, the George Mason research team conducted a randomized hot spots policing experiment in Agency 1 that involved an examination of the use and impacts of technology in hot spots patrol work. Assessing the use of technology in the context of hot spots policing is another opportunity to view the potential uses and impacts of technology in street-level decision making. Hot spots policing—i.e., police patrols and interventions focused on small areas or very specific places (e.g., particular addresses, intersections, street blocks, or clusters of street blocks) where crime is concentrated—has proved to be an effective approach in reducing crime (Braga et al., 2012). Enhancing patrol officer capabilities in hot spots using mobile computer technologies might enable officers to be even more effective in this mode of operation.

In particular, Lum et al. (2011) suggest that police can be more effective when they are place-based and proactive, and when they tailor their strategies toward specific problems. However, more studies are needed to determine the most effective types of enforcement, prevention, and problem-solving activities for officers to engage in while patrolling hot spots (Braga et al., 2012; Taylor et al., 2011a. Mobile computing technology might facilitate proactive and problem-tailored strategies by providing officers with easy-to-access information in the field about very specific addresses within a hot spot block, for example, or by giving officers the capability to search past information on crimes and calls for service at the location. Further, examining the use of technology in this proactive way might also provide more general insights into the nature of technology uses and impacts in policing.

Toward these ends, we conducted a randomized experiment with Agency 1 that was intended to increase dosages of police presence, activity, and technology utilization at randomly selected high-risk locations (i.e., hot spots) that accounted for a large share of crimes and calls for service in Agency 1's jurisdiction. In the course of this experiment, we sought to answer a series of questions about how officers use technology at hot spots and how technology impacts the effectiveness of hot spots policing. More specifically, we asked:

- How do officers use technology at hot spots? What technologies do they typically use, how extensively do they use them, and which do they find to be most useful?
- What impacts does technology use have on hot spots policing? How does it shape officers' actions? How does it affect the outcomes of their efforts?
- How might police use technology more effectively for hot spots policing?

In the sections below, we first describe the design and implementation of the experiment. We then describe officers' use of technology at the hot spots based on interviews with the participating officers and analysis of activity logs that they filled out during the experiment. Finally, we assess the impacts of technology on hot spots policing using both qualitative analysis of the officer interviews and quantitative analyses that examine whether changes in crime at the experimental hot spots were linked to officers' use of technology.

9.2 Study Design

The study was implemented as part of a broader collaboration with Agency 1 to design, implement, and test a hot spots strategy that would optimize the agency's resource allocation and effectiveness by increasing patrol presence, activity, and technology utilization at hot spot locations that accounted for disproportionate shares of crimes and calls for service. Commanders in Agency 1 were particularly interested in testing a hot spots patrol strategy like that tested recently in Sacramento, California, where patrol officers made short (12–16 minute) stops at designated hot spots roughly every two hours during their shifts based on the "Koper curve" principle of hot spots patrol (Koper, 1995). A 90-day study of the Sacramento strategy found that it was effective in reducing both crime and calls for service at the targeted locations without the need for additional resources (Telep, Mitchell, and Weisburd, 2012). Accordingly, this served as a model for designing the experiment with Agency 1.

Selection and random assignment of hot spots

The experiment was conducted in one of Agency 1's districts. In planning the experiment, the research team analyzed data on crime incident reports and calls for service (CFS) in this district for 2010 and 2011 to identify suitable micro hot spot locations. Specifically, the team analyzed incident reports and CFS by street segment to identify street blocks with the highest concentrations of crime and disorder. The research team then held a series of meetings with district commanders and officers to screen and select candidate locations. This process involved reviewing maps of the proposed study locations, discussing their crime patterns and features, and refining the boundaries of those selected for the project.[67] Based on this screening process and the availability of agency staff and resources for the intervention, the team selected 18 candidate locations for the study.[68]

The selected hot spots consisted primarily of apartment complexes, retail shopping centers, parking lots, and other types of business, commercial, or residential locations (e.g., locations with restaurants and bars or mixed-use locations with both residential and commercial areas). A few also included small wooded areas known for homeless encampments or homeless shelters. Given the suburban nature of Agency 1's jurisdiction, incident reports and CFS at these locations largely pertained to theft offenses (e.g., larceny and shoplifting) and other general forms of crime and disorder, such as simple assaults, disorderly conduct, drug violations, and destruction of property. More serious forms of crime, such as robbery, burglary, and sex offenses, also occurred at these locations, though not frequently.

To assign the locations to the experimental (intervention) or control (no intervention) groups, the research team matched the 18 candidate hot spots into 9 pairs (or statistical "blocks") based on counts of crime incidents and calls for service during 2011, the location type (i.e., retail/commercial or residential), and the types of crime incidents that occurred in the location during 2011 (i.e., predominantly

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[67] For example, street segments corresponding to special locations like police agency stations, schools, or hospitals were excluded from consideration for the experiment. In setting the boundaries for the final locations, the research team and officers considered things like roadways, barriers, size of the location, and the boundaries of places like apartment complexes and retail shopping centers.
[68] The research team also worked with commanders and officers in a second district to plan a larger experiment that would have involved 36 hot spots (18 experimental and 18 control spots) across the two districts. However, agency personnel from the second district were unable to implement the study as planned due to other pressing issues that were affecting the district at that time.

theft or general crime and disorder).[69] From each pair, we randomly assigned one hot spot to the experimental group and the other to the control group (using a random numbers generator), thus designating nine experimental locations and nine control locations. Tests comparing the experimental and control hot spots confirmed that they had no statistically significant differences with respect to size or levels of crime and disorder: both groups averaged 135 reported incidents and 133-135 CFS during 2011, and they averaged from 0.002 to 0.006 square miles in size.

Intervention design

The hot spots intervention was carried out by a group of nine officers. Six of these officers were members of a special unit that engaged in various types of proactive work (e.g., bike patrols, investigations, stakeouts, etc.) throughout the district. The officers from this unit worked in pairs, and each pair had responsibility for working two of the experimental hot spots. In addition, three district patrol officers participated in the experiment, with each assigned to cover one experimental hot spot. However, there were times during the experiment when officers worked hot spots that were assigned to others, depending on need.

Project officers were initially asked to conduct three 15–30 minute stops per day at their assigned hot spots. However, they were given flexibility to remain longer than 30 minutes during a particular visit if they were engaged in an activity that warranted a longer stay (e.g., problem solving). Approximately one month into the experiment, the research protocol was formally modified to give the officers more discretion to conduct fewer but longer visits to the hot spots on a given shift when they felt that was most appropriate. This change was made in response to officer feedback indicating that they were often having difficulty making it to each location for three visits and that they felt it was often more productive to remain at the hot spots for longer periods.

Officers were also asked to complete a log sheet each time they stopped at a designated hot spot (see Appendix D). Officers used the logs to identify the hot spots they visited and to record the times when they entered and left the locations. The logs also had a checklist of proactive tactics grouped into the following categories: extra proactive visibility (e.g., foot or bike patrol, surveillance in a prominent location), using information technology (see list below), offenders and victims at places (e.g., conducting knock-and-talk visits with offenders or repeat victims,

[69] The matches were done independently by two members of the research team, who then discussed and resolved any discrepancies in their matches.

following up on incidents already reported), and proactive problem solving (e.g., engaging with property managers or business owners, conducting traffic stops and field interviews). Officers were asked to check off each type of activity that they conducted while in the hot spot, though the activities they chose were left to their discretion. Finally, the log had space for officers to provide a brief synopsis of actions they took at the hot spot and to record any noteworthy results from these actions (e.g., detecting a wanted person or making an arrest).

Within the technology section of the checklist (which was developed in consultation with the participating officers and others from Agency 1), we included the following items for possible application in crime hot spots using the officers' mobile computer units:

- Conduct deeper investigation of specific individuals or addresses.
- Examine recent calls, incidents, and other events in hot spot.
- Check license plates of moving or parked vehicles (with or without LPRs).
- Use LinX (Law Enforcement Information Exchange) to check suspects stopped.[70]
- Use the agency's AFIS (automated fingerprint identification system) to check suspects stopped who do not have identification.

In planning and training sessions, the research team encouraged the officers to consider proactive and strategic ways that they might use available information technology for more in-depth investigation and problem solving at hot spots. To help encourage and facilitate this, the back of the log sheet listed a number of tips for using Agency 1's RMS and computer-aided dispatch in proactive ways (see Appendix D).[71] These tips, which were developed with the assistance of those officers involved in the study who were well versed in the agency's technology functions, included the following (references to the name of the RMS system have been removed to preserve the anonymity of the agency and to avoid the appearance of promoting or critiquing a particular commercial product):

- Please use the technology available to you (see tips below) to help you address problems at that hot spot. This could involve simply running a tag or name on your mobile computer units, or finding patterns and problem

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[70] LInX is a regional data sharing system developed by the Department of the Navy, Naval Criminal Investigations. See http://www.ncis.navy.mil/PI/LEIE/Pages/default.aspx.

[71] The log also included other general tips on hot spots policing and responding to domestic violence (which was identified by agency personnel as a notable problem in many of the agency's hot spots).

addresses or people on [RMS] or LinX. Document as much as you can on the log regarding specific activities you do, even if they seem "ordinary."

- To problem solve at specific locations, you may need to obtain recent calls/incidents at that location. To do this on your MCT (mobile computer-aided dispatch terminal) – Go to Query / Events and enter in the address in question to search for prior events. Via [RMS] - Open the Locations Module and search on a location. This will bring up all Involvements for a particular address to include CFS, Incidents, Arrests, Citations, and Field Contacts.

- To search for people or find out about alerts linked to these hot spots, go to the Persons Module in [RMS] and perform a search using "Alerts" and the location in question.

- LInX is an excellent system for finding people associated with a subject, vehicle, or a location. You need to have received training on LInX to use this system. To access it via the MCT [mobile computer-aided dispatch terminal], go to Program Files / XXX [reference to server]. Launch the XXX neighborhood. The username and password required are the same as the County logon. Once logged into XXX, launch one of the Internet Explorer apps and go to [site removed] to connect. Once in LInX, you can search for people linked to an address or a vehicle. You can also search for a person and then search for associates related to that person.

- Crime analysts often collect specific trend information about hot spots. Talk to your station's crime analyst or examine the maps or list of repeat offenders they produce for your station. These analyses combine [RMS] information to create useful patterns to better understand crime problems at hot spots.

9.3 Implementation of the Intervention

The hot spot patrols were implemented over 11 weeks spanning from September through November 2012. In total, officers made 168 visits to the target hot spots. This averaged to almost 19 visits per location over the course of the 11-week experiment, or close to two visits per week to each location. The visits averaged 26 minutes. Officers spent most their time in the hot spots between the hours of 3 p.m. and 1 a.m. More specifically, 69% of the visits occurred between 3 p.m. and 1 a.m., and 81% occurred between 1 p.m. and 1 a.m. The remaining 19% of the visits were between 5 a.m. and 1 p.m., though most of these took place between 11 a.m. and 1 p.m. [72]

The dosage of patrol delivered to the experimental locations was considerably less than planned. As noted, some of the officers reported difficulty making it to their assigned hot spots, particularly for multiple visits during a shift. This was especially true for the patrol officers, who were assigned to hot spots outside their normal patrol areas. Further, there were occasions during the study when the specialized squad was called away from the experimental patrols for other assignments. However, our primary focus in this assessment is on how officers used technology at the hot spots. Further, our outcome analysis presented below controls for differences in dosage levels across the experimental hot spots and examines how the effects of dosage levels varied based on the officers' use of technology.

9.4 Technology Use and Other Activities at the Hot Spots

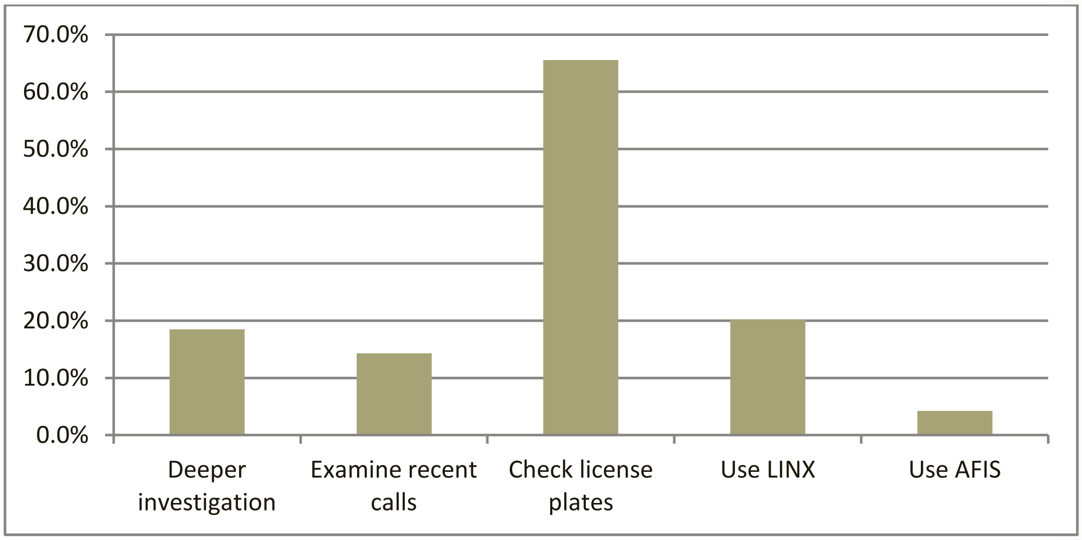
Analysis of Activity Logs

In general, officers were most likely to patrol the hot spots using traditional roaming patrol in their vehicles, which was an activity reported in 73% of visits. Other common activities included conducting surveillance in prominent locations (35% of visits) and conducting traffic stops (32% of visits). In this report, we specifically focus on the officers' use of technology. As the activity logs indicated, the most frequent use of technology in hot spots was checking license plates of moving or parked vehicles, which officers did in two thirds (66%) of their visits (see Figure 9-a). Officers used LinX to run checks on suspects in 20% of their visits. Further, they used the agency's information systems to conduct deeper investigations of particular people or places during 19% of their visits, and they used these systems to examine recent calls in the hot spots during 14% of their visits. Finally, officers used AFIS to check suspects without identification during 4% of their visits. The officers' log summaries also showed that there were two visits during which officers reported detecting wanted persons or vehicles using the agency's information systems.

[72] The officers assigned to the project worked three to four days per week, depending on shift rotations; hence, the experimental hot spots did not receive additional patrols every day of the week, nor did the patrols necessarily occur on the same days each week.

Although the officers appeared to make limited uses of technology, it is notable that they relied on technology more heavily than on many other strategies. Checking license plates was one of the most common of all activities in the hot spots, second only to vehicle patrol. Further, officers used technology to examine recent calls and conduct deeper investigation of persons or places more often than they conducted many other activities, including foot or bike patrol (used in 11% of visits), discussion of problems with community stakeholders and authorities (used in 10% of visits), and various other activities that were conducted even less frequently.

Figure 9-a: Percentage of visits in which officers used specific information technologies



Qualitative assessments of technology use

We also rode along with officers to observe their technology use and interviewed officers participating in the experiment during the intervention and after it was completed. During our ride-alongs with members of the specialized unit, we found, consistent with the activity logs, that officers were primarily focused on running license plates of vehicles either parked or in motion. Indeed, the officers spoke positively about working in two-person cars, precisely because one person could use the mobile computer unit to check tags while the other could drive and observe the location (they did not have LPRs affixed to their vehicles). During the post-experiment focus groups, officers reflected that running tags has been made easier and quicker by mobile technologies, and that automated fingerprint systems also improve their efficiencies. Interestingly, one officer remarked that the mobile technology systems reduced the necessity to make traffic stops, given that so much information could be examined even prior to the stop. This could potentially reduce contacts with individuals, which some officers viewed in a positive light, since traffic stops can often result in friction between the police and the community.

However, the complex and sometimes contradictory nature of technology in law enforcement was revealed when we pressed officers further about using technology for traffic stops. One officer said, “There are three generations of officers when it comes to technology—officers who won’t use it, a mixed middle-of-the-road group, and young officers who rely too much on technology.” Even though they found value in technologies allowing them to *not* stop vehicles that could be checked ahead of time, they also stated that these young officers “who rely too much on technology lack the ability to interact well with people…. Technology is depersonalizing.” Another example of this complexity was when one officer mentioned that “you can often learn more from a quick conversation with someone than from technology,” while other officers stated that not having good technology can hurt their ability to do their job. Ultimately, as one officer put it “There needs to be a balance between the technology and human work. There can be an overuse of technology.”

Further, when entering a hot spot, we noticed that officers tended to respond visually to problems rather than proactively engage with technology ahead of time to develop strategies or think about problems beforehand. Officers also confirmed this in our post-experimental focus groups, emphasizing that common sense and visual cues were particularly important in their work. Officers from both the specialized unit and regular patrol pointed to motivated supervisors, knowledgeable field training officers, or personal motivation as key determinants of whether officers use technology proactively towards strategic goals. They also argued that problem solving with technology took longer in some spots than others; 15 minutes in a spot may not always be useful for problem-solving strategies. Another felt that officers were getting less aggressive in policing, and that only a “small percentage do most of the proactive work.”

As with our findings from our surveys and interviews, we found that officers in Agency 1 who participated in our experiment were less likely to engage with technology in proactive or strategic ways other than running license plates or running information on people they had stopped. Further, when we asked them what technologies would be particularly important to them, they emphasized technologies that would help them identify people (i.e., fingerprint technology) or allow them to “get deeper into an investigation.” When they did use technology to do research on a particular place, they focused on locations given to them by other people (referrals, tips, bulletins) or places they had identified through social media (e.g., a place where a potentially troublesome party was going to occur). While they may do further research on that place, the technology systems available to them are primarily used in a reactive way, or for on-the-spot investigations of individuals or license plates.

Interestingly, when speaking to the regular patrol officers who also participated in the experiment, we found a wide range of technology use. Some officers conducted more non-technological proactive activities, including talking to juveniles, following up on particular crimes or other pieces of information, or showing visible presence. One officer described working with the local gym to encourage managers to reinstall a camera system to deal with larcenies from lockers, which was a frequent source of calls for officers. One particularly active officer in the experiment used technology in ways similar to those of the specialized unit described above—to run license tags. The officer also used technology to look at the call histories of specific locations (e.g., specific apartments in an apartment complex) and to read past reports of crimes at those locations.

The patrol officers mentioned that they do not receive highly customized information—and do not know how to access such information—from the RMS. For example, a "top 10" offender or address list within a hot spot could not be obtained, although the call history for a particular address could. One patrol officer suggested that when working alone, the computer work could be distracting and pose a safety hazard, especially when an officer was unfamiliar with the area. Unlike the specialized unit, the patrol officers did not have regular access to LInX.

When we asked the patrol officers what might encourage more use of technology within the rank and file, officers mentioned more training, knowing specific "tricks" to operating the system (especially for obtaining more in-depth information from the system), stressing the benefits of the system to officers, and using the email system to exchange information. But like the specialized unit officers, the patrol officers felt that some generational issues could not be overcome, and that not only do some officers not like change, but that some just won't adapt (they particularly pointed to older officers).

Overall, it appeared that technology enhanced the work of officers who participated in the experiment, although technology was more often used in support of traditional proactive work such as making traffic stops, conducting field interviews, and supporting investigations. Officers tended to adapt to the technology based on their own training and knowledge, and many tried to carry out proactive policing without technology in crime hot spots. Indeed, many officers we worked with were motivated by the prospects of being more proactive. One patrol officer stated that she would "rather be doing proactive work than writing reports, which is very cumbersome and time-consuming. If proactive work reduces crime, then it will eventually reduce report writing as a benefit." However, technology was rarely used to strategically or systematically direct officers' work outside of these operational modes, nor did the RMS system itself motivate officers to be proactive. Rather, officers characterized the system more as a resource to help them do more proactive work. The majority of their efforts (notably stops) are driven by visual cues and observations rather than computer information. Officers remarked that they were not entirely negative about the new RMS system, and that despite its problems, the growing base of data within the system helps them to access information more quickly.

9.5 Assessing Impacts from the Patrols and the Use of Technology

Data and methods

We examined the effects of the hot spots intervention on crime and disorder at the experimental locations as measured by total incident reports, thus testing the intervention's effects on a range of minor and serious forms of offending. To boost the sample size and statistical power of the analysis, we modeled the impacts of the intervention on a weekly basis using a panel dataset in which each observation corresponded to a given hot spot (i) during a given week (t). This produced a full panel database of 18 hot spots * 11 weeks = 198 observations. Using these data, we estimated the impacts of the patrols and technology uses using count models that controlled for dependence between observations from the same hot spot (e.g., see Allison, 2005). Based on preliminary tests of Poisson and negative binomial count distributions, we used models of the latter, which provided a better fit to the data as assessed by a likelihood ratio test. In log-linear form, a general representation of our basic model is given by:

$$\text{Log } \lambda_{it} = \mu_t + \delta \text{Intervention}_i + \phi \text{Block}_i + \beta X_{it-52} + \alpha_i$$

where the outcome variable, Y_{it}, has a negative binomial distribution with an expected value of λ_{it} (for additional details regarding these distributions, see, e.g., Allison, 2005; Cameron and Triverdi, 1986); δIntervention$_i$ represents the impact of the patrol intervention for the experimental locations; ϕBlock$_i$ represents the fixed effects of the statistical blocks used in the randomization procedure; βX_{it-52} represents a seasonally lagged time 1 crime measure of crime at hot spot (i) during the same week of the prior year (i.e., 52 weeks lagged from week t);[73] μ_t represents an intercept term that is allowed to vary with time; and α_i represents an unobserved random location-specific effect.[74] We estimated the models with generalized estimating equations (Zeger, Liang, and Albert, 1988; also see Allison, 2005) that allowed for dependence between observations from the same hot spot.[75, 76]

To assess how the impacts of the patrols may have been affected by officers' use of technology, we rank ordered the experimental hot spots based on measures of how frequently officers used technology in each location. As described below, we examined whether the effects of the patrols varied for locations with higher and lower levels of technology use.

Experimental results

Figure 9-b presents a series of implementation measures for the experimental locations. Visits per week to the experimental hot spots averaged about 1.7 and ranged from zero to 8. Total minutes spent by officers at these locations averaged 42 per week within a range of zero to 225. As noted earlier, dosage across spots and from week to week within spots varied considerably;

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[73] We used a seasonally lagged time 1 crime measure to ensure that the lagged crime measure for the experimental locations would not be affected by the impacts of the intervention in weeks prior to week t.

[74] This random component, which represents unmeasured differences between the locations, should be uncorrelated with the treatment effect by virtue of the experimental design.

[75] Preliminary testing using the QIC statistic (Hardin and Hilbe, 2003; Pan, 2001) suggested that an autoregressive process provided the best approximation of the correlation structure between observations from the same hot spot. We estimated the models using the generalized estimating equations method available in the GENMOD procedure of SAS software, version 9.3.

[76] Our method can also be explained with reference to a standard experimental analysis in which an outcome measure at time 2 is modeled as a function of the treatment / control group assignment and a measure of the outcome variable at time 1. In this application, time 2 would represent a given week of the experiment and time 1 would refer to the seasonal lag for that week. For each hot spot, this was tested 11 times (once for each week of the experiment).

approximately one third of the hot spot-week observations did not have any visits from the experimental patrols.

Figure 9-b: Implementation measures for experimental locations

Measure	Mean	Standard Deviation
Visits per week	1.67	1.86
Minutes per week	42.45	51.67
Technology uses per week	2.06	2.41
Technology uses per visit	1.41	0.98

N = 99 hot spot-week observations for the measures of visits, minutes, and technology uses per week. The technology uses per visit measure is based on 68 hot spot-weeks with one or more visits.

Figure 9-b also displays two measures of technology utilization. One reflects the total number of times officers used technology in a hot spot per week. This measure is a function of both how often officers visited their hot spots and how extensively they used technology when there. This indicator averaged two uses per week and ranged from zero to eleven. The second measure is technology uses per visit. This measure reflects how extensively officers used technology at the hot spots conditional on how frequently they visited. It was calculated as the number of total technology uses for the week divided by the number of visits for the week, conditional on the number of visits being greater than zero.[77] This measure averaged 1.4 uses per visit and ranged from zero to 4 (corresponding to the four types of technology use on the officer log).

Crime measures for the experimental and control locations are displayed in Figure 9-c. For each group, the table shows the average weekly number of crime reports during the project period and the average weekly number that occurred during the corresponding weeks of the prior year (i.e., a seasonally lagged time 1 crime measure). Hot spots in both groups averaged about two crimes per week during both the intervention and seasonally lagged periods. During the project period, the number of incident reports ranged from zero to six in the experimental locations and from zero to nine in the control locations.

[77] The first measure is thus an absolute measure of technology use while the second measure reflects more on relative use.

Figure 9-c: Crime measures for all locations

Measure	Mean	Std. Deviation
Crime reports (control)	2.02	2.05
Seasonally lagged crime reports (control)	2.04	2.30
Crime reports (experimental)	1.80	1.74
Seasonally lagged crime reports (experimental)	1.85	1.60

N = 99 hot spot-week observations for the experimental group and the control group (for a total N of 198).

Key results from two basic models of the intervention's effects are displayed in Figure 9-d. Model 1 shows the overall change in the experimental locations relative to the control locations (i.e., treatment as assigned) during the project period. Overall, crime reports declined 11% in the experimental hot spots, though this decline was not statistically significant (as judged by the conventional standard of a *p* level of 0.05 or less).[78] Because the delivery of the intervention varied considerably across sites, we also estimated a second version of the model in which the experimental locations were divided into high and low dosage groups. The high dosage locations were designated as those that were above the median (i.e., the top four treatment hot spots) on the average number of minutes of special patrol per week. By this criterion, the high dosage locations averaged 47 to 90 minutes of patrol per week during the experiment (which was still far below the target level), and the low dosage locations averaged 8 to 45 minutes per week. As shown by model 2, the high dosage locations experienced a significantly significant 24% reduction in crime reports relative to the control locations, while the low dosage locations showed no change. This suggests that the patrols reduced crime in the target locations when the dosage was sufficiently high.

[78] The percentage change measure is calculated by exponentiating the model coefficient, subtracting one, and multiplying the result by 100. This shows the percentage change in the outcome measure for a one unit increase in the predictor variable. In the case of the experimental variable, this represents the change in the experimental group relative to that in the control group.

Figure 9-d: Impacts of the hot spot patrols on rime incident reports

Models and Variables	Impact Coefficient (% change estimate)	Standard Error	P Level
Model 1:			
Experimental group	-0.12 (-11%)	0.09	0.18
Seasonally lagged crime	0.06 (6%)	0.03	0.02
Model 2:			
Experimental low dosage	0.01 (1%)	0.10	0.93
Experimental high dosage	-0.28 (-24%)	0.14	0.05
Seasonally lagged crime	0.06 (6%)	0.03	0.04

Models include statistical block effects and an intercept term, which are not shown. Estimates are based on generalized estimating equations that control for first-order autoregressive dependence between observations from the same hot spot. P levels are based on Z score statistics. N = 198.

In light of this finding, we focused our remaining analyses on the four high dosage locations (and their corresponding control locations) and examined whether the impacts of the patrols in these hot spots were enhanced by officers' use of technology. Figure 9-e presents models illustrating how the effects of strong patrol dosage varied by technology use as measured by technology uses per week (an indicator of overall technology dosage). Locations above the median on this technology measure were designated as high technology use locations, and the remaining locations were classified as having low technology use.

Model 1 contrasts two experimental hot spots that ranked high on dosage but low on technology use with their corresponding control hot spots over the 11 weeks of the study. Incident reports in these experimental locations declined 42% relative to trends in their matched controls, and this difference was statistically significant. Model 2 estimates the intervention's impact in two experimental locations that ranked high on both dosage and technology use. Relative to their matched controls, these experimental locations experienced no change in crime reports.

Figure 9-e: Impacts of the patrols on crime incident reports at high dosage locations by level of technology use (measured by technology uses per week)

Models and Variables	Impact Coefficient (% change estimate)	Standard Error	P Level
Model 1: High Dosage / Low Technology Versus Matching Controls			
Experimental group	-0.55 (-42%)	0.23	0.02
Seasonally lagged crime	0.15 (16%)	0.06	0.01
Model 2: High Dosage / High Technology Versus Matching Controls			
Experimental group	0.04 (4%)	0.11	0.70
Seasonally lagged crime	0.08 (8%)	0.08	0.29

Models include statistical block effects and an intercept term, which are not shown. Estimates are based on generalized estimating equations that control for first-order autoregressive dependence between observations from the same hot spot. P levels are based on Z score statistics. N = 44 for both models.

In Figure 9-f, we examine how the effects of the patrols varied based on technology use as measured by the average weekly number of technology uses per visit (a measure of technology use relative to patrol dosage). Among the four high dosage hot spots, the two locations that ranked highest on this measure were designated as high technology use locations, and the other two locations were designated as having low technology use.[79] The results of these models were similar to those presented above with respect to technology's mediating influence on the patrol results. The patrols were associated with a statistically significant reduction of 45% in crime reports in the high dosage, low technology locations. The patrols also reduced crime in the high dosage, high technology locations, but this effect was much smaller at 14%. Hence, none of the models in Figures 9-e and 9-f provide

[79] In this case, the high technology locations ranked at or just above the median on the technology measure across all nine experimental locations. The low technology locations ranked at the bottom of the experimental locations on this technology measure.

support for the notion that greater use of technology enhanced the effects of the patrols.[80]

Figure 9-f: Impacts of the patrols on crime incident reports at high dosage locations by level of technology use (measured by technology uses per visit)

Models and Variables	Impact Coefficient (% change estimate)	Standard Error	P Level
Model 1: High Dosage / Low Technology Versus Matching Controls			
Experimental group	-0.59 (-45%)	0.33	0.08
Seasonally lagged crime	0.49 (63%)	0.12	< .01
Model 2: High Dosage / High Technology Versus Matching Controls			
Experimental group	-0.15 (-14%)	0.03	< 0.01
Seasonally lagged crime	0.06 (6%)	0.05	0.19

Models include statistical block effects and an intercept term, which are not shown. Estimates are based on generalized estimating equations that control for first-order autoregressive dependence between observations from the same hot spot. P levels are based on Z score statistics. N = 44 for both models.

9.6 Discussion

Consistent with many other studies of hot spots policing, our patrol experiment in Agency 1 provides evidence that hot spots patrols reduce crime at high-risk locations given sufficient dosages (though this study suggests that sufficient dosages for crime prevention can be rather modest). More importantly, this study enabled the research team to examine the uses and impacts of mobile technology in the context of hot spots policing. We found that officers used technology primarily for checking automobile license plates and for running checks on people that they encountered in the course of activities like traffic stops and field interviews.

[80] Similar patterns for the interaction of patrol effects and technology use were found in analyses with the low patrol dosage locations and their matched controls (analyses not shown), though the patrol effects were not statistically significant in those analyses.

Technology was an important tool that officers used to support proactive policing, but they tended to use technology in more traditional ways that emphasized surveillance and enforcement. In contrast, officers did not often use technology in ways that emphasized problem solving and crime prevention.

Further, our examination of the effects of the patrols indicated that greater use of technology was associated with weaker rather than stronger crime prevention effects. In other words, greater use of technology did not make officers more effective in reducing crime; if anything, the results suggested that officers were less effective when they used technology more extensively. These results can arguably be interpreted in multiple ways. One possibility is that officers' use of technology was largely in reaction to the level of activity in the locations. Hence, officers may have tended to use technology more extensively, particularly for running checks on license plates and people, in places with higher levels of vehicular and pedestrian traffic, and the patrols may have tended to have less impact in these locations. Under this interpretation, technology use did not discernibly enhance officer performance, but it did not undermine it either.

Another interpretation, however, is that the patterns in the experimental results could be due to officers conducting other types of proactive approaches in hot spots that were effective and did not rely on technology. Some officers, for example, discussed carrying out non-technology activities like speaking with children and discussing problems with place managers. Some also remarked that technology can be distracting when driving alone, and that officers can get too preoccupied with technology at the expense of other effective activities. Further, technology may shift street-level activity to one type of activity—checking license plates. As officers indicated, this might reduce the amount of interaction between officers and people and reduce the visibility and activity of officers more generally. In these regards, it is possible that an overreliance on technology makes officers less effective, as perhaps suggested by the experimental results.

An additional point to emphasize is that officers tended to use technology to facilitate more traditional types of proactive activities (i.e., surveillance and enforcement) rather than preventive problem solving, which tends to be particularly effective in reducing crime at hot spots (e.g., Taylor et al., 2011a). The value added (or marginal effects) from more limited, traditional uses of technology in the field may be small, as evidenced by the experimental results and the fact that the hot spots officers made very few apprehensions based on information pulled from their technology systems.[81] It is thus possible that greater training and emphasis on the uses of technology for problem solving at hot spots—and better design of technology systems to facilitate such work—would lead to more effective technology use and more discernible impacts from technology in the field.

As a caveat, we note that our experiment was based on small numbers of hot spots and officers in one suburban jurisdiction. Accordingly, we must be cautious in generalizing our results to other places and officers. Also, our quantitative assessment of the impact of technology on crime at the hot spots was not based on random assignment (which was not practical) but rather on the interaction of technology use with a randomly assigned patrol intervention, supplemented by quantitative and qualitative analyses of officer activities and technology use. Nonetheless, our study provides insights into the uses and impacts of police technology at the street level and illustrates some of the complexities and contradictions involved in assessing the effects of technology on police behavior and effectiveness. It also serves to further illustrate that whether technology brings about measurable benefits in policing can depend heavily on how it is implemented and used.

[81] This is also consistent with inferences from our more general trend analysis (see Section 8) that examined the impacts of Agency 1's RMS and LPR expansion on trends in crime and clearances.

10. Evaluating the Effects of an Information-Sharing Social Media Technology on the Outcomes of Robbery Investigations in Agency 2

10.1 Introduction

In addition to our surveys, fieldwork, and experiment, the George Mason team also sought to understand the effects that technology had on improving investigation outcomes. As discussed in Section 6, police agencies often define the efficiency and effectiveness of technology through the lens of case clearance and arrest. In the spring of 2012, Agency 2 implemented a new information-sharing technology that was modeled after social media and designed to increase information flow and collaboration among detectives, crime analysts, and patrol officers. Access to the technology was initially limited to crime analysts and robbery detectives citywide and to a select group of patrol officers in one of the city's six patrol zones. As part of our research in Agency 2, we studied the implementation of this technology and conducted a series of trend and quasi-experimental analyses to assess its impact on the outcomes of robbery investigations. More specifically, we used survival analysis techniques to determine whether the use of this technology improved the likelihood and timing of case clearances in robbery investigations.

10.2 The Technological Innovation (Describing the "W-System")

The information-sharing system implemented by Agency 2 is an innovation that was developed by the agency's crime analysis unit (CAU) with the assistance of a private software vendor. We refer to it here as the "W-System" in order to preserve the anonymity of Agency 2 and to avoid the appearance of promoting a commercial product. The W-System was designed to be an "all access source" that would facilitate better communication and information exchange between crime analysts, detectives, and patrol officers, particularly on cases linked to crime patterns, series, and trends identified by the CAU. It was implemented in response to what some in the department considered to be a key limitation of how crime information was currently disseminated, namely, that it originated in one place and was unidirectional, simply flowing outwards from the CAU with little opportunity for others to participate or provide feedback. The idea behind the W-System was to provide a more dynamic system that allowed information to be collected and shared in one location from diverse sources throughout the agency all at once.

The W-System is located on the CAU's home web page and can be used interactively by personnel who have been trained on the system and given a user's identification. The system operates much like a discussion board or blog. Indeed, one key consideration in the system's design was that the CAU wanted it to look and feel much like other contemporary social media technologies that many officers are accustomed to using in their personal lives. It was believed that this would increase enthusiasm about using the system, particularly among younger detectives and patrol officers.

On the CAU website, one can view various crime maps and alerts regarding patterns, series, and trends identified by the CAU. The website also has update links providing information about recent events pertaining to each agency zone and specific types of crime. Registered users of the W-System have the ability to post comments regarding CAU alerts and to create new posts of their own. They can then link (i.e., "tag") their posts to information regarding particular crime types and/or zones, as applicable.[82] For detectives, this also provides the ability to post information regarding specific cases that can be shared with other detectives and crime analysts, as well as with patrol officers. As described by one of Agency 2's crime analysts, the ideal vision for the system was to promote exchanges like the following:

> We [crime analysis] put out the information and then officers themselves could post and that information would be there for us. A posting regarding a white male and … a black Honda Civic … we put the posting out there and below there would be areas for replies, and an officer, if they had any information, could go and post with a simple informal message: "hey, you know, I had contact with somebody"; or, "I did a [field interview] with somebody during that particular time that may be a possible suspect." Analyst would see it, detective [who is working the case] would see it, officer would see it, and his peers would see it. Like a wall posting on Facebook."

[82] The system also gives users the ability to attach pictures or videos to their posts.

Agency 2 staff members noted that within the agency there were already many formal and informal channels of information exchange—including emails, phone calls, alerts, and in-person meetings—among detectives, crime analysts, and patrol officers. Further, one crime analyst is assigned to work specifically with the robbery unit.[83] However, the W-System was meant to supplement and expand these channels of information exchange. As one detective noted, the idea behind the system was that “everyone could put their two cents in” and share this information more rapidly and easily.

In addition, CAU integrated various databases into the system in order to give officers and analysts a “one-stop” location for accessing and searching a variety of agency data systems. For example, a search for a particular individual through the W-System can provide information on investigations, field interviews, or other information related to that person.[84]

In sum, the W-System was designed to try and provide a basis for more dynamic, systematic, and widespread information exchanges between officers (particularly detectives) and crime analysts, as well as among officers themselves. CAU managers also hoped that the system could help the agency to harness what they believed to be a reservoir of untapped, informal knowledge that officers pick up in the course of their formal duties and their off-duty interactions with people around the city—information that might not otherwise be shared or put to use within the agency. Finally, a goal of the system was to provide new opportunities for the CAU to obtain feedback on its analyses and provide a more dynamic, interactive form of crime analysis. The W-System is an opportunity for officers to provide feedback on crime analysis information in real time. Analysts can then incorporate and immediately share this information with others. Some hoped that this would increase the use of crime analysis, particularly among patrol officers, and prompt more officer engagement with crime analysts.

[83] As discussed elsewhere in this report, detectives in Agency 2 generally reported having very strong cooperative relationships with crime analysts.

[84] Agency 2 also has a master name index system that enables officers and analysts to find reports and data entries related to particular people, but the W-System was intended to make it easier for officers to retrieve the information from these sources.

10.3 Implementation and Use of the Technology

Agency 2 managers chose to pilot the W-System for robbery investigations in 2012. Agency 2's robbery detectives, who constitute a centralized unit of approximately 26 individuals serving the entire city, were trained on different aspects of using the system during 2011 and June 2012. In addition, the CAU trained approximately 120 patrol officers on the system in one of the agency's patrol zones, designated here as "Zone X," during late 2011. In this section, we assess the implementation and use of the W-System based on: 1) an analysis of Agency 2 data that tracked system views and contributions by crime analysts, detectives, and patrol officers; and 2) results from interviews and focus groups with robbery detectives and staff of the CAU. Use of the system by detectives and patrol officers began in earnest in June 2012 (the CAU had begun using it earlier), and our analysis focuses on uses of the system from that time through the beginning of August 2013.

Use by analysts

Figures 10-a and 10-b show monthly trends during this period in crime analysts' views of the system and their contributions to it. Both figures indicate that analysts viewed and posted robbery alerts (which pertain to robbery suspects or to patterns, series, or trends identified by the analysts) fairly regularly throughout the study period.[85] In terms of postings, there were five months when they contributed between 10 and 20 alerts to the system each month, five months when they made 30 to 81 contributions, and one month when they added over 100 contributions. (This left three months when the analysts made less than ten contributions.) As a caveat, the particularly large spikes in viewings and postings in March 2013 and the large spike in postings in February 2013 correspond to months when the analysts were conducting system training for burglary detectives and patrol officers in another patrol zone (outside Zone X). Excluding these months, viewings per month were typically in the range of 200 to 500. Postings per month were typically in the range of 10 to roughly 60. Note that some of the postings made by analysts during the spring and summer of 2013 likely corresponded to burglary cases (we could not count this precisely), but the use of the system to solicit patrol assistance with

[85] It was not possible to count how many of these corresponded specifically to Zone X, but that area accounted for 23% of Agency 2's robbery cases during this time.

burglary cases was delayed until after the study period (consequently, most of the analysts' postings during the study period would have pertained to robbery alerts).[86]

Figure 10-a. Analyst views of W-System by month, June 2012 – July 2013

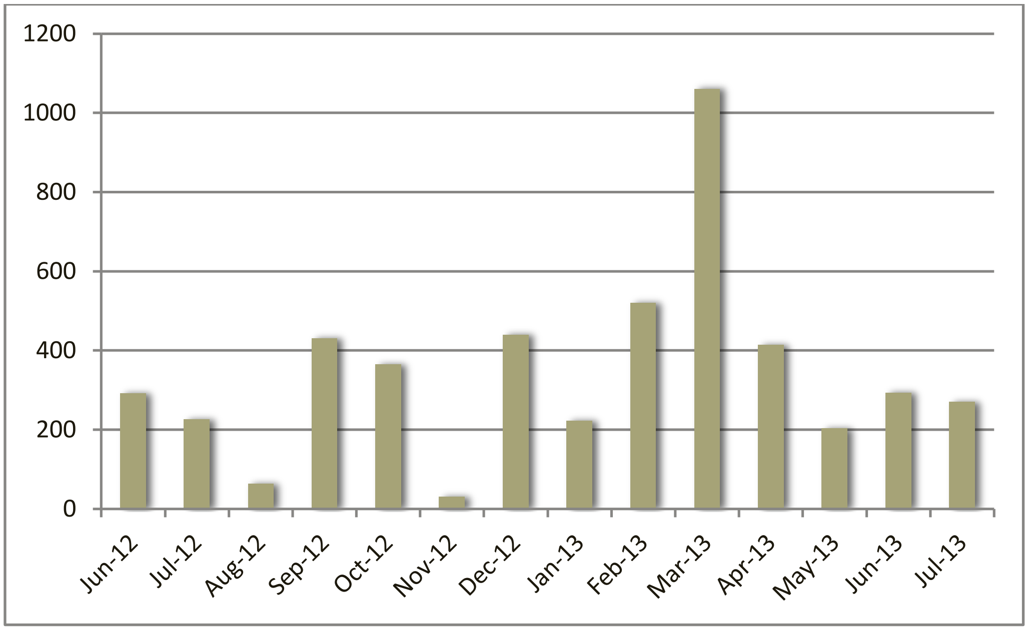
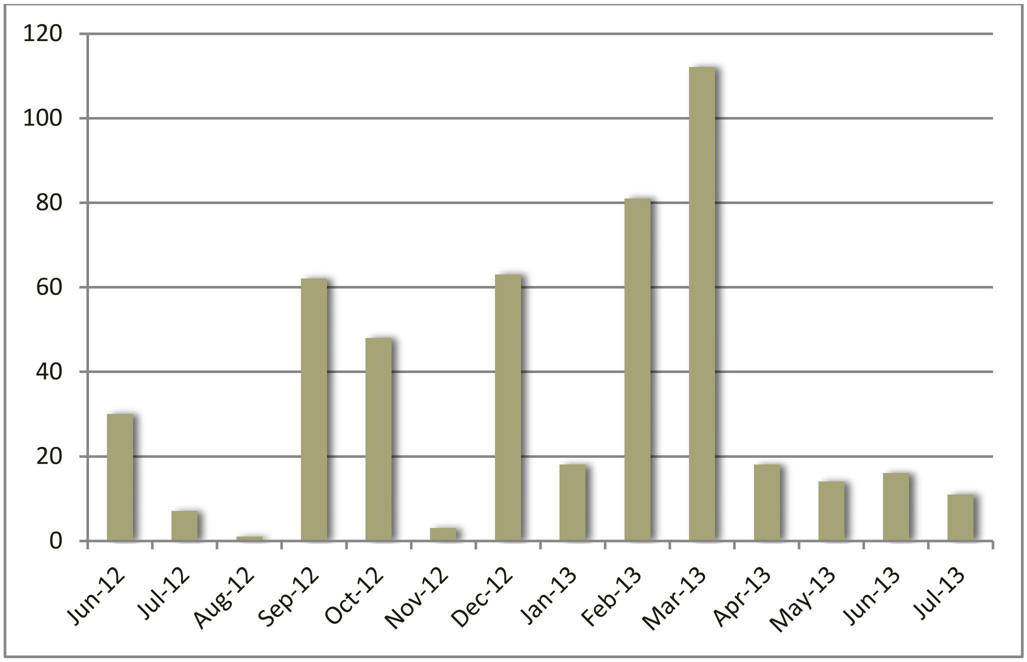


Figure 10-b. Analysts' posts to W-System by month, June 2012 – July 2013

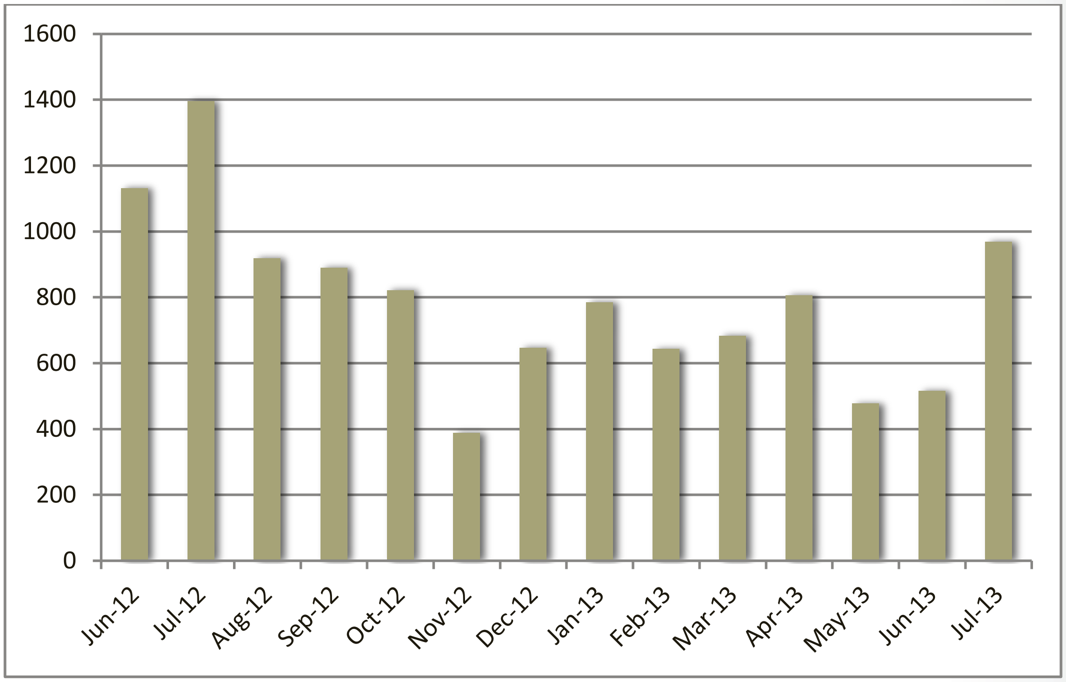


[86] The system was used by 17 analysts, 12 of whom made postings.

Use by robbery detectives

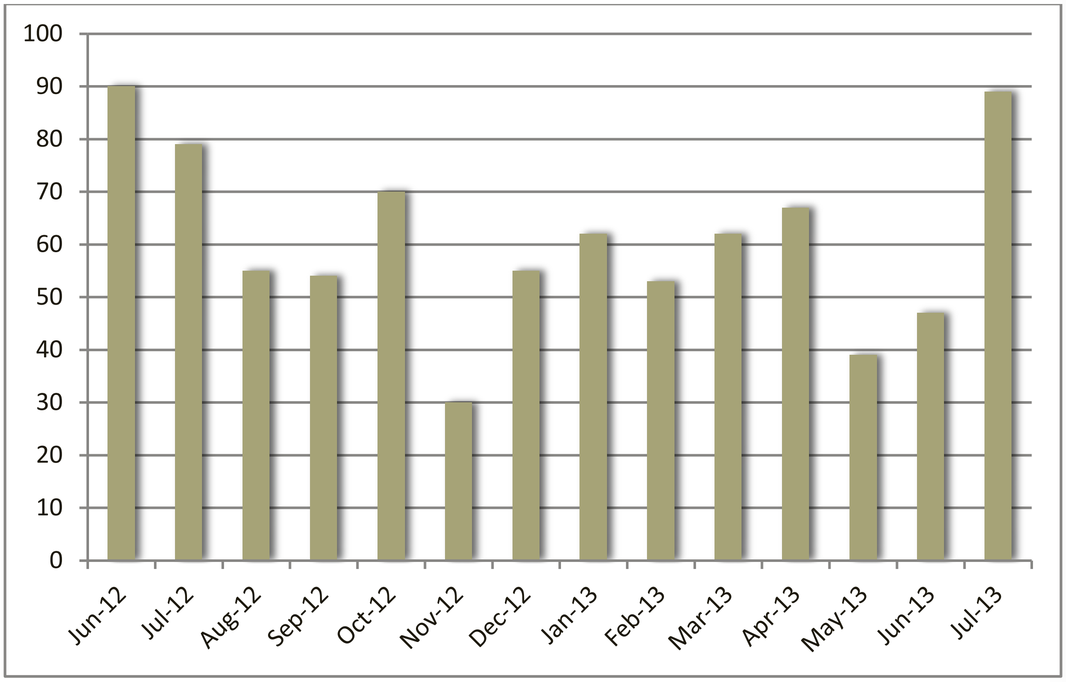
Trends in the use of the W-System by robbery detectives are illustrated in Figures 10-c and 10-d. Both figures show that robbery detectives were viewing and posting information on the system regularly throughout the study period. The robbery detectives made between 50 and 90 posts to the system during most of the study months, and there was no pronounced trend upward or downward in their postings. Overall, detectives entered information on 29% of their robbery cases into the system during this period.[87]

Figure 10-c. Robbery detective's views of W-System by month, June 2012 – July 2013



[87] Case information entered into the system included basic information about the type of robbery and its location, the identities of the victim(s) and suspect(s), a synopsis of the event, and pictures (if available).

Figure 10-d: Robbery detectives' posts to W-System by month, June 2012 – July 2013



In our interviews with robbery detectives, many indicated that they primarily used the W-System to replace a "pass-down" log system that they had long used (initially in paper form and later in electronic form). The "pass-down" log system allowed detectives working evening, night, and weekend shifts to pass along case information from one shift to the next to maintain continuity of casework and information flow among shifts. Although the use of the W-System for this purpose seemed to vary across circumstances and detectives (the detectives also had other databases that they used regularly for case management),[88] it seemed in general that cases posted for this pass-down function had greater significance due to their characteristics or to developments in their respective investigations. Examples included cases in which a suspect(s) was arrested or identified, cases linked to alerts posted by the CAU, cases involving gunshot victims, and other cases that resulted in a detective being called out to the scene. Managers also encouraged detectives to enter all business robberies, home invasion robberies, and carjacking robberies, irrespective of when they occurred. An analysis of Agency 2's robbery cases by the research team revealed that while detectives entered nearly all business robberies

[88] Twenty-one of the 26 robbery detectives (81%) trained on the system posted cases. Roughly two thirds (69%) of the contributors posted more than 30 cases, and nearly one quarter (23%) posted more than 50.

into the system (these cases are highlighted in the outcomes analysis presented below), they were less consistent in posting home invasion and carjacking cases.

Although detectives entered a substantial share of cases into the W-System, interviews with detectives suggested that they felt the W-System had little, if any, effect on collaboration among detectives or on case outcomes. As noted, many cases entered into the system involved a suspect that had already been identified or arrested. Further, detectives continued using other databases with which they were well accustomed for case management. Detectives found these other data systems easier to search than the W-System, which reportedly had technical problems in its rollout (including connectivity issues) that made data entry and searching more difficult. Thus, detectives found the W-System increased their data entry work. In part for these reasons, detectives did not regularly update case information entered into the system (i.e., once a case was entered, they did not return to it to input information on any developments), nor did they use it to engage in more general discussions of cases. Instead, they continued to rely on other well-established means to communicate among themselves (i.e., email exchanges, phone calls, staff meetings, and other personal contacts). In these respects, detectives felt that the W-System was redundant with other data systems and communication norms that detectives had for sharing information.

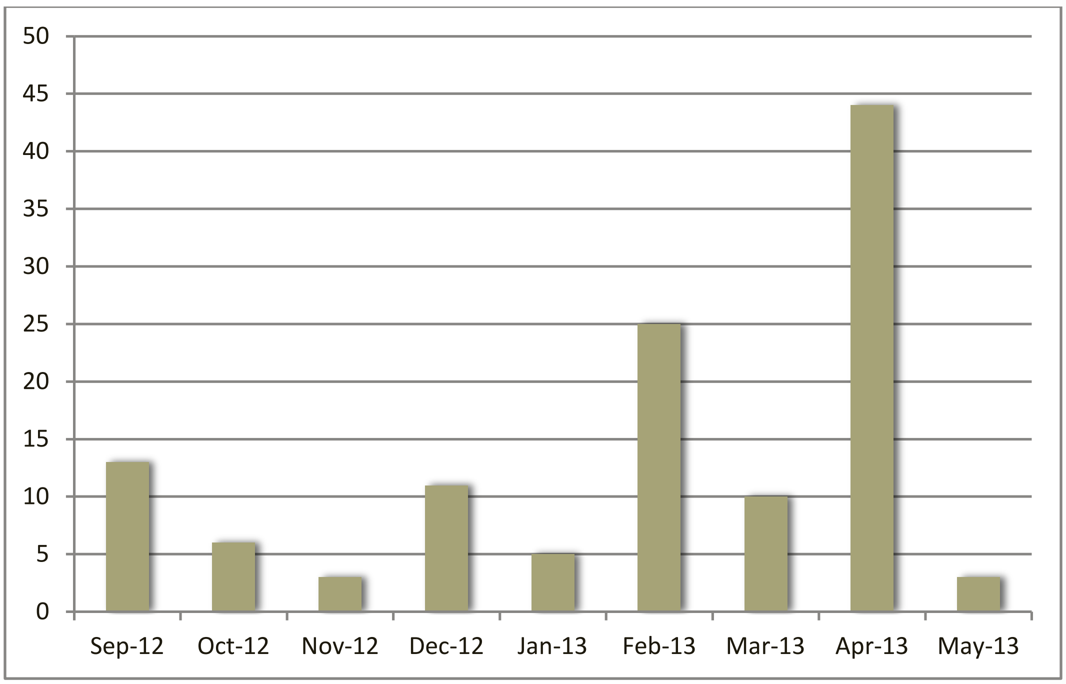
Similarly, the W-System seemed to prompt little, if any, change in robbery detectives' communication and collaboration with crime analysts and patrol officers. As discussed above, one member of the CAU is assigned to work with robbery detectives, and both analysts and detectives felt that the two groups had strong working relationships before the implementation of the W-System. It was clear that detectives greatly valued crime analysts and their role in robbery investigations, irrespective of the W-System. Consequently, detectives may have seen little need to use the system to engage in broader discussions with crime analysts.

Perhaps more significantly, detectives did not report using the system to solicit wider assistance from patrol officers in Zone X. Patrol officers trained on the system do not have access to cases entered by robbery detectives (this access is controlled by a users' group function that limits viewing of these cases to robbery detectives). However, the system gives detectives the ability to post information for review and comment by patrol officers. This provides robbery detectives with an additional means of soliciting assistance from patrol officers when detectives have leads about possible suspects but need further information or assistance in identifying and apprehending them. Yet despite this capability, detectives continued to rely on other established means of formal and informal communication when they needed assistance from patrol.[89]

Use by patrol officers in Zone X

Zone X patrol officers who were trained on the W-System had the ability to comment on CAU alerts and to add information regarding specific robbery cases when such information was posted for general viewing by system users. Nonetheless, these officers made very limited use of the system. Only 13 of the trained patrol officers used the W-System, and none submitted postings. Further, most of the patrol users (62%) viewed the system no more than 10 times. As shown in Figure 10-e, Zone X patrol officers only accessed the system between September 2012 and May 2013, and they collectively viewed the system no more than 13 times during most of those months.

Figure 10-e. Patrol officers' views of the W-System by month, June 2012 – July 2013



The fact that robbery detectives made little use of the system to solicit assistance from patrol likely contributed to the low levels of system use by patrol officers. The lag time between the officers' training and the implementation of the

[89] During the study period, Zone X experienced nearly 950 robberies.

system may have been another contributing factor. However, members of the CAU who participated in officer training noted that officers did not seem particularly receptive to the technology from the outset. As with many technological changes, officers may have felt that using this technology (particularly for posting comments) was too time consuming and burdensome in the context of patrol work (and this sentiment was likely exacerbated by technical difficulties users experienced during the initial rollout of the system). Some interviewees felt that the patrol officers' reaction to the system also reflected a general disconnect between patrol and crime analysis. As explained by some (and as discussed elsewhere in our study of Agency 2), patrol officers tend to have less direct communication with the CAU and to view crime analysis as a product that was less relevant to their work than to that of supervisors and command staff, who were less familiar with conditions at the street level. Some interviewees also pointed to a more general, cultural reluctance among officers to share information about what they knew or were doing in order to ensure that they could take credit for any significant developments in any cases with which they were involved. It is difficult to know whether officers had information to offer for any substantial portion of the robbery alerts posted. But when they did, they may have preferred to make the cases for themselves or to rely, as did detectives, on their normal networks and methods of communication to share information.

In sum, our process evaluation of the implementation and operation of the W-System suggests that crime analysts and robbery detectives used the system regularly for, respectively, posting robbery alerts and passing case information between shifts. However, robbery detectives made very limited strategic use of the system to increase communication and collaboration among themselves or with crime analysts and patrol officers. Patrol officers in Zone X also made very little use of the system to provide feedback or intelligence regarding robberies and robbery patterns reported by the CAU. These findings suggest that it is unlikely the W-System had any appreciable impact on the outcomes of robbery investigations during its pilot phase. In the next section, we examine this issue more explicitly.

10.4 Assessing the Technology's Impact on Robbery Case Outcomes

To evaluate the W-System's impact on the outcomes of robbery investigations in Agency 2, we focused on two issues. First, we examined whether there was an agency-wide improvement in case clearance rates following the implementation of the W-System in June 2012. To do this, we tested for pre- to post-intervention changes in clearances of robberies overall and for changes in clearances of particular types of robberies that were prioritized for entry into the W-System. Second, we examined whether robbery case outcomes improved in Zone X (where Agency 2 provided patrol officers with access to the system and training in its use) relative to trends in other patrol zones following the implementation of the system. For the latter analysis, we employed a quasi-experimental nonequivalent control group design to test for differences in pre-post case clearance trends in Zone X and other patrol zones.

Data and methods

We studied these questions using data on 4,097 robbery incidents reported to Agency 2 from January 2011 through August 7, 2013. Overall, 27% of these cases had been cleared as of August 8, 2013. Of these, 82% were cleared by arrest and the remainder (18%) were "exceptionally cleared," meaning that the agency had identified and located the suspect(s) but could not arrest the suspect(s) due to circumstances outside the agency's control (e.g., death of the suspect or a victim's refusal to cooperate with prosecution).[90] Just over a quarter (26%) of the cleared cases were cleared on the same day as the incident. In these cases, we can expect that the suspects were typically captured at or near the scene or readily apprehended based on identification by victims or witnesses. These cases were dropped from the analysis based on the premise that the W-System would have its greatest utility and impact in cases that required more follow-up investigative effort. This left a final sample of 3,813 cases for analysis.

Among this final sample of cases, 443 (12%) were entered into the W-System. More than half of these cases (54%) occurred during 2012 and virtually all of the remainder occurred during 2013.[91] W-System cases represented 17% of all robbery cases in the sample from 2012 and 25% of all robbery cases in the sample from 2013. Overall, 49% of W-System cases were cleared during the study period in contrast to 18% of cases not entered into the system. However, this cannot be interpreted as evidence that the W-System improved case outcomes, because, as

[90] Agency 2 follows Federal Bureau of Investigation guidelines for determining exceptional clearances (e.g., see http://www.fbi.gov/about-us/cjis/ucr/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/clearances).
[91] Only three cases were entered into the system during 2011.

noted, detectives were more likely to enter cases into the system when (among other things) an arrest had been made or a suspect had been identified.

We assessed the impact of the W-System on case outcomes using methods of survival analysis, a group of statistical techniques for analyzing the occurrence and timing of events (e.g., see Allison, 1995). These methods were used to analyze the time from each robbery's occurrence until its clearance by police or the end of the study period (August 8, 2013), whichever came first. In the latter case, an observation was censored, meaning that we know only that the case was not cleared—i.e., that it "survived"—during the time that elapsed between its commission and the end of the study period. Survival analysis techniques were developed specifically for the study of censored data. These methods allow us to control for the time during which each case was observed to be under investigation (i.e., "at-risk" of clearance) and to control for the simultaneous influence of other case characteristics on the likelihood and timing of case clearance. We say more about the specific survival methods below.

Agency-wide changes in robbery clearance rates following implementation of the W-System: Life table and multivariate results

Figure 10-f shows the probabilities that robbery cases handled by Agency 2 were cleared within selected follow-up periods for cases that occurred before and after the implementation of the W-System. These estimates are based on the life table method of survival analysis.[92] They are adjusted for censoring and thus

[92] In the life table method, the analyst groups the event times into intervals of a chosen length—in this application, weeks—and calculates S_t, which is the probability that the case "survived" (i.e., did not experience the event of interest) to the start of interval t. For each interval, the value of S_t is based on the probabilities of events occurring in prior intervals. For example, the probability of surviving to the third interval or beyond would be the product of $(1-q_1)(1-q_2)$, where q_1 and q_2 represent the probabilities of events occurring during intervals 1 and 2, respectively. For a given interval, the probability of an event (conditional on survival to the start of the interval) is denoted as $q = d / (n – m/2)$, where d equals the number of events occurring during the interval, n refers to the sample at risk at the start of the interval (i.e., the number of cases that haven't experienced an event or been censored by the start of the interval), and m is the number of cases censored during the interval (Teachman, 1983:270). For further discussion of the life table method, see Allison (1995) and Teachman (1983). The life tables were estimated using the LIFETEST procedure in SAS software, version 9.3.
The values presented in Figure 9-6 are based on $1-S_t$. To illustrate, the probability that a pre-W-System case survived (i.e., was not cleared) to the start of week 2 (7 days) was 0.93. Conversely, the probability that the case was solved by the start of week 2 was 1-0.93, or .07, which is presented in Figure 9-6 as the probability that the case was cleared within 1 week (7%).

account for differences in follow-up time for cases that occurred at different points during the study period.[93]

Prior to the use of the W-System, robbery cases had a 7% chance of being cleared within one week, a 14% chance of being cleared within four weeks, a 20% chance of being cleared within 12 weeks, and a 24% chance of being cleared within a year. These probabilities declined somewhat after the W-System was established. For example, the likelihood of clearing a case within a year dropped from 24% to 21%. (Note that these figures should not be interpreted as Agency 2's overall robbery clearance rate because they exclude cases that were cleared on the day of occurrence.)

Figure 10-f. Likelihood of case clearance within selected periods for robbery cases before and after implementation of the W-System (N = 3,813 robbery cases investigated by Agency 2, 2011 – August 2013)

Follow-Up Time	Before W-System	After W-System
1 week	7%	7%
2 weeks	10%	10%
3 weeks	12%	11%
4 weeks	14%	12%
8 weeks	18%	15%
12 weeks	20%	16%
1 year (52 weeks)	24%	21%

Life table estimates. Differences between groups were statistically significant at $p <= .05$. Analyses exclude cases that were cleared on the day they occurred.

To further assess changes in clearance rates after the start of the W-System, we also estimated multivariate models testing for a post-system change in clearances while controlling for selected case characteristics (and changes therein over time). Robbery incident data provided by Agency 2 contained information on several case characteristics including the number of offenders, the number of

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[93] For example, a robbery that occurred on August 8, 2012, would have had a potential follow-up time of one year in the data before being censored. In contrast, a robbery on August 1, 2013, would have had only eight days of potential follow-up time before the end of the study period.

victims, the nature of the robbery and victim (e.g., business or individual robbery), whether or not a juvenile suspect was involved, and the type of weapon used.[94] Preliminary analysis suggested that a number of these variables were related to the likelihoods of both clearance and entry into the W-System.

We assessed the simultaneous effects of these factors on the outcomes of robbery investigations using Cox proportional hazards (CPH) models. These models provide estimates of how the selected characteristics affected a case's "hazard rate," which essentially represents the risk that the event of interest—in this case, a clearance—occurred at a given point in time, conditional on the event not having occurred before that point.[95]

The results of this model are displayed in Figure 10-g. The effect of each indicator is presented as a hazard ratio, which shows the indicator's multiplicative impact on the hazard rate of clearance (i.e., the likelihood of clearance). If the ratio is greater than one, it indicates that the characteristic in question increased the hazard; a ratio less than one shows that the characteristic reduced the hazard. If the robbery involved a business, for example, the hazard was increased by a factor of 1.87. This effect can also be expressed in percentage terms by subtracting one from the hazard ratio and multiplying the difference by 100. Thus, the hazard of clearance increased by (1.87 - 1)*100 = 87% when the case involved a business. Ninety-five percent confidence intervals are also presented, showing a likely range for each estimated hazard ratio (coefficients that were statistically significant at the 5% level are listed in bold).

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[94] We also tested indicators for home invasion and carjacking robberies. These indicators were statistically nonsignificant, and we did not include them in the final models.

[95] The Cox proportional hazards model is often expressed as: $h_i(t) = \lambda_0(t)\exp(B_1x_{i1}+\ldots+B_kx_{ik})$, where $h_i(t)$ represents the hazard for subject i at time t, $\lambda_0(t)$ represents a baseline hazard function (which can be regarded as the hazard function for a subject whose covariates all have values of zero), x_{i1} through x_{ik} represent a set of fixed covariates, and B_1 through B_k represent the effects of those covariates (these effects are then exponentiated) (Allison, 1995: 113–114). The model assumes that the ratio of the hazards for any two subjects remains constant over time (i.e., that they remain proportional to one another), but makes no assumption about the distribution, or shape, of the baseline hazard rate. Estimation was done using procedure PHREG in SAS software, version 9.3, with robust standard errors (Lin and Wei, 1989).

Figure 10-g. Change in the likelihood of robbery case clearance pre– and post–W-System, controlling for selected case characteristics: Cox proportional hazards model estimates (N = 3,812 robberies investigated by Agency 2, 2011 – August 2013)

Indicators	Hazard Ratios and 95% Confidence Intervals
Post–W-System	0.99 (0.86 – 1.15)
Business robbery	1.87* (1.57 – 2.22)
Juvenile suspect	7.30* (6.07 – 8.78)
Number victims	0.98 (0.88 – 1.09)
Number offenders	1.74* (1.57 – 1.92)
Gun robbery	0.82* (0.71 – 0.95)

* Statistically significant at $p <= .05$. Analyses exclude cases that were cleared on the day they occurred.

In general, the results indicate that cases were more likely to be solved when they involved a business robbery, a juvenile suspect, and/or multiple offenders. Cases were also more likely to be cleared when they did not involve firearms. However, there was virtually no change in clearances (more specifically, there was only a statistically nonsignificant 1% drop) following the establishment of the W-System (as represented by the "post–W-System" indicator).

We supplemented the preceding analyses of all robbery cases with an examination of changes in clearances for business robberies. As noted earlier, robbery unit and CAU managers made a special effort to encourage more collaboration on these cases by directing detectives to enter all of them into the W-System. Compliance with this directive was high, as detectives entered 84% of business robberies into the system after May 2012. Analyzing changes over time in the outcomes of these cases enabled us to focus on a subset of cases that were more likely to have been affected by the system and to compare pre-system and post-system cases with similar characteristics (thus reducing the influence of potential confounders).

Life table estimates of clearance rates for business robberies are shown in Figure 10-h. In general, business robberies had higher clearance rates than other types of robberies (for comparison, see Figure 10-6). But more importantly, clearance rates for business robberies did not improve after the W-System was started (rather, they declined for longer follow-up periods).[96]

Figure 10-h. Likelihood of case clearance for business robbery cases before and after implementation of the W-System (N = 533 robbery cases investigated by Agency 2, 2011 – August 2013)

Follow-Up Time	Before W-System	After W-System
1 week	10%	11%
2 weeks	16%	14%
3 weeks	20%	15%
4 weeks	22%	17%
8 weeks	29%	20%
12 weeks	36%	26%

Life table estimates. Differences between groups were statistically significant at $p <= .05$. Analyses exclude cases that were cleared on the day they occurred.

We also estimated a multivariate CPH model for business robberies, which is displayed in Figure 10-i. The model controls for the juvenile suspect, victim, offender, and weapon variables described earlier. Controlling for these factors, the clearance rate for business robberies declined 21% following the implementation of the W-System, though this change was not statistically significant.

[96] As discussed, 16% of post-intervention business robberies were not entered into the system. However, a separate analysis that compared cases actually entered into the system with those not entered (during both the pre- and post-intervention periods) also failed to show any improvement for cases entered into the system. To illustrate, the one-year clearance rate was 31% for business robberies entered into the W-System and 33% for other business robberies.

Figure 10-i. Change in the likelihood of business robbery case clearance pre– and Post–W-System, Controlling for Selected Case Characteristics: Cox proportional hazards model estimates (N = 533 business robberies investigated by Agency 2, 2011 –- August 2013)

Indicators	Hazard Ratios and 95% Confidence Intervals
Post–W-System	0.79 (0.56 – 1.11)
Juvenile suspect	5.17* (3.53 – 7.57)
Number victims	0.97 (0.66 – 1.43)
Number offenders	1.39* (1.01 – 1.91)
Gun robbery	0.45* (0.33 – 0.62)

*Statistically significant at *p* < = .05. Analyses exclude cases that were cleared on the day they occurred.

In summary, our examination of post-intervention changes in clearance rates for total robberies and business robberies suggests that use of the W-System did not improve the outcomes of robbery investigations.[97] This is consistent with inferences drawn from our process evaluation of the system's implementation. In the next section, we examine whether the added patrol intervention in Zone X produced any effects on robbery investigations that were unique to that zone.

Testing the Impact of providing W-System training and access to patrol officers: Quasi-experimental life table and multivariate results for Zone X

Our study of the W-System also included an evaluation of whether patrol officer participation enhanced its effectiveness. We evaluated the impacts of this aspect of the W-System's implementation using a quasi-experimental nonequivalent control group design that compared before and after changes in robbery clearances in Zone X to trends in robbery clearances over the same period in the city's other zones.

[97] We also estimated CPH models for total and business robberies in which the post–W-System indicator was replaced by a series of annual time indicators that estimated annual changes in clearances from 2011 through 2013. These models indicated that clearance rates held steady in 2012 but then improved in 2013. The likelihood of clearance increased 23% across all robberies in 2013 and rose 38% for business robberies. However, the change for business robberies was not statistically significant. Given the findings of our process evaluation and the inconclusive results of the business robbery model, we concluded on balance that the overall improvement in clearance rates in 2013 was due to causes other than the W-System.

During the study period, Zone X experienced 898 robberies, 104 of which (12%) were entered into the W-System. The city's other zones experienced 2,915 robberies during this time, and 339 of these cases (12%) were entered into the W-System.[98] In general, W-System cases in Zone X were no more likely to be solved than were those in other zones. As shown in Figure 10-j, for example, 30% of W-System cases in Zone X were cleared within 4 weeks and 50% were closed in one year. These figures were actually somewhat higher for W-System cases in other zones, and the differences across zones were not statistically significant. These figures provide some initial indication that the attempt to engage patrol officers with the W-System did not produce any additional gains in Zone X.

Figure 10-j. Likelihood of case clearance within selected periods by one for W-System cases (N = 443 W-System robbery cases investigated by Agency 2, 2011 – August 2013)

Follow-Up Time	Zone X	Other Zones
1 week	23%	20%
2 weeks	27%	29%
3 weeks	28%	33%
4 weeks	30%	34%
8 weeks	40%	38%
12 weeks	43%	42%
1 year	50%	53%

Life table estimates. Differences between groups were not statistically significant ($p > .10$). Analyses exclude cases that were cleared on the day they occurred.

Next, we compare trends over time in case clearances in Zone X and other patrol zones. As shown in Figures 10-k and 10-l, life table estimates indicate that clearance rates dropped in both Zone X and other patrol zones during the post-intervention period, particularly for longer follow-up periods. Further, the decline was somewhat larger in Zone X. The one-year clearance rate, for instance, dropped from 25% to 19% in Zone X and from 23% to 21% in other zones.

[98] There were 22 robberies for which the zone of occurrence was not indicated. These cases were treated as robberies outside Zone X.

Figure 10-k. Likelihood of case clearance within selected periods for robbery cases in Zone X before and after implementation of the W-System (N = 898 robbery cases investigated by Agency 2, 2011 – August 2013)

Follow-Up Time	Before W-System	After W-System
1 week	7%	8%
2 weeks	9%	10%
3 weeks	12%	11%
4 weeks	14%	12%
8 weeks	19%	15%
12 weeks	20%	16%
1 year	25%	19%

Life table estimates. Differences between groups were not statistically significant ($p > .05$) by log-rank and Wilcoxon tests but were statistically significant ($p < .05$) based on a log-likelihood ratio test. Analyses exclude cases that were cleared on the day they occurred.

Figure 10-l. Likelihood of case clearance within selected periods for robbery cases outside Zone X before and after implementation of the W-System (N = 2,915 robbery cases investigated by Agency 2, 2011 – August 2013)

Follow-Up Time	Before W-System	After W-System
1 week	8%	7%
2 weeks	10%	10%
3 weeks	12%	11%
4 weeks	13%	12%
8 weeks	17%	15%
12 weeks	20%	17%
1 year	23%	21%

Life table estimates. Differences between groups were not statistically significant ($p > .05$) by log-rank and Wilcoxon tests but were statistically significant ($p < .05$) based on a log-likelihood ratio test. Analyses exclude cases that were cleared on the day they occurred.

To more formally assess whether pre-post clearance trends differed between Zone X and the other patrol zones, we estimated the CPH model presented in Figure

10-m. The model includes a Zone X indicator to account for any general (i.e., preexisting) difference in clearance rates that may have existed between Zone X and other zones (independent of the W-System), a post–W-System indicator to capture any general effect that the system had across the agency, and a post–W-System / Zone X interaction term to capture any change that was unique to Zone X during the post-intervention period. The model also includes the case characteristics used in our previous models. Consistent with results presented earlier, the model shows no general impact from the W-System across the agency (as represented by the post–W-System term). In addition, the W-System / Zone X interaction term was statistically nonsignificant, thus providing no indication that clearances changed in Zone X relative to trends in the rest of the agency during the post-intervention period.[99]

Figure 10-m. Changes in the likelihood of robbery case clearance in Zone X and other zones pre– and post–W-System, controlling for other case characteristics: Cox proportional hazards model estimates (N = 3,812 robberies investigated by Agency 2, 2011 – August 2013)

Indicators	Hazard Ratios and 95% Confidence Intervals
Zone X	0.96 (0.78 – 1.19)
Post–W-System	1.00 (0.85 – 1.17)
Post–W-System in Zone X (Interaction)	0.99 (0.71 – 1.38)
Business robbery	1.87* (1.57 – 2.23)
Juvenile suspect	7.31* (6.08 – 8.79)
Number victims	0.98 (0.88 – 1.09)
Number offenders	1.74*(1.57 – 1.92)
Gun robbery	0.82*(0.71 – 0.95)

*Statistically significant at *p* < =.05. Analyses exclude cases cleared on the day they occurred.

[99] As a complement to this model, we estimated another model in which the post–W-System indicator was replaced by annual time trend indicators and the interaction term for the post–W-System and Zone X indicators was replaced by an interaction term for the year 2013 and Zone X indicators. This model suggested that clearances improved in 2013 (p < .10), but there was no evidence of an effect unique to Zone X during that year.

Finally, to provide some additional insights into these patterns, we estimated a CPH model that examined whether cases entered into the W-System were more likely to be cleared in Zone X (see Figure 10-n). This model includes a term for W-System cases, a term for Zone X cases, and an interaction term to capture any unique effect for W-System cases in Zone 4. The model also includes year indicators to capture annual trends in clearances across the agency as well as the case characteristic variables used in earlier models.[100] Consistent with life table results presented above (see Figure 10-j), the model results show that W-System cases were no more likely to be cleared in Zone X than in other zones (see the statistically nonsignificant W-System / Zone X interaction term in Figure 10-n). Hence, consistent with inferences from our process evaluation, our various outcome analyses failed to produce evidence that introducing patrol officers to the W-System enhanced the effectiveness of robbery investigations.

Figure 10-n. Likelihood of clearance for W-System and Zone X cases, controlling for other case characteristics: Cox proportional hazards model estimates (N = 3,812 robberies investigated by Agency 2, 2011 – August 2013)

Indicators	Hazard Ratios and 95% Confidence Intervals
W-System case	3.37* (2.67 – 4.25)
Zone X	0.97 (0.80 – 1.17)
W-System case Zone X	1.09 (0.74 – 1.61)
Year 2012	0.72* (0.60 – 0.86)
Year 2013	0.76* (0.61 – 0.95)
Business robbery	1.35* (1.11 – 1.64)
Juvenile suspect	6.60* (5.36 – 8.14)
Number victims	0.98 (0.88 – 1.09)
Number offenders	1.60* (1.40 – 1.82)
Gun robbery	0.80* (0.69 – 0.93)

*Statistically significant at $p < =.05$. The year indicators are interpreted relative to cases in 2011. Analyses exclude cases cleared on the day they occurred.

[100] The annual trend indicators also account for differences in follow-up time for cases that occurred in different years. These variables were not used in earlier models because they are highly correlated with the post-intervention period indicator that was used in those models.

10.5 Discussion

In conclusion, the W-System was a social media technology implemented by Agency 2 to help increase communication and collaboration among detectives, crime analysts, and patrol officers. The application of social media technology to policing has generated considerable interest in recent years. Most discussion of this issue has focused on the use of social media to increase communication with the public and to improve information gathering from external sources (often for criminal investigations). In contrast, in this study the emphasis was on the use of social media within a police agency.

Our results suggest that Agency 2's effort to pilot this technology for robbery investigations had little, if any, impact on the outcomes of these cases. Robbery detectives used the technology in only a minimal way to pass information between detectives on different shifts (something that was done by other means before the W-System was established) while continuing to rely on their traditional methods and networks to communicate among themselves and with both crime analysts and patrol officers. Further, our discussions with Agency 2 personnel did not suggest any obvious limitations to these networks of communication and collaboration. Detectives and crime analysts in particular described their relationship as very strong and collaborative.

Patrol officers also made little use of the technology. In part, this was because robbery detectives made scant effort to elicit assistance from patrol officers through the system. Even so, patrol officers did not use the system to offer information or comments on postings by crime analysts. The low levels of use by patrol may reflect a general disconnect between patrol officers and crime analysts, a lack of time for using the technology in the context of patrol work (some noted that Zone X is a particularly busy zone and that this may have also limited officer participation), a lack of useful information to offer in regard to crime analysts' alerts (in other words, officers' street information is perhaps more limited than hoped), a tendency to rely on established means and networks of communication with analysts and detectives, or some combination of these factors.

In sum, these considerations may suggest that little is to be gained from the internal application of social media technologies in police agencies. If information exchange and collaboration is reasonably good with standard technologies (e.g., email, case management systems) and methods, then perhaps the additional effort involved in using a new technology like the W-System offers little motivation for potential users to engage with it.

However, there were also issues with the implementation of the W-System that undermined its use and effectiveness. As noted, there were delays between the system training for detectives and officers and the implementation of the system. As with many new technologies, the system seemed to have bugs that made it less than user friendly for data entry and searching. It was also implemented as an add-on to other systems. Using the system required additional work for detectives and analysts who had to input information into their normal databases and then enter it separately into the W-System—in effect they were doing the same work twice, a source of frustration to members of both groups. Detectives and patrol officers also did not need to access the W-System to view crime analysis materials, which continued to be available through the CAU's normal website interface. Some persons interviewed felt that use of the system might have been more substantial had it been the primary system for managing case information and viewing crime analysis materials: If W-System had been the only source of crime information, then members of the department would have been forced to use it rather than going elsewhere.

Moreover, a number of those interviewed felt that the technology had the potential to be more effective for other types of investigations. Agency 2 chose to pilot the system for robberies because the robbery detectives were viewed as a seasoned group that might be a good bellwether of how detectives would react to the technology more generally. However, there were important limitations to testing the technology with robbery investigations. Robbery is a relatively low volume crime with a relatively high clearance rate (compared, for example, to property crimes). Because robbery is a personal crime, detectives are more likely to have identified suspects or strong leads to pursue. Indeed, robbery detectives noted that robbery investigations move very quickly and that they would typically expect to have suspects identified and/or apprehended in the time it would take to get responses from patrol officers through the W-System. This factor, combined with their high caseloads, reduced detectives' incentive to blog about cases. (A related point is that some robbery detectives felt the interactive blogging aspect of the W-System technology might be more helpful for detectives working crimes that involved a smaller number of long-term cases.) Also, detectives may prefer not to share information about suspects while they are building cases against them in case this undermines their efforts. All of these factors limit the potential for the W-System to affect robbery investigations. The fact that the system was piloted with patrol in only one district then further limited the sample of potential cases for this test.

Moving forward, Agency 2 plans to test the W-System next with burglary investigations. A number of persons interviewed felt that the system has greater potential for property crimes like burglary and auto theft, which have lower clearance rates. Identification of suspects is often more difficult in these cases, so there is greater potential for patrol officers to contribute to the investigations and look for suspects. Due to the high volume of burglary cases, Agency 2 already uses its patrol officers more extensively for conducting burglary investigations and burglary-related stakeouts. Accordingly, burglary investigations may present more meaningful opportunities for patrol officers to participate in the W-System and affect the outcomes of investigations.

Even so, others noted that realizing the vision for this technology will require a cultural shift among officers that places greater value on collaboration, crime analysis, and openness to organizational change. Managers will need to place more emphasis on the use of this technology with their officers, and both managers and the CAU will likely need to do more to illustrate its benefits for detectives and patrol officers.[101] Agency 2's experience with this technology shows that realizing the potential benefits of new technologies can be difficult even in agencies that are more advanced in their technological and analytical capabilities.

[101] For example, the CAU is considering the development of after-action reports to illustrate how crime analysis could have helped detectives and officers in different scenarios.

11. Discussion and Research Recommendations

11.1 Summary of Findings

In this study, we sought to understand the impact that core technologies and technological changes have had on law enforcement. While technological advancements have shaped policing in many important ways, there has been relatively little research on the impacts of technology in policing beyond technical, efficiency, or process evaluations (Lum, 2010a). Further, the research that is available suggests that technology does not necessarily bring anticipated benefits to police agencies (Byrne and Marx, 2011; Chan et al., 2001; Koper et al., 2009; Lum, 2010a; Manning, 1992a). We sought through this study to develop a better understanding of how and why specific "core" technologies affect law enforcement processes and outcomes—both positively and negatively, and in both intended and unintended ways—and how this information might inform police decision making about technology.

Toward this end, we investigated the social, organizational, and behavioral aspects of police technologies in four large police agencies, focusing on information, analytic, surveillance, and forensic technologies that are critical to police functions. Specifically, we examined the uses and impacts of information technologies (which included capabilities for in-field wireless reporting and information retrieval) in all of our study agencies. Other technologies that we studied in one or more of the study sites included crime analysis, license plate readers (LPRs), in-car video cameras, and DNA testing. We studied the impact of these technologies on policing using multiple methods that included agency-wide surveys of sworn officers, extensive semistructured interviews and focus groups with sworn and civilian personnel, field observations, and experimental and quasi-experimental studies that examined the impacts of selected technologies on outcomes like case clearances and crime levels.

Using these methods, the research team addressed several questions about the relationship between technology and policing:

- How and for what purposes are technologies used in police agencies across various ranks and organizational subunits?

- How do technologies influence police, at both the organizational and individual levels, in terms of operations, structure, culture, behavior, satisfaction, and other outcomes—and, concurrently, how do these organizational and individual aspects of policing shape the uses and effectiveness of the technologies?

- How do the uses of these technologies affect crime control efforts and police-community relationships?

- What organizational practices and changes—in terms of policies, procedures, equipment, systems, culture, and/or management style—might help to optimize the use of these technologies and fully realize their potential for enhancing police effectiveness and legitimacy?

Our work yielded numerous findings as well as questions for future study. Generalizing from our findings should be done cautiously, as the findings are based on the study of four police agencies (and two in particular) with experiences that may be different from those of many other agencies. Further, our surveys and interviews assessed agency personnel's experiences with and perceptions of technology; as such, they help to illuminate the dynamics of technological change in police agencies but do not provide a basis for strong causal inferences. (Limitations to other components of the study have been noted elsewhere.) Nonetheless, the agencies we chose seem fairly typical of large urban and suburban agencies, and many of our findings echo themes found in other studies (see, e.g., Chan et al., 2001).

In general, our findings reinforce the notions that the effects of technology in policing are myriad and complex and that advances in technology do not always produce obvious or straightforward improvements in communication, cooperation, productivity, job satisfaction, or officers' effectiveness in reducing crime and serving citizens. Indeed, the uses and impacts of technology can be quite variable both within and across agencies, as shown by our officer survey results. Similar to Orlikowski and Gash (1994) and Chan et al. (2001), we discovered sometimes conflicting technological frames across different units and ranks in agencies, which led to officers in those units and within those ranks interpreting the benefits (or lack thereof) of technology differently. Implementing technology effectively and using it in the most optimal ways seems to be most challenging at the line level in patrol, but much can depend on management practices, agency culture, and other contextual factors. Further, desired effects from technology (like improving clearance rates and reducing crime) may take considerable time to materialize, if they do at all, as agencies adapt to new technologies and refine their uses over time.

Each agency's history with technology revealed important reasons and processes for adopting new technology. Technology was generally viewed as a positive development in policing, and most technologies were initially adopted because they were viewed as bringing more efficiency to the agency (Allen and Karanasios, 2011). The theme of efficiency as a justification for technology adoption was often far stronger than that of crime control effectiveness (as discussed below). But each agency's history also revealed important lessons and cautions regarding the adoption and development of new and core technologies. Indeed, the interaction between the police and technology became a lens though which to view the culture, workings, and nature of law enforcement more generally. Below, we present some generalizations from our findings, organized around the key study themes that we have discussed throughout the report.

Receptivity to technology

Police officers' attitudes toward technology are complex, shaped by a technology's technical aspects and by its broader relationship to existing organizational routines, practices, and outlooks. Our officer surveys showed that police generally have positive attitudes towards technology, but their views about technology's applications and effects in their agencies can vary substantially. Consequently, it is difficult to predict to what extent a particular technology will be embraced or resisted in a police department without knowing more about the broader attitudes and beliefs that shape the agency's organizational culture. So, for example, in organizations distinguished by a rigid command hierarchy and an emphasis on record keeping, a technology may well be defined in terms of existing authority relations or data collection and management even if it has the potential to accomplish other important ends, such as improving crime prevention.

What is clear is that technology can evoke powerful responses from those who implement and use it, particularly information technologies and analytic technologies, which have the potential to transform fundamental aspects of how police work is done. Unsurprisingly, technologies that are cumbersome to use and disruptive to established daily routines are more likely to be met with resistance. Thus, there were some important agency-level differences here; agencies in which automated reporting was well established and crime analysis units were highly integrated into daily operations seemed to be more positive in their general views about technology.

Where our agencies were more similar was in their tendency to attribute resistance to technologies to the attitudes and capabilities of individual officers rather than broader social-organizational factors. In our interviews and focus groups, for instance, officers often remarked that older officers were more resistant to technological change. However, this point was usually made about unranked older officers. (Indeed, from our survey, it appears that higher ranking officers, who are also typically older, appeared more positive or receptive to technology.) Older officers often struggle with technological proficiency, but many among them also believe that technology detracts from important aspects of policing (such as interacting with people and having good situational awareness). At the same time, there are other general aspects of police culture—such as resistance to change, a resistance to collaboration (in some contexts), an emphasis on traditional reactive policing tasks, and a lack of appreciation for analytical work—that can limit the effective implementation and use of technology even in agencies that are more technologically and analytically advanced (as seen, for example, in our study of the W-System in Agency 2).

Technology implementation

In the main, the agencies we visited generally recognized the need to provide officers with the necessary training and technical support systems to help them meet the challenges of learning new technologies and to overcome the problems they experienced in their use, especially when the technology was first implemented. However, our research also suggested that officers' understanding of how to use a technology and the value they placed upon it might have evolved or changed over time as they adapted to its requirements. Thus even though agencies might commit significant resources to explaining why a particular technology is important and how it should be used at the outset, officers might still feel the need for longer term feedback mechanisms that allow them to continue to clarify the purpose of the technology, to influence the development of its technical aspects, and to receive timely responses to the challenges that arise in the course of using it. For example, it was common across agencies in our survey for officers to feel a need for more staff input in the development and adoption of technologies and a need for greater or continued support for staff in the implementation and use of technology.

Further, in some agencies, officers expressed uncertainty about the usefulness of some technologies because the potential benefits of those technologies for assisting them in how they went about doing or thinking about their daily work were not always clear. Police training for technology tends to emphasize the basics of operating the technology (such as how to properly fill out and submit reports on mobile computer terminals); there is less emphasis on how officers can use technology strategically to address crime or disorder problems or how both the organization and individual officers can benefit from use of the technology through, for example, improved information sharing inside and outside the police organization.

While perhaps obvious, it warrants emphasis that the technical and training aspects of implementing police technology are very consequential. Our studies of the RMS in Agency 1 and the W-System in Agency 2, for instance, illustrate that problems with the functioning and use of technology can offset desired gains in efficiency and effectiveness, reduce officer satisfaction, and foster resistance to the use of technology. Moreover, training that fails to address all key aspects of a technology's impact on an officer's job (such as learning how to report new crime codes) can also be a source of resistance and frustration. As shown by Agency 1's experience, implementation of new technology can cause significant disruptions even with significant planning efforts, and this can have negative and potentially long-lasting effects on officer morale and perceptions.

More generally, implementation of new technologies can also be hampered by more macro factors that are beyond training of officers. In Agency 3, a strong police union influence in policy decisions within the police agency impacted technological adoption, as did issues of interoperability and software and hardware problems.

Organizational units, hierarchy, structure, and relationships

In terms of information sharing and workplace relationships, law enforcement officers recognized some of technology's potential benefits and limitations. Many felt technology could improve communication across units, especially when coupled with the shared goal of reducing crime. But officers also recognized that technology could undermine work relationships. In the case of first-line supervisors, for example, having to sift through large amounts of data and respond accordingly drained time from other valuable activities, such as mentoring and guiding patrol officers. Technology could also help create new units, weaken old ones, and exacerbate workplace tensions by changing existing power relations within the organization. Finally, even though information technologies could contribute to information sharing and additional opportunities for brainstorming, it did not necessarily lead to a more inclusive or participatory decision-making process. Rather than being decentralized down the command hierarchy to the rank and file, decision making on which crimes to tackle and how best to tackle them largely remained the province of command staff.

Technology can also worsen (or fail to improve) perceptions of inequality for line-level staff. In particular, patrol officers may feel heavily burdened and/or scrutinized by the reporting demands and monitoring that often come with new information and surveillance technologies (in-car cameras provide an example of the latter). This is consistent with prior research suggesting that officers tend to be most dissatisfied with innovations that focus on “directing, controlling, or correcting discretion and practice” (Mastrofski and Rosenbaum 2011: 9) At the same time, they feel that they accrue few of the benefits of these technologies (or certainly fewer than those gained by supervisors, commanders, and other staff). And again, survey results on these matters were variable across agencies, suggesting that the push and pull of these forces vary considerably based on agency management and culture.

Our study of the W-System in Agency 2 also suggests that there are barriers and limits to increasing collaboration in police agencies through new technology. Although implementation and functionality problems seemed to hamper Agency 2’s piloting of that technology, its application also seemed to face limits caused by cultural norms, time constraints, and perhaps information overload.

Accountability and management

Perhaps the most recognized feature of new information technologies among officers was their capacity to monitor officers’ work and hold them accountable for their performance. While supervisors were generally positive about this function, the attitudes of first-line officers were more mixed, as shown by our survey results. Furthermore, rank-and-file officers were also less inclined to believe that information technology improved supervision and management. In discussions, officers expressed the view that quantitative, technology-driven assessments of performance needed to be balanced with more qualitative, holistic evaluations that took proper account of various factors that might affect an officer’s counts of various activities. We did see differences across agencies, however, with officers in Agencies 2 and 3 more optimistic about their agencies’ intention to use technology to identify and respond to crime problems, and more positive in the belief that technology was valuable to agency performance or supervision of officers. Thus, there appears to be an important nuance in not only how officers view how they are being held accountable or supervised, but how that supervision is connected to the overall performance of the agency and the ability of the agency to respond to crime problems.[102]

The widespread perception of information technology as a tool for monitoring implies that this is perhaps one of the more common effects of technology use in policing—and one that could be having significant and widespread impacts on police performance. In other words, is technological advancement in policing prompting officers to be more productive and proactive by making them feel more accountable? While this could well be the case in some agencies, our study of Agency 1 does not seem to support this notion, as we found no obvious improvements in overall agency performance (as measured by clearance rates and crime reduction) following the implementation of its RMS. Further, our observations in these agencies suggest that while technology has fostered accountability at higher managerial levels in policing (for example, through Compstat-type management processes), the innovative use of technology (including information, analytic, and surveillance technologies) as a tool by middle and lower level supervisors to manage the performance of line-level officers still is not institutionalized.

Finally, technology can also be used to enhance external accountability by making an agency's decisions more transparent to its publics and by holding it accountable for its performance, particularly in reducing crime. However, our research suggests that agencies placed much more emphasis on using technology to enhance internal rather than external accountability.

Discretion and decision making

Officers were much more likely to use (and be influenced by) information technologies to guide and assist them with traditional enforcement-oriented tasks (e.g., check call history or locate suspects) than for more strategic proactive tasks (like problem solving or hot spots policing). This tendency of agencies to interpret and use technologies through a more traditional law enforcement lens was prevalent in the interviews and surveys in all four agencies, and also our observations of officers involved in the experiment in Agency 1. Higher ranking supervisors and command staff were more open and knowledgeable about the use

[102] Additionally, while managers used information technology for monitoring officer performance in our agencies (e.g., tracking traffic stops, arrests, and other activities), they appeared to make little if any use of these technologies to monitor problematic conduct (e.g., excessive use of force or racially biased policing) through early warning systems or other similar means. This is another potentially powerful management capability provided by IT and one that has significant implications for internal and external accountability.

of technology for more strategic purposes, but these sentiments did not often permeate the rank and file.

This finding is significant, especially in an era of policing in which proactivity, problem solving, and place-based policing have been found to be effective in reducing and preventing crime. However, as we know from organizational studies, employees make sense of innovations or technologies through familiar frames of reference (see Manning, 1992a,b; Orlikowski and Gash, 1994). In other words, police officers will be guided by technology through the mindset by which they view their existing goals or objectives. Despite the interest of police chiefs and scholars in advancing a more proactive police service, police are still very much focused on responding and reacting, not necessarily proactive problem solving. Although police leaders may often discuss innovations in policing (i.e., problem solving, evidence-based policing, intelligence-led approaches, and community policing), line-level officer surveys and interviews seem to indicate that police are still primarily operating in a reactive, response-oriented, case-by-case enforcement mode.

This reactive, traditional approach that dominates policing mediates the impact of technology on police decision making and discretion. Officers are less likely to use technology and to use it in proactive ways during their noncommitted time because it is not the norm for them to conduct this type of policing (although some may, depending on their personal preferences). Line-level officers are also less likely to use analytic outputs of crime analysis technology to assist them with problem solving, and more likely to view such outputs with indifference or suspicion. Instead, officers are more likely to use technology to prepare them to respond to calls for service, find individuals wanted for crimes, and investigate stopped individuals, because that is what they are trained to do and what is expected from them.

One exception is when officers and detectives proactively use technology to run license plates to check suspicious vehicles, although this approach also emphasizes surveillance and enforcement rather than prevention and problem solving. Some officers remarked that this use of technology may in some instances have reduced opportunities to interact with the public because they no longer have to stop vehicles. But even in hot spots and when not assigned to calls, officers involved in the hot spots experiment in Agency 1 who checked license plates extensively appeared more guided by what they observed rather than trends or analysis that technology could provide for them prior to entering the hot spots.

Our observations suggest that officers may often use technology in support of discretionary activities (like checking the identification of a stopped suspect), but they are less likely to use technology to guide those activities. Indeed, our survey results suggest that officers rely much more on their experience than on information available from information and analytic technologies. Technology sometimes changes officers' behaviors (such as when an LPR officer changes his or her patrol style or routine to better make use of the technology, or when an officer chooses to use crime analysis to guide his or her patrolling between calls), but this seemed to be very individualized in the study agencies, as the officers received little in the way of consistent training or direction on ways to optimize technology use in their work. That said, the example of Agency 2 suggests that agency leadership and emphasis can make a difference in this regard.

Efficiencies of police processes and productivity

Technology is often adopted to improve the efficiency of agencies (Allen and Karanasios, 2011; Groff and McEwen, 2008). Yet, as Chan et al. (2001) found, while technology can help officers be more productive, at the same time it can frustrate them and increase their workload. In our officer surveys, it was common for officers to say that information technology increased their workload, but in some agencies they still agreed that it made them more productive overall. How pronounced this conflicting finding was varied across the agencies and officers (views were particularly negative in surveys and interviews from Agencies 1 and 4). Further, whether officers judged technology as efficient was linked to issues regarding the purpose and type of technology, new requirements necessitated by technology, adjustment periods for technology implementation, and other factors.

Some technologies (i.e., LPR or LInX) were viewed very positively in this regard, while more core technologies (e.g., information technologies used for report writing) were sometimes seen as increasing workload. Given our findings, we suspect that efficiency is connected to the length of time an agency has had a technology as well as whether officers view the purpose of the technology to be something that helps them in their enforcement mode (as opposed to a more preventative mode). Further, views about efficiency varied across rank and assignment in our survey, showing how perceptions of law enforcement function and purpose might mediate the view of technology and work productivity.

These conflicting views about the efficiency of technology point to deeper issues in policing itself. As with our findings on discretion and effectiveness, officers do not view the usefulness and efficiency of a technology through a long-term strategic lens, despite any potential long-term gains from improvements in core technologies like records management, crime analysis, and information sharing. They do not differentiate between which system or requirement caused an inefficiency (for example, whether it was new reporting requirements of an incident-based reporting system in Agency 1 or the actual new RMS technology). Rather, officers judge the immediate gains and losses of technological change on efficiency in the context of their position within the agency and their perceived roles and responsibilities.

In addition, burdens and inefficiencies stemming from poorly functioning technology or new requirements linked to technology can discourage more innovative uses of technology. This was seen in Agency 1's adoption of its RMS and Agency 2's experiment with the W-System. If new technologies do not help officers to be more efficient, we should not expect those technologies to free officers' time for proactive policing (it may even reduce their proactivity) or encourage their use of technology to that end. This can be a particular concern in the early phases of implementing new technology.

Forensics technology can also raise special issues regarding productivity and efficiency. With its expanded lab facilities and DNA testing capabilities, Agency 3 improved its processing of forensics evidence and reduced its backlog in DNA testing. However, this also required changes in staffing, resource allocation, and procedures for handling forensics evidence. Moreover, the agency's expanded forensics capabilities led to a substantial increase in demand for forensics evidence and testing that nearly overwhelmed lab personnel. In order to keep their caseloads manageable and use their resources in the most efficient and effective ways, crime lab personnel had to educate officers on the types of evidence and tests that are most necessary and useful.

Effectiveness in reducing crime and assisting citizens

Officers are much less likely to speak of the effectiveness of technology in reducing or preventing crime. Rather, they are much more likely to associate effectiveness with the efficiencies of technology or the ability of technology to help them make arrests. As with discretion and decision making, technology is used and viewed through how officers view their profession and function—as reactive responders to crime. Although there were a few exceptions among a few personnel we spoke to or surveyed, agency personnel were much less likely to associate the effectiveness of technology with preventing or deterring crime in proactive or problem-solving ways. Indeed, the technologies most likely to help do this, such as crime analysis technology or informational sharing systems, were not the focus when we asked agency personnel, “How does technology make you more effective?”

This finding is especially challenging in an era of community-oriented, problem-solving, and evidence-based policing. The technologies most able to facilitate these types of policing and assist with crime control, prevention and reduction, are not technologies that facilitate arrest, per se. Instead, “core” technologies such as RMS, information sharing technologies and crime analysis are much more important. However, these technologies are not easily linked to the immediate gratification that may come with arrest. Further, the effects of these technologies are dependent on the culture of the agency and the way officers perceive their function and purpose.

Agency-level differences were again apparent. Most notably, officers in Agency 2 appeared more likely to use information and analytic technologies in more proactive, prevention-oriented ways. This seemed to reflect the agency’s overall emphasis on analysis and data-driven policing. Yet even in that agency, this was not the norm among the majority of officers.

Also noteworthy was that our trend analysis and field evaluations in Agencies 1 and 2 failed to find evidence of technology improving police effectiveness in a number of contexts: Implementation of the new RMS and expansion of LPR capabilities in Agency 1 had no clear impact on crime rates and case clearances; officers’ use of technology in hot spots did not appear to enhance the crime control effectiveness of hot spots patrol in Agency 1 (if anything, it appeared to reduce it); and Agency 2’s test of an internal social media technology to enhance information sharing on robbery cases generated little enthusiasm among detectives and patrol officers and had no impact on case clearances. As discussed in earlier sections, these findings can be attributed to a number of factors, including functionality problems and technical limitations, unintended inefficiencies created by technology, a failure to deploy and use technology in strategic ways, officer resistance, mistaken assumptions about how certain technologies will work, and unintended ways in which technology might sometimes undermine officer effectiveness.

The overriding point from these examples is that the adoption of new technology often does not produce immediate or directly measurable improvements in police effectiveness. Desired or expected gains may not occur initially, if at all. Even setting aside functionality issues and the unintended drains on productivity that technology might sometimes cause, improving police effectiveness through technology is likely to be contingent on how police manage and use technology.

Basic application of information technologies, for example, might have marginal effects that improve police efficiency, increase detection capabilities in the field, and improve officer safety in responding to calls. Yet these improvements—what we might call "level 1" effects—may not alone be enough to measurably enhance police performance as measured by indicators like case clearance and crime reduction. Hence, the value added of technology might sometimes be hard to quantify. Achieving greater gains—i.e., "level 2" effects—requires more strategic uses of technology for purposes of prevention and problem solving. The use of crime analysis and Compstat-style managerial processes to guide agency decisions is one example of this, but police arguably need to further expand the application of technology for prevention and problem solving in both the command ranks and lower levels of their organizations. In this regard, the mixed findings on technology and police effectiveness from this study (and others) are perhaps analogous to those from research on how changes in police staffing affect crime—and the conclusion of scholars that *how* officers are used is likely the more critical factor in determining police effectiveness (e.g., National Research Council, 2004).

Police-citizen communication and legitimacy

We also discovered that, at least in the eyes of the police, technology can help improve the public image of the police and influence perceptions of legitimacy. Departments that adopt the latest glitzy technologies, the harbingers of science, can garner public support by appearing progressive. However, this approach can simultaneously create unrealistic expectations about the capacity of the police to solve crime (the "CSI effect"). The experiences of Agencies 3 and 4 also suggest that forensics and camera technologies can increase the public's expectation that police should produce physical, video, and/or audio evidence in criminal and citizen complaint cases, thus undermining their belief and confidence in police when police are unable to produce such evidence.

Some technologies also have the potential to undermine police legitimacy. When it came to LPRs, some of the officers we spoke to expressed concern about their potential to undermine existing police-community relations and, as a consequence, had limited their use of this technology to tasks that were unlikely to be regarded as controversial, such as recovering stolen motor vehicles. As to whether technology improved how officers communicated with citizens, feelings were mixed. Information technologies in particular were seen by some officers as helping them provide citizens with useful information, while others felt they were a distraction from the kinds of face-to-face interactions essential to daily police work.

And, again, opinions were quite variable across agencies, reflecting broader contextual factors.

Job satisfaction

Technology can increase job satisfaction or reduce it, depending on how the organization uses and implements technology and what officers perceive to be the purpose of the technology. Most directly, officers obtain satisfaction from technology when they see it as helping with arrest and case closure. As discussed above, this reflects the traditional way in which officers still view their jobs and effectiveness.

But while technology may be connected to job satisfaction and dissatisfaction, it is likely mediated by the officer's satisfaction with the agency more generally. How officers view the agency and the command staff, the implementation of technology and their inclusion in their process, and the purpose they believe technology is being used for by their command impacts the satisfaction they feel for their jobs when it comes to using technology.

Views on technology and job satisfaction in general varied widely across the agencies, and Agency 1's experience in particular suggests that problematic implementation experiences and functionality problems can have substantially negative and long-lasting impacts on officers' satisfaction. This illustrates one of the key challenges of managing major technological change in police agencies.

11.2 Recommendations for Future Research

This study has raised many issues that can inform future research on police technology. Here, we conclude by briefly addressing some key implications of the study for future research and evaluation efforts. (The next and final section of the report contains recommendations for practitioners that also include ways that police can contribute to the research base on this topic).

Technology and technological change in policing and criminal justice more generally is currently one of the most important issues in the field, affecting the way agencies conduct their daily responsibilities and functions. This, in turn, has real impacts on crime prevention and control, interactions between law enforcement officers and citizens, and internal relationships within police organizations. Information technology has the potential for increasing information sharing and connectivity across the many autonomous law enforcement agencies in the United States and improving the ability to combat and prevent crime. At the same time, technological change is expensive and can have unintended consequences, ranging from simply not delivering purported benefits to being harmful to society. Technology has great allure to policing, especially because of the promise of faster productivity and processing. But does this efficiency equate to effectiveness? And if so, is the amount of effectiveness or efficiency achieved worth the price?

These questions of the outcome and cost-effectiveness of technology have not been adequately examined. How do we know that greater information connectivity and sharing actually leads to more case closures and crime reduction? Do improvements in forensics technologies have enough of an impact on case closures, for example, to in turn create a deterrent effect? Does increased use of crime analysis reduce and prevent crime? Can LPR be used in ways that create a crime control effect that can be cost-justified?

We also need greater understanding as to organizational strategies that are most effective for achieving desired outcomes with technology. What types of organizational approaches to changes in core technologies seem to work best in terms of smooth adoption? Are there effective ways to improve receptivity of agencies to needed innovations?

Greater understanding of the impact of police technology on improving law enforcement's relationships with citizens and communities is also needed. For example, does adoption of Internet reporting and anonymous Internet tip lines improve a citizen's view of the police and likelihood of their cooperation? Do schemes to disseminate information to the community using social media reduce or increase fear of crime? How is privacy impacted by technological innovations? Under what conditions are community members more receptive to technology than others?

To pursue these and other questions, not only do we need more evaluations of technology generally, but we need careful attention paid to fundamentals of program evaluation for technology. This includes studies of needs assessment, program theory, process evaluation, intermediate and distal outcomes, and cost efficiency (Rossi, Lipsey, and Freeman, 2004). A list of questions that researchers might ask about any given technology might include the following:

- What is the theory about how a technology will affect officer and organizational performance? What is the theory about how the technology and associated changes will reduce crime or improve legitimacy?

- How is the technology used in the agency? Is it being used as intended? Is it changing management and supervision? Is it changing activities of line-level officers?

- How is technology affecting intermediate outcomes like efficiency and productivity? Can the uses and outcomes associated with the technology be quantified? For example, can an agency track hits with LPR technology (and the results of those hits) or track hits that officers get from running people and vehicles through an RMS system? Also, how is a technology affecting outcomes like job satisfaction and police-community relations?

- What is the impact of technology on crime reduction and prevention or citizen satisfaction?

- Can outcomes achieved with technology be measured and assessed in terms of cost efficiency? What types of technologies are cost beneficial and cost effective?[103] Researchers should do more to compare the impacts and cost-efficiencies of different technologies relative to one another. For example, what technologies make for the best investments for police? How should technological acquisitions be prioritized?

- Additionally, researchers should examine what organizational strategies—with respect to training, implementation, management, and evaluation—are most effective for achieving desired outcomes with technology.

Finally, researchers must keep up with technological change and use in police agencies. Technology acquisition and deployment decisions are high-priority topics for police and policy makers, as police agencies at all levels of government are spending vast sums in the hopes of improving their efficiency and effectiveness. Greater attention to technology evaluation by researchers can help police agencies optimize technology decisions and fully realize the potential benefits of technology for policing.

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[103] Aligned with Rossi et al. (2004), technology would be cost beneficial when the benefits of its uses are greater than its costs when both can be translated into monetary units. A technology would be cost effective when it provides the least costly way of achieving a particular outcome.

12. Recommendations for Law Enforcement Agencies

This study has examined some of the complex and conflicting effects that stem from technological changes in policing and how those effects can sometimes limit and offset the potential of technology to improve police efficiency and effectiveness. This is not to say that technological advancement in policing is undesirable and will not bring improvement. However, technological changes may not bring about easy and substantial improvements in police performance without significant planning and effort, and without infrastructure and norms that will help agencies maximize the benefits of technology. Technological change also may not be a panacea for agencies struggling with financial and staffing shortages; although technology can improve productivity, it can also reduce it, and may reduce it in areas that are most important to an agency.

Technological adoption is not only a long and continuous process of its own, but one that is highly connected to many other aspects of policing, including daily routines and deployments, job satisfaction, interaction with the community, internal relationships, and crime control outcomes. Thus, managing technological change in policing is difficult and closely connected to managing other organizational reforms (such as improving professionalism, reducing misconduct, and adopting community, problem-solving, or evidence-based policing). Further, technology expenditures can be quite significant, and it is critical for police to make the most of these expenditures.

Given our findings, we make the following 10 recommendations to law enforcement agencies to consider. We do not make these suggestions lightly and understand that many require fundamental organizational changes to accomplish. However, our research indicates that because of the complex and interconnected nature of technological reform and changes to the core aspects of policing, the recommendations below appear necessary for leaders to optimize the use technology in their organizations.

1. Build and adjust organizational norms first, then adapt technology to those norms.

How technology is used is highly dependent on the norms and culture of an agency and how officers view their profession. Because officers continue to view reactive response to calls for service, reactive arrests for crimes, and the following of standard operating procedures as the foundations of policing, they use and are influenced by technology to achieve these goals. Further, officers associate effective policing with efficient policing because the latter reflects the culture and philosophical norms within which they operate. They view technology as making them more effective when it makes them more efficient.

However, to reap the benefits of technology in ways that research evidence suggests can be most useful, agencies must consider changing these traditional and long-standing philosophical norms about the role of law enforcement. For example, research suggests that police are most effective when their strategies are proactive, focused (both on high-risk places and groups), and oriented towards problem solving and prevention (Eck and Weisburd, 2004; Lum et al., 2011). Police leaders should thus consider how they might orient their agency's goals, operations, and uses of technology towards these aims. We say more about this in our recommendations on training, below.

Broader norms that exist in policing beyond crime control and response functions also can impact the receptivity to new technology and other innovations. Resistance to change and cynicism are especially pronounced in policing, an important feature of which is the quasi-military nature of police work with its focus on internal discipline and rules and regulations (Bennett and Schmitt, 2002; Caplan, 2003; Niederhoffer, 1969). As our interviews indicate, these feelings seem more connected to this overall social-organizational context, not to specific changes. Given that many innovations (technological or not) may mean significant changes in the way agencies do business, finding ways to reduce change resistance and cynicism would be valuable internal investments for the law enforcement agencies. While the research on cynicism in policing is not the focus of this study, given previous research and our own study, we suspect that improvements in job satisfaction, clearer expectations about roles and responsibilities, more training in new innovations, and other factors may play important parts in modifying these cultural norms that seem to inhibit reform and change.

2. Strategize and make a long-term commitment to important technological advancements.

Aligned with the previous recommendation, strategizing about technology, especially as part of the overall vision of the police agency to prevent and reduce crime as well as improve internal accountability and functioning, is essential. The long-term commitment to the development and integration of information technology and crime analysis in Agency 2 shows how benefits can be gained from a long-term commitment to these types of technologies despite difficulties in adoption. In strategizing about technology adoption and use, police leaders should give careful consideration to the specific ways in which new and existing technologies can be deployed and used at all levels of the organization to meet goals for improving efficiency, effectiveness, and agency management.

Further, agencies might consider implementing new “core” technologies in stages, and not combined with other major changes. In Agency 1, a new reporting system (RMS) *and* a new approach to reporting (incident-based reporting) were implemented simultaneously. This amplified the difficulties in making the RMS transition and may have undermined agency productivity and effectiveness in the short run. Further, problems associated with adjusting to reporting requirements were then linked to the new technology itself, leading to an amplification of resistance to the technology.

One important part of strategizing about technology over the long run is for agencies to adopt a strong research and development agenda regarding technology. Technology is often adopted before research about its effectiveness is conducted, but agencies should review what research exists about the effectiveness, use, and consequences of specific technologies. They should also consider carrying out their own pilot testing and evaluation of technologies before investing in them. Of course, this evidence-based approach to technological adoption is somewhat dependent on improving and increasing the research base of technology more generally, which we discuss in Section 11.3.

3. Maximize participation in the planning process for personnel who will be affected by technological changes. Where possible, consider pilot testing to refine technologies and their applications.

Trying to increase receptivity to new technology means attending to the social context and processes that determine how technologies are understood, and not just to the technical abilities and outlooks of particular individuals. Success in this regard is likely improved by encouraging a broad base of participation in the entire technology implementation process, including ample opportunities for testing early versions and soliciting input that can be incorporated into the final design of the technology. Soliciting the participation and support of respected formal and informal leaders in the agency can also help to facilitate the processes of planning, training, and implementation. Further, generating working groups and open discussion about technological change can also facilitate change.

Pilot testing new technologies can be a valuable way for agencies to assess and refine some new technologies without causing widespread disruptions in the agency. This can be helpful in identifying and correcting technical problems with a technology and for determining its most effective applications. Agency 2's experimentation with the W-System provides one example of how pilot testing can be beneficial. As another example, an agency might test the deployment of LPRs through different means (e.g., fixed versus moving) and in different locations to determine how to most effectively use the devices (e.g., see Cohen, Plecas, and McCormack, 2007; Ohio State Highway Patrol, 2005). Such assessments should include quantitative performance indicators as well as debriefings of officers who have taken part in the pilot tests. Giving users input into the final design and application of the technology may help improve both its reception and effectiveness.

4. Consider how new technologies will change accountability and performance criteria and how the organization's accountability structures can benefit from (or be harmed by) technology.

Internal accountability and management systems for monitoring and assessing organizational and individual performance can be considerably enhanced through technology. At the same time, research and practice suggests that employees can have negative perceptions of the use of technology to monitor and assess them. Considerable efforts should therefore be expended to get officers "on board" with the implications of technology for the agency as a whole and mitigate suspicion and resistance (Jacobs, Zettlemoyer, and Houston, 2013). If a new technology is going to be linked to individual performance appraisal, departments might consider ways to involve as many of those individuals as possible in the appraisal process.

We could even think of LPR in these terms and the establishment of criteria for how officers should be using it in the course of their daily work. Those who know and perform the job might be able to provide some useful insights on how technologies like RMS, crime analysis, and LPR might be best integrated into assessments of their performance. Furthermore, allowing those who are being assessed to participate will likely increase levels of understanding and acceptance of the technology being used in this way.

Our study also revealed divided opinion on the utility of using statistics generated by information technology for performance measures. The objectivity and easy availability of these statistics (e.g., tickets, arrests, field investigation reports) made them attractive to supervisors and assessors, but in officers' minds they did not capture the most important criterion of job performance, namely work quality. Nor did these indicators provide a context for helping evaluators make useful comparisons among officers. In addition to consulting patrol officers on ways that IT could be used to provide a more accurate accounting of their performance (as mentioned above), agencies might also consider how to supplement objective measures by developing indicators of work quality, or "how well" officers performed their duties and not just "how much" (Willis, 2013).

5. Consider ways that technology might be designed or redesigned for ease of use and to facilitate successful, evidence-based policing practices.

Technology can be a powerful lever for improving police performance, but agencies need to consider how technology can be designed and used to facilitate the most effective forms of policing. As noted above, pilot studies of new technologies can be helpful in this regard. However, other technology design issues are also relevant.

Technology's potential, particularly with respect to computerized record systems, to overwhelm users with huge amounts of data is an issue not easily resolved. This problem is compounded when information is housed in different databases, making it difficult to extract and collate. Although not as successful as hoped, Agency 2's experiment with a single website (the W-System) that allowed patrol officers in a particular district to post information on specific robberies being investigated by detectives was an innovative attempt to overcome this challenge. Agencies might consider similar possibilities for integrating information in a user-friendly format from different sources on a particular crime issue. For example, one could imagine a "one-stop shopping" record system focused on crimes occurring at a particular hot spot or small geographic unit such as a street block. In addition to identifying the types of crimes that were occurring in this area (including information on the specific nature of different incidents), these data might be combined with records of what police actions were taken and why, information on relevant stakeholders or their parties, known offenders associated with the location, and the recommendations of any working groups assigned to the particular problem.[104] The challenge is trying to move away from an agency's traditional focus on calls-for-service data and the separate incident report file toward a focus on finding ways to match information. For crime data to be most useful, the task of

[104] For example, see the "case of places" tool developed by Lum and Koper at: http://cebcp.org/evidence-based-policing/the-matrix/matrix-demonstration-project/case-of-places/ which could be used as a model for such a system.

identifying any underlying factors that help explain or tie together the occurrence of a number of crime events needs to be easier.

6. Preparation and training for technological changes should emphasize the purposes and benefits of new technology as well as the fundamentals of how to use the technology.

Training on new technologies adopted by an agency is essential, and it especially important for the most difficult technological adoptions, which are often also the most fundamental to effective policing.[105] Some technologies (LPRs, for example) require very little training and are fairly intuitive. At the same time, such technologies may not be fundamental to an officer, detective, or commander's performance and function. In contrast, learning how to use an RMS properly, in terms of both input and use of output, requires extensive training, follow-up, and consistent adjustment. But such knowledge could facilitate a number of proactive approaches to policing that have been shown to be effective. Police care about the technical aspects of technologies, including how easily they are integrated into existing routines and the benefits they promise, but their receptivity to technology goes far beyond these practical concerns. Encouraging others to embrace technology requires that police leaders and managers anticipate the assumptions that different personnel may make about how a technology is implemented and used and consider how these might be addressed ahead of time. Doing so can increase the likelihood that a technology will be more broadly accepted.

For example, first-line patrol officers will likely undervalue a complex and demanding new RMS that emphasizes accurate record keeping should its advantages appear unclear. Support may further decrease when the new system is used to monitor and assess patrol officer performance with little warning. To overcome officer resistance, leadership could underscore how the collection of reliable and detailed performance data on individual crime and arrest incidents (rather than just the kind of summary data associated with UCR reporting) will provide a database that helps the agency learn significantly more about its handling of specific kinds of incidents. Providing officers with regular feedback, including meaningful examples summarizing the benefits of this approach, could then increase their commitment to the new reporting format, and increase their motivation to

[105] Our recommendations focus primarily on the content of training, though it is certainly important for agencies to devote sufficient quantities of time and resources to their training efforts, as shown by the experience of Agency 1.

enter all the requisite information into the field provided (Mastrofski and Wadman, 1991: 387). Having first-line supervisors work with their officers to increase their understanding about what could improve their performance, as well as developing approaches that could improve a squad's performance as a team, might be a more positive approach to accountability and use of technology than simply using the technology to account for officer activity.

During our field work in Agency 1, we often heard stories about individual successes achieved through the use of the new RMS (e.g., the arrest of a suspect due to an officer taking the time to enter an individual's cell phone number into the RMS), but there did not seem to be a mechanism in place for systematically clarifying and disseminating these activities, or for sharing news about some of the other benefits of more complex and detailed incident reporting. Nor were any rewards given when officers showed initiative, something that our surveys confirmed. Officers tend to tell stories about their successes which, in turn, can influence others' attitudes about the benefits of a new technology if they feel motivated enough to "go the extra mile." Thus, finding ways to publicize when the RMS contributed to a successful problem-oriented policing approach, the identification of a crime pattern, the apprehension of a suspect, or the safety of an officer during an encounter, and rewarding the officers who were involved, could help officers assess a technology more positively.

Addressing the purposes, intended uses, and potential benefits of technology may also help to improve perceptions of technologies like in-car video systems, which are used primarily to monitor officer conduct and interactions with citizens. Training for such technology could, for example, address the specific ways and circumstances under which managers will use the technology and provide examples of how the technology has been used in the past. Examples of the latter could also be used to illustrate how the technology benefited the agency (e.g., improving the agency's reputation and legitimacy in the community) and individual officers (e.g., protecting them against false complaints).

In sum, merely attending to the technical aspects of the new technology, no matter how useful the training, is unlikely to do much to shape entrenched beliefs and attitudes about existing social relationships, work routines, and performance systems through which many types of technology are likely to be interpreted.

7. Training is needed on evidence-based policing more generally and the application of technology for such practices.

More fundamentally, training about proactive and evidence-based tactics and why they can reduce crime is needed. In our fieldwork, for example, we found that officers did not always understand why tasks that they were asked to do in hot spots (field interviews, truancy citations) would be beneficial. While training officers and supervisors on how to use systems is important, more training is needed on what the systems can do for officers with regard to their functions. For example, it was clear that officers were not being trained on, and therefore had limited understanding of, how technology might help them reduce and prevent crime, be more proactive, or conduct problem solving. Often, officers interpreted "proactivity" as running license plates of suspicious vehicles or running information on individuals they had stopped. Further, there seemed to be little emphasis on direction or accountability at the lower levels of the agencies for the use of technologies like information systems, crime analysis, and LPR for crime prevention. The perceived purpose of RMS, crime analysis, or other information technology systems was limited to more traditional policing functions, such as how the technology might help officers respond to 911 calls or catch offenders. Given that an agency is trying to reduce, prevent, and control crime (as opposed to react, respond, and manage it), training regarding technology or other tools needs to incorporate how technology might be used for these goals. How, for example, can officers use their agency's information systems and crime analysis to guide their patrol activities between calls for service, identify and address problems at hot spot locations, and monitor high-risk people in their areas of responsibility? At the same time, how can managers use these technologies to encourage such work by their subordinates?[106]

Training can also draw attention to the potential benefits and rewards of making information sharing and decision making about crime problems more inclusive or participatory through technology. For the most part, our fieldwork revealed that determining how best to respond to crime problems fell to middle managers and first-line supervisors. Patrol officers might be involved in this process, but this was not a routine feature of daily operations. Given that those working the street might also be most aware or knowledgeable about crime and disorder problems, finding ways to solicit their insights on local problems and computerized

[106] Police managers might also caution officers on the ways in which overreliance on technology might make them less effective (for instance, by reducing their contacts with citizens), as was sometimes suggested in our fieldwork.

crime data regularly, including potential problem-solving solutions, might help improve the overall quality of decision making. Patrol officers might be able to bring concerns important to a particular community, but that are not captured in official records, to the surface (Skogan, 2006: 38). Creating a dataset for tracking these kinds of problems over time (as mentioned above) could also help ensure that a department was being responsive to a broad array of community-related issues that go beyond the rather narrow focus on part I crimes (Willis, Mastrofski, and Kochel, 2010).

Training on the use of technology for evidence-based practices can also extend to the enhancement of police legitimacy in the community. Officers who will have a video and audio recorder in their car or on their person, for example, might be more receptive to training on how they can reduce the chances of conflict in their encounters with citizens and maximize citizens' sense that they have been treated respectfully and fairly. Training might also emphasize issues such as how officers can use their technologies (such as information systems) to be more helpful to citizens in their encounters and how they might explain the purpose and uses of surveillance technologies (like LPR) that may arouse privacy concerns.

But training is not just needed on using technology for evidence-based purposes. Officers must also be trained in strategies that are effective in reducing crime and improving their legitimacy and service to the community in the first place. Without this understanding, using technology in evidence-based ways is putting the cart before the horse, as we emphasized in Recommendation 1 above. Absent this mindset and understanding, and without the expectations of these innovations in everyday police patrol and investigations, officers would have no reason to be motivated to use technologies for proactive, or place-based policing.

8. Other training must also adapt to changing technology.

Other common training elements in academy and in-service training must also keep up with the times. For example, because of the advent of mobile computing technology, emergency vehicle operation training is not only about operating the vehicle, but doing so safely and with operational awareness. Motor vehicle crashes continue to be a top killer and injurer of law enforcement officers, and ensuring that training adapts to technology is important. Similarly, officers are now interacting with technology during on-the-street investigations, field interviews, and report taking, which might affect their situational awareness. Revamping training to accommodate changes in technology will be important in maintaining officer safety.

9. Develop appropriate support systems to assist users, solve problems, and facilitate the effective implementation of technology on an ongoing basis.

Once training is done, agencies must continue to reinforce knowledge and develop support systems for end users. As part of a strategic plan for technology, agencies should prepare a systematic and continuous approach to follow-up, in-service training, reinforcement, and adaptation to new lessons. As shown by this study, the effective implementation of new technologies can necessitate the creation of substantial support systems. Those working in technological support must be capable of resolving hardware or software issues and be sufficiently familiar with the technology to address any user questions fully and promptly. Consequently, it is necessary to consider ahead of time whether an agency has sufficient resources not only for the technology's initial implementation but also for sustaining its use over the long term.

Our fieldwork indicated that enthusiasm for a technology, especially among users, soon wanes when resources, such as repair shops or help desks, are not providing timely or useful feedback. Similarly, new technologies may require new servers to run effectively and the assignment of additional personnel for their maintenance and management. Regarding user support, the generally high level of enthusiasm for technology in Agency 2 compared to other sites could be attributed, at least in part, to the development of relatively straightforward mechanisms (like websites) where users could offer suggestions for improvements to existing technologies. These suggestions were then acted upon so that users could see that the time they had taken to report a problem or area for improvement was being taken seriously and, where possible, corrections were being made. Implementing changes in response to user suggestions could help improve the technology's functionality and also help an agency demonstrate its commitment to the needs of its personnel. In contrast, some agencies had expensive equipment (like LPRs) that were broken and sat idle because the process for fixing them was mired in red tape, resulting in the kinds of delays that frustrate and disappoint users.

Ongoing user support can also include dissemination of information about effective practices, success stories (as noted earlier), and tips for easier or faster use of a technology (such techniques are often discovered by individuals but not shared widely or systematically). This form of support may help improve receptivity to new technology and gradually improve its use.

10. Monitor and evaluate uses, outcomes, and impacts from technology and be aware of the unintended consequences and problems that technology might cause.

We also recommend that police managers do more to systematically track the ways in which new technologies are used and the outcomes of those uses. This is particularly applicable to technologies like LPRs, which (based on the research team's familiarity with many agencies) are typically deployed with no systematic tracking of how they are being used and with what results. In the case of LPR, for example, police managers should consider tracking the specific areas in which LPRs have been deployed; the manner in which LPRs have been deployed (e.g., fixed or on patrol cars); the number and nature of hits (i.e., matches) achieved with the LPRs, and the nature and results of those hits (e.g., vehicles recovered and arrests made); the number and outcomes of investigations for which LPRs or LPR data have been used; and whether crime was reduced in areas where LPRs were deployed. Agencies could then use these results to refine their use of this technology. One could envision similar forms of tracking and evaluation for other technologies, like in-car (and personal) cameras and new forensics technologies, to name a few. This would help police evaluate the benefits of new technologies relative to their costs (an important consideration given the costs of many new technologies and the general fiscal pressures faced by police agencies) and inform their assessments of which technologies are most beneficial to their agencies.

As part of this monitoring, police managers must also be aware of, and prepared for, the problems that technology can cause. As discussed throughout our report, technical problems like poor connectivity, loss of data, and slow wireless technology that does not match officers' expectations (especially given their experience with their personal technologies) can have problematic effects on officer productivity and perceptions. Police executives should pay careful attention to these issues in selecting and implementing their technologies; unlike the fundamental trainings issues discussed above, technical problems might sometimes be more easily or quickly addressed.

At the same time, our study (and others) suggests that police leaders may have to temper and manage expectations about technology's impacts. Technology can bring many benefits to police agencies, but it also brings new demands and challenges that may offset expected gains in efficiency and effectiveness to some degree. Police executives need to be aware of some of the unintended consequences that may stem from technological changes in their agencies and consider methods of countering these effects.

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13. Appendices

Appendix A. Agency-wide, Officer-level Survey Instrument

Appendix B. Interview and Focus Group Instrument

Appendix C. Survey Results for Assignments and Ranks by Agency

Appendix D. Hot Spots Log Sheet for Technology Experiment in Agency 1

Appendix A. Agency-wide, Officer-level Survey Instrument

POLICE EXECUTIVE RESEARCH FORUM

Police Technology Survey

GEORGE MASON UNIVERSITY

The Police Executive Research Forum and George Mason University are conducting a study of policing technology for the U.S. Department of Justice. The study is examining how key technologies affect various aspects of police work and organizations, and the results will be used to make recommendations on how police can best use current and new technologies. Your Chief or Sheriff has agreed to participate in the study and has granted us permission to administer this survey to personnel in your agency. It asks for your views on a variety of issues related to the implementation and uses of technology in your agency. In addition to providing useful information to the law enforcement field generally, the survey will also help your agency to assess its own efforts to better utilize technology.

This is a confidential survey. We are not asking for your identity on the survey, and individual responses will not be reported to your agency or anyone else. The survey should take approximately 15 minutes to complete. We ask you to please complete this survey by XXXX. Thank you for your participation--we greatly value your input.

NOTE:

-If you have any questions regarding the survey, please call or e-mail Dr. Christopher Koper from George Mason University at (703) 993-4982 or ckoper2@gmu.edu.

-This is an online survey only. If you have difficulty accessing or submitting the online questionnaire, please contact Nathan Ballard of the Police Executive Research Forum at (202) 454-8311 or nballard@policeforum.org.

-After a successful online submittal, you will be redirected to a confirmation page letting you know that it has been received.

SURVEY BEGINS ON NEXT PAGE...

ID NUMBER

General Views on Technology

We are interested in your general views on technology in your agency. By technology, we mean such things as record management systems (RMS), in-car cameras, forensics, computer-aided dispatch (CAD), mobile computer units, analytic technologies (like crime analysis), etc.

Please answer whether you **"strongly agree," "agree," "disagree,"** or **"strongly disagree"** with the following statements:

	Strongly Agree	Agree	Disagree	Strongly Disagree
1. Successful policing requires keeping up with new technologies.	☐	☐	☐	☐
2. My agency is generally open to implementing the latest technologies.	☐	☐	☐	☐
3. In general, younger officers/detectives are more receptive to using technologies than older officers/detectives.	☐	☐	☐	☐
4. The use of technology has led to a less trusting atmosphere inside of my agency.	☐	☐	☐	☐
5. My agency prioritizes the acquisition of the newest technologies.	☐	☐	☐	☐
6. Technology makes my agency's decisions more transparent to the community.	☐	☐	☐	☐
	Strongly Agree	Agree	Disagree	Strongly Disagree
7. Up-to-date technology improves the image of my agency in the eyes of the community.	☐	☐	☐	☐
8. Technology increases the community's expectations of my agency to reduce crime.	☐	☐	☐	☐
9. In general, technology functions well in my agency.	☐	☐	☐	☐
10. In comparison to my fellow officers, I consider myself "technology-savvy".	☐	☐	☐	☐
11. I like to experiment with new technologies.	☐	☐	☐	☐
12. In my agency, officers who use technology in creative or innovative ways are more likely to be rewarded than those who do not.	☐	☐	☐	☐
13. My agency puts more value on officers making decisions based on data and analysis than on officers using their personal experience.	☐	☐	☐	☐
14. Technology has helped make decision making more transparent to others in the agency.	☐	☐	☐	☐

Implementation of Technologies

Now we'd like to get your views on general aspects of how technologies are implemented in your agency.

Please answer whether you **"strongly agree," "agree," "disagree,"** or **"strongly disagree"** with the following statements:

	Strongly Agree	Agree	Disagree	Strongly Disagree
15. My agency adequately prepares me to use new technologies.	☐	☐	☐	☐
16. Overall, supervisors and command staff in my agency work hard to generate the widespread acceptance of technology.	☐	☐	☐	☐
17. I feel that my agency adopts technologies that are designed to meet important needs.	☐	☐	☐	☐
18. Before implementing a new technology, command staff work hard to get input from employees.	☐	☐	☐	☐
19. After implementing a new technology, my agency seeks regular feedback from employees on how it is working.	☐	☐	☐	☐
20. After implementing a new technology, my agency provides sufficient help and support to employees who are experiencing problems with it.	☐	☐	☐	☐
21. In general, I am satisfied with how new technologies are implemented in this agency.	☐	☐	☐	☐
22. The successful implementation of a new technology in my agency depends on supervisors and commanders requiring its use.	☐	☐	☐	☐
23. My agency tends to adopt technologies that are often not useful.	☐	☐	☐	☐

Information Technologies and Analytic Systems

In the questions below, we ask about <u>information technologies and analytic systems</u> in your agency. These technologies may include records management systems (RMS), computer-aided dispatch, mobile computer units, and other mobile or stationary computer and database systems in which you can enter and/or receive information on persons, places, incidents, crime analysis, intelligence, etc.

Please answer whether you **"strongly agree," "agree," "disagree," or "strongly disagree"** with the following statements:

	Strongly Agree	Agree	Disagree	Strongly Disagree
24. Information technology enhances the importance of my unit or division.	☐	☐	☐	☐
25. Information technology causes conflict between organizational units and staff.	☐	☐	☐	☐
26. Information technology improves cooperation across units and people in my agency.	☐	☐	☐	☐
27. Information technology creates more equality among ranks and units in my agency.	☐	☐	☐	☐
28. Information technology improves communication between me and my immediate supervisor.	☐	☐	☐	☐
	Strongly Agree	**Agree**	**Disagree**	**Strongly Disagree**
29. Information technology improves communication that I have with the higher levels of command staff.	☐	☐	☐	☐
30. Information technology improves relationships between me and other officers/detectives/supervisors of my same rank.	☐	☐	☐	☐
31. Information technology improves relationships between sworn and civilian personnel in my agency.	☐	☐	☐	☐
32. My immediate supervisor uses information technology to track and monitor my daily activities.	☐	☐	☐	☐
33. The command staff uses information technology to track and monitor my unit's daily activities.	☐	☐	☐	☐
34. Commanders and supervisors use information technology to identify under-performing officers.	☐	☐	☐	☐
35. Information technology generates statistics that are valuable in assessing officer performance.	☐	☐	☐	☐
36. Information technology generates statistics that are valuable in assessing my agency's performance.	☐	☐	☐	☐
37. My superiors expect me to use information technology systems to identify and respond to crime problems.	☐	☐	☐	☐
38. Information technology improves supervision and management within the agency.	☐	☐	☐	☐

FOR PATROL OFFICERS ONLY (OTHERS SKIP TO QUESTION 48)

To what extent do you use information technologies and analytic systems to do the following?

Please answer using the following responses: **"never," "rarely," "sometimes," "often," or "very often."**

	Never	Rarely	Sometimes	Often	Very often
39. Provide information to citizens that is not related to a specific call or emergencies (for example, information about area crime patterns or follow-up information about a matter involving the citizen.)	☐	☐	☐	☐	☐
40. Determine where to patrol when not answering a call for service.	☐	☐	☐	☐	☐
41. Locate suspects, wanted persons, and other persons of interest.	☐	☐	☐	☐	☐
42. Locate vehicles of interest.	☐	☐	☐	☐	☐
43. Collect and search for information during a field interview.	☐	☐	☐	☐	☐
44. Determine how to respond to a crime problem.	☐	☐	☐	☐	☐
45. Check the history of a specific location or person(s) before responding to a call for service.	☐	☐	☐	☐	☐

To what extent do you agree or disagree with the following statements?

Please answer whether you **"strongly agree," "agree," "disagree,"** or **"strongly disagree"** with the following statements:

	Strongly Agree	Agree	Disagree	Strongly Disagree
46. Information technology increases my capacity to prevent crime on patrol when not answering calls for service.	☐	☐	☐	☐
47. Information technology enhances my safety on the job.	☐	☐	☐	☐

FOR SUPERVISORS AND COMMANDERS ONLY (OTHERS SKIP TO QUESTION 54)

To what extent do you use information technologies and analytic systems to do the following?

Please answer using the following responses: **"never," "rarely," "sometimes," "often," or "very often."**

	Never	Rarely	Sometimes	Often	Very often
48. Monitor the daily activities of officers, detectives, or supervisors who work for you.	☐	☐	☐	☐	☐
49. Identify crime trends and problems in your area of responsibility.	☐	☐	☐	☐	☐
50. Determine what to do about crime trends and problems in your area of responsibility.	☐	☐	☐	☐	☐
51. Focus the activities of my personnel on specific locations that have the most problems.	☐	☐	☐	☐	☐
52. Share information with community leaders or business owners.	☐	☐	☐	☐	☐
53. Identify problem behaviors of those who work for you.	☐	☐	☐	☐	☐

FOR ALL SURVEY PARTICIPANTS

To what extent do you agree or disagree with the following statements?

Please answer whether you "**strongly agree**," "**agree**," "**disagree**," or "**strongly disagree**" with the following statements:

	Strongly Agree	Agree	Disagree	Strongly Disagree
54. When making decisions about crime problems, I tend to rely more on my own experience than using information technologies.	☐	☐	☐	☐
55. Information technologies help me to engage in proactive, self-initiated activities.	☐	☐	☐	☐
56. Generally, information technology in this agency is easy to use.	☐	☐	☐	☐
57. I am satisfied with the quality of information I can access from our information technology systems.	☐	☐	☐	☐
58. The information technology my agency uses creates extra work for me.	☐	☐	☐	☐
59. Overall the information technology helps me be productive in my daily work.	☐	☐	☐	☐
	Strongly Agree	Agree	Disagree	Strongly Disagree
60. Information technology makes me more effective in identifying and locating suspects, wanted persons, and other persons of interest.	☐	☐	☐	☐
61. Information technologies and crime analysis help me understand and respond effectively to crime problems.	☐	☐	☐	☐
62. Information technologies improve the way I interact and communicate with citizens.	☐	☐	☐	☐
63. Information technology allows me to be more effective in helping victims.	☐	☐	☐	☐
64. It is important to citizens that I am knowledgeable about the latest information technologies.	☐	☐	☐	☐
65. Using information technologies makes my work interesting.	☐	☐	☐	☐
66. Working with information technologies in my agency frustrates me.	☐	☐	☐	☐
67. The demands of using information technologies take time away from aspects of police work that I enjoy.	☐	☐	☐	☐
68. Information systems enhance my job satisfaction.	☐	☐	☐	☐

Background Information

Finally, we would like to ask a few questions about your background.

69. What is your age (in years)? [ ] years old

70. What is your gender? ☐ Male ☐ Female

71. Are you of Hispanic, Latino, or Spanish origin? ☐ Yes ☐ No

72. What is your race?
    - ☐ White
    - ☐ Black or African American
    - ☐ American Indian or Alaskan Native
    - ☐ Asian
    - ☐ Native Hawaiian, Samoan, Filipino or other Pacific Islander
    - ☐ Two or more races (please list): [ ]

73. How long (years and months) have you been with this department: [ ] years [ ] months

74. How long have you been a sworn officer (Total years across any department): [ ] years

75. How long (years and months) have you been in your current assignment: [ ] years [ ] months

76. Education Level:
    - ☐ High school graduate
    - ☐ Some college without a degree obtained
    - ☐ Associate Degree
    - ☐ Bachelor's Degree
    - ☐ Graduate or Professional Degree (Graduate certificate, Masters, Law, Doctorate)

77. Rank:
    - ☐ Line level, non-ranked (officer, detective, non-supervisory)
    - ☐ 1st line supervisor (sergeant, supervisory corporal)
    - ☐ 2nd line supervisor (lieutenant, supervise 1st line supervisors)
    - ☐ Above 2nd line supervisor

78. Which of the following BEST represents the current type of assignment you are in?
    - ☐ Patrol
    - ☐ Traffic
    - ☐ Detective
    - ☐ Administration and Support Services
    - ☐ Other (please describe): [ ]

Thank you for your time and assistance!

Appendix B. Interview and Focus Group Instrument

Provide individual and groups with some guidelines at start. [Ask for SPECIFIC EXAMPLES.] Also, ask for basic information (will be kept confidential) including name, rank, specific charge, time in police agency.

1. "History" of RMS or LPR in the organization. [connected to culture]

a. DESCRIBE HISTORY OF THIS SYSTEM IN ORGANIZATION: Briefly, old, new systems, why adopted the technology. For example, want to get a clear sense of the implementation process from decision to adopt to implementation to how technology has been managed over time. What were reasons for adopting technology? How were expectations/understandings about technology managed over time? Who was involved in implementation process? What changes were made to accommodate the new technology? What were some of the major challenges of implementing the technology? How were these overcome?

2. Impact on police culture [connected to history] [SURVEY]

a. RECEPTIVITY to the technology or change in technology. Was the agency receptive to this technology? How does it view it?
b. ACTIVITIES DONE TO INSTITUTIONALIZE TECHNOLOGY: What did agency do to receive technology and teach employees about it?
c. GENERAL QUESTIONS ABOUT BELIEFS OF TECHNOLOGY: What do you think is the role of this technology in policing overall?
d. For example, the key here is trying to get a sense of people's images of technology, how they think of it or make sense of it. This is about the nature of technology: "What is your overall assessment of X technology in the department?" "Is it a useful technology?" "How does it affect your life as a commander/sergeant/police officer?" "What capabilities does it give you?"

3. Impact on police organizational units, hierarchy and structure

a. ORGANIZATIONAL LAYOUT: Describe how this technology/technological change affected the organizational structure, such as unit existence and function, sworn/civilian mix?
b. EMPLOYEE RELATIONS: What were some of the most visible changes in between employees, specifically, relationships across ranks, across

"generations", sworn-civilian relations? How they relate everyday and power relationships.

4. **Impact on internal accountability and management systems**

    a. USE OF RMS FOR MANAGEMENT AND INTERNAL ACCOUNTABILITY IN AGENCY - For example, describe how this system is used to assess the performance of the agency, managers, line level, and other personnel? Is it used (and how) for internal affairs?
    b. CHANGES IN RMS SYSTEMS - Have you noticed any differences since the adoption of the new RMS system on your management and accountability systems?
    c. PERCEPTIONS AND RMS SYSTEMS - How has the new system changed perceptions by employees of accountability and management systems?

5. **Impact on individual police/supervisor discretion and decision making [connected to every business] [SURVEY]**

    a. HOW IS THIS TECHNOLOGY USED IN DAILY ACTIVITIES?
    b. CHANGE ON CHOICES THEY MAKE ABOUT RESPONSE TO CRIME: Describe how new system affects the approach officers take in responding to crime and community problems generally (overall prioritization) and to specific incidents.
    c. [CHANGE ON THE DECISIONS THEY MAKE ABOUT CRIME GENERALLY and INCIDENTS SPECIFICALLY, information sharing?]

6. **Impact on police processes, efficiencies and daily business and work [connected to discretion] [SURVEY]**

    a. CHANGE ON EFFICIENCIES: Describe how the new system affects productivity, speed and ease, of daily activities (for example speed in making arrest, writing reports, handling admin).
    b. REQUIRED ACTIVITIES: Are there changes in required activities that need to be done?

7. **Impact on effectiveness related to crime control, prevention, detection, deterrence, crime reduction**

    a. BROAD QUESTION ON REDUCING CRIME: How does this system (or change in system) affect organization's ability to reduce, detect, deter, prevent crime (including limitations). For example, how do different units, USE this system for crime control, detection, prevention; how technology affects crime control ability across ranks, units, groups; how does this system affect strategizing about crime control; has there been any documentation/previous studies done?

8. Impact on police-citizen communication and police legitimacy

a. USE OF TECHNOLOGY FOR THIS? Is this technology used for police-citizen/community relations?
b. IMPACT ON ACTUAL INTERACTIONS: Has the technology or change in technology affected actual interactions between officers and people or command and community in terms of NATURE of interactions.
c. SATISFACTION DUE TO TECHNOLOGY: Describe effect (if any) on victim OR community satisfaction, including perceptions of the police by the community.

9. Impact on job satisfaction [SURVEY]

a. JOB SATISFACTION: How does this system affect job satisfaction for different ranks, units, people (including civilians), in the agency?

Appendix C. Survey Results for Assignments and Ranks by Agency

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TABLE 1. OFFICER SURVEY FOR GENERAL VIEWS ON TECHNOLOGY (AGENCY 1)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
General Views on Technology						
Successful policing requires keeping up with new technologies.	3.49 (95%)	3.63 (96%)	3.73 (97%)	3.54 (95%)	3.44 (96%)	3.70 (95%)
My agency is generally open to implementing the latest technologies.	2.44 (52%)	2.51 (56%)	2.58 (62%)	2.45 (53%)	2.42 (51%)	2.58 (53%)
In general, younger officers/detectives are more receptive to using technologies than older officers/detectives.	3.14 (86%)	3.23 (90%)	3.23 (88%)	3.14 (86%)	3.22 (91%)	3.30 (84%)
The use of technology has led to a less trusting atmosphere inside of my agency.	2.54 (49%)	2.52 (47%)	2.33 (34%)*	2.52 (48%)	2.56 (50%)	2.23 (28%)**
My agency prioritizes the acquisition of the newest technologies.	2.11 (31%)	2.13 (35%)	2.32 (37%)	2.13 (32%)	2.04 (27%)	2.23 (38%)
Technology makes my agency's decisions more transparent to the community.	2.41 (44%)	2.47 (53%)	2.56 (58%)*	2.42 (47%)	2.39 (44%)	2.65 (61%)*
Up-to-date technology improves the image of my agency in the eyes of the community.	2.96 (77%)	3.05 (84%)	3.05 (83%)	2.93 (77%)	3.02 (84%)	3.26 (82%)
Technology increases the community's expectations of my agency to reduce crime.	2.91 (75%)	3.05 (78%)	3.07 (85%)*	2.93 (75%)	3.02 (85%)	3.18 (88%)*
In general, technology functions well in my agency.	1.97 (29%)	1.97 (30%)	2.13 (38%)	1.97 (30%)	1.95 (24%)	2.21 (44%)*
In comparison to my fellow officers, I consider myself 'technology-savvy.'	2.84 (68%)	2.82 (65%)	3.10 (80%)*	2.85 (68%)	2.93 (70%)	3.04 (77%)

Agency 1

I like to experiment with new technologies.	2.99 (78%)	3.14 (80%)	3.23 (86%)	3.06 (80%)	3.04 (84%)	3.12 (86%)
In my agency, officers who use technology in creative or innovative ways are more likely to be rewarded than those who do not.	2.40 (43%)	2.44 (41%)	2.33 (39%)	2.40 (42%)	2.43 (46%)	2.49 (49%)
My agency puts more value on officers making decisions based on data and analysis than on officers using their personal experience.	2.55 (46%	2.67 (53%)	2.55 (44%)	2.55 (45%)	2.67 (57%)	2.63 (49%)
Technology has helped make decision-making more transparent to others in the agency.	2.30 (39%)	2.48 (52%)*	2.29 (38%)	2.33 (42%)	2.22 (31%)	2.46 (49%)
Scale Score **Overall Reliability: α = .693**	**2.65**	**2.72**	**2.75**	**2.66**	**2.66**	**2.79**

Statistical significance levels for differences: **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 489 to 495. The sample size range for assignment is 502 to 508.

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TABLE 2. OFFICER SURVEY RESULTS FOR IMPLEMENTATION OF TECHNOLOGIES (AGENCY 1)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Implementation						
My agency adequately prepares me to use new technologies.	2.20 (40%)	2.05 (30%)	2.37 (51%)	2.18 (39%)	2.17 (37%)	2.40 (54%)*
Overall, supervisors and command staff in my agency work hard to generate the widespread acceptance of technology.	2.32 (46%)	2.24 (43%)	2.33 (47%)	2.28 (44%)	2.17 (39%)	2.60 (61%)*
I feel that my agency adopts technologies that are designed to meet important needs.	2.17 (41%)	2.16 (37%)	2.42 (53%)*	2.18 (41%)	2.26 (41%)	2.39 (49%)
Before implementing a new technology, command staff work hard to get input from employees.	1.73 (17%)	1.82 (22%)	2.01 (30%)**	1.69 (16%)	1.91 (20%)	2.32 (42%)***
After implementing a new technology, my agency seeks regular feedback from employees on how it is working.	1.83 (20%)	1.87 (23%)	1.95 (20%)	1.80 (20%)	1.92 (19%)	2.16 (28%)
After implementing a new technology, my agency provides sufficient help and support to employees who are experiencing problems with it.	2.33 (50%)	2.23 (43%)	2.48 (58%)	2.30 (49%)	2.43 (56%)	2.65 (65%)*
In general, I am satisfied with how new technologies are implemented in this agency.	1.93 (27%)	2.01 (31%)	2.16 (34%)	1.96 (29%)	1.87 (17%)	2.21 (37%)
The successful implementation of a new technology in my agency depends on supervisors and commanders requiring its use.	2.54 (56%)	2.65 (59%)	2.72 (66%)	2.50 (54%)	2.76 (70%)*	2.91 (72%)*
My agency tends to adopt technologies that are often not useful. [REVERSE CODED]	2.07 (32%)	2.25 (39%)	2.28 (48%)**	2.03 (31%)	2.23 (40%)	2.74 (67%)***
Scale Score **Overall Reliability: α = .892**	2.13	2.15	2.29	**2.10**	**2.19**	**2.49**

Statistical significance levels for differences: $*p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean

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differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 491 to 496. The sample size range for assignment is 503 to 509.

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TABLE 3. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND AGENCY RELATIONSHIPS (AGENCY 1)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Relationships						
Information technology enhances the importance of my unit or division.	2.62 (59%)	2.84 (73%)*	2.80 (66%)	2.65 (60%)	2.65 (60%)	2.93 (77%)*
Information technology causes conflict between organizational units and staff. [REVERSE CODED]	2.53 (54%)	2.55 (60%)	2.52 (59%)	2.53 (55%)	2.37 (50%)	2.66 (66%)
Information technology improves cooperation across units and people in my agency.	2.57 (58%)	2.71 (68%)	2.58 (62%)	2.57 (59%)	2.58 (58%)	2.77 (72%)
Information technology creates more equality among ranks and units in my agency.	2.13 (27%)	2.26 (35%)	2.16 (31%)	2.13 (27%)	2.24 (30%)	2.26 (37%)
Information technology improves communication between me and my immediate supervisor.	2.50 (50%)	2.79 (66%)*	2.57 (57%)	2.49 (49%)	2.65 (60%)	2.93 (79%)***
Information technology improves communication that I have with the higher levels of command staff.	2.14 (31%)	2.29 (36%)	2.43 (53%)***	2.10 (30%)	2.42 (42%)	2.63 (58%)***
Information technology improves relationships between me and other officers/detectives/supervisors of my same rank.	2.46 (51%)	2.71 (62%)	2.49 (55%)	2.45 (50%)	2.56 (59%)	2.84 (72%)**
Information technology improves relationships between sworn and civilian personnel in my agency.	2.28 (39%)	2.60 (58%)**	2.46 (49%)	2.31 (41%)	2.35 (44%)	2.65 (60%)**
Scale Score	**2.40**	**2.60**	**2.50**	**2.41**	**2.48**	**2.71**
Overall Reliability: α = .869						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 485 to 493. The sample size range for assignment is 499 to 506.

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TABLE 4. OFFICER SURVEY RESULTS FOR TECHNOLOGY, INTERNAL ACCOUNTABILITY, AND MANAGEMENT (AGENCY 1)

SCALE ITEMS	**ASSIGNMENT** Patrol Avg. (% agree)	Detective Avg. (% agree)	Other Avg. (% agree)	**RANK** Line Avg. (% agree)	1st Line Avg. (% agree)	2nd Line/+ Avg. (% agree)
Internal Accountability & Management						
My immediate supervisor uses information technology to track and monitor my daily activities.	3.00 (82%)	2.69 (62%)***	2.54 (55%)***	2.96 (81%)	2.69 (65%)**	2.59 (52%)***
The command staff uses information technology to track and monitor my unit's daily activities.	2.97 (82%)	2.65 (60%)***	2.54 (56%)***	2.89 (77%)	2.85 (75%)	2.64 (59%)**
Commanders and supervisors use information technology to identify underperforming officers.	2.95 (83%)	2.64 (60%)***	2.64 (64%)***	2.81 (75%)	2.93 (78%)	3.00 (84%)
Information technology generates statistics that are valuable in assessing officer performance.	2.61 (63%)	2.43 (55%)	2.62 (67%)	2.50 (56%)	2.82 (82%)***	2.96 (84%)***
Information technology generates statistics that are valuable in assessing my agency's performance.	2.63 (63%)	2.55 (58%)	2.79 (74%)	2.57 (59%)	2.78 (76%)*	3.04 (82%)***
My superiors expect me to use information technology systems to identify and respond to crime problems.	2.82 (77%)	2.90 (79%)	2.75 (66%)*	2.77 (74%)	2.94 (85%)	2.95 (78%)
Information technology improves supervision and management within the agency.	2.37 (48%)	2.35 (45%)	2.38 (51%)	2.28 (42%)	2.51 (56%)*	2.84 (75%)***
Scale Score	**2.76**	**2.60**	**2.60**	**2.68**	**2.79**	**2.86**
Overall Reliability: α = .784						

Statistical significance levels for differences: **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 488 to 493. The sample size range for assignment is 496 to 505.

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TABLE 5. OFFICER SURVEY RESULTS FOR TECHNOLOGY, DISCRETION, AND DECISION-MAKING AMONG OFFICERS (AGENCY 1)

To what extent do you use information technologies and analytic systems to do the following:	Never	Rarely	Sometimes	Often	Very Often	Mean (on 1 to 5 scale)
Provide information to citizens that is not related to a specific call or emergencies.	21%	28%	38%	10%	2%	2.44
Determine where to patrol when not answering a call for service.	20%	27%	37%	11%	4%	2.52
Locate suspects, wanted persons, and other persons of interest.	4%	8%	41%	36%	12%	3.44
Locate vehicles of interest.	20%	27%	37%	11%	4%	2.52
Collect and search for information during a field interview.	5%	8%	35%	33%	19%	3.53
Determine how to respond to a crime problem.	14%	26%	41%	14%	5%	2.71
Check the history of a specific location or person(s) before responding to a call for service.	2%	2%	25%	41%	29%	3.93

*The sample size varies for each item. The sample size range is 334 to 336.

Agency 1

TABLE 6. OFFICER SURVEY RESULTS FOR TECHNOLOGY, DISCRETION, AND DECISION-MAKING AMONG SUPERVISORS AND COMMANDERS (AGENCY 1)

To what extent do you use information technologies and analytic systems to do the following:	Never	Rarely	Sometimes	Often	Very Often	Mean (on 1 to 5 scale)
Monitor the daily activities of officers, detectives, or supervisors who work for you.	17%	13%	31%	31%	8%	3.00
Identify crime trends and problems in your area of responsibility.	9%	15%	40%	27%	9%	3.12
Determine what to do about crime trends and problems in your area of responsibility.	13%	20%	41%	19%	7%	2.86
Focus the activities of my personnel on specific locations that have the most problems.	13%	15%	39%	25%	8%	3.00
Share information with community leaders or business owners.	20%	29%	34%	14%	3%	2.52
Identify problem behaviors of those who work for you.	24%	20%	31%	20%	5%	2.63

*The sample size varies for each item. The sample size range is 109 to 111.

Agency 1

TABLE 7. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND AGENCY PROCESSES AND EFFICIENCIES (AGENCY 1)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Process/Efficiencies						
Generally, information technology in this agency is easy to use.	1.91 (27%)	1.87 (25%)	2.16 (42%)**	1.92 (28%)	1.79 (23%)	2.16 (35%)
I am satisfied with the quality of information I can access from our information technology systems.	2.38 (51%)	2.30 (52%)	2.34 (48%)	2.33 (49%)	2.44 (56%)	2.54 (53%)
The information technology my agency uses creates extra work for me. [REVERSE CODED]	1.65 (15%)	1.71 (13%)	2.06 (32%)***	1.69 (16%)	1.65 (17%)	1.96 (26%)
Overall the information technology helps me be productive in my daily work.	2.25 (41%)	2.53 (55%)*	2.50 (57%)*	2.26 (42%)	2.29 (42%)	2.77 (74%)***
Scale Score	**2.05**	**2.10**	**2.26**	**2.05**	**2.03**	**2.36**
Overall Reliability: α = .784						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 490 to 492. The sample size range for assignment is 502 to 504.

Agency 1

TABLE 8. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND POLICE EFFECTIVENESS (AGENCY 1)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Effectiveness						
Information technology makes me more effective in identifying and locating suspects, wanted persons, and other persons of interest.	2.87 (76%)	3.11 (89%)*	2.96 (81%)	2.89 (78%)	2.87 (76%)	3.22 (91%)*
Information technologies and crime analysis help me understand and respond effectively to crime problems.	2.57 (59%)	2.90 (80%)**	2.74 (71%)	2.60 (61%)	2.65 (65%)	2.98 (83%)**
Information technologies improve the way I interact and communicate with citizens.	2.17 (32%)	2.42 (48%)**	2.54 (56%)***	2.20 (34%)	2.19 (30%)	2.74 (65%)***
Information technology allows me to be more effective in helping victims.	2.29 (40%)	2.62 (62%)***	2.46 (47%)	2.32 (41%)	2.32 (43%)	2.72 (69%)***
It is important to citizens that I am knowledgeable about the latest information technologies.	2.52 (52%)	2.76 (70%)**	2.82 (71%)**	2.53 (53%)	2.72 (62%)	2.98 (86%)***
Scale Score	**2.47**	**2.76**	**2.70**	**2.50**	**2.53**	**2.91**
Overall Reliability: α = .839						

Statistical significance levels for differences: $*p \le .05$; ** $p<=.01$; *** $p<=.001$. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 487 to 491. The sample size range for assignment is 492 to 500.

TABLE 9. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND JOB SATISFACTION (AGENCY 1)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Job Satisfaction						
Using information technologies makes my work interesting.	2.29 (42%)	2.59 (58%)*	2.76 (66%)***	2.34 (46%)	2.42 (43%)	2.77 (65%)**
Working with information technologies in my agency frustrates me. [REVERSE CODED]	1.83 (20%)	2.04 (29%)	2.03 (32%)*	1.84 (21%)	1.91 (19%)	2.24 (36%)*
The demands of using information technologies take time away from aspects of police work that I enjoy. [REVERSE CODED]	1.82 (20%)	2.08 (32%)*	2.18 (41%)***	1.86 (23%)	1.96 (19%)	2.20 (39%)**
Information systems enhance my job satisfaction.	2.13 (31%)	2.38 (49%)*	2.39 (52%)***	2.18 (35%)	2.17 (30%)	2.46 (54%)**
Scale Score	**2.11**	**2.28**	**2.33**	**2.12**	**2.17**	**2.46**
Overall Reliability: α = .816						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 489 to 491. The sample size range for assignment is 496 to 504.

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TABLE 10. ADDITIONAL SURVEY ITEMS ON EFFECTIVENESS AND JOB SATISFACTION (AGENCY 1)

Patrol Effectiveness and Satisfaction	Mean	% Agree
Information technology increases my capacity to prevent crime on patrol when not answering calls for service.	2.41	49%
Information technology enhances my safety on the job.	2.52	61%

*The sample size varies for each item. The sample size range is 335 to 337.

TABLE 11. ADDITIONAL SURVEY ITEMS ON DISCRETION AND DECISION-MAKING (AGENCY 1)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Discretion/Decision-Making						
When making decisions about crime problems, I tend to rely more on my own experience than using information technologies.	3.09 (83%)	2.76 (60%)***	2.60 (54%)***	3.05 (80%)	2.94 (77%)	2.55 (49%)***
Information technologies help me to engage in proactive, self-initiated activities.	2.56 (57%)	2.76 (71%)*	2.88 (80%)***	2.55 (56%)	2.76 (74%)*	2.96 (86%)***

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 487 to 491. The sample size range for assignment is 496 to 503.

Agency 2

TABLE 1. OFFICER SURVEY RESULTS FOR GENERAL VIEWS ON TECHNOLOGY (AGENCY 2)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
General Views on Technology						
Successful policing requires keeping up with new technologies.	3.77 (97%)	3.63 (98%)	3.71 (96%)	3.69 (97%)	3.72 (97%)	3.65 (96%)
My agency is generally open to implementing the latest technologies.	3.06 (84%)	2.98 (83%)	3.07 (85%)	3.01 (84%)	3.13 (88%)	3.24 (89%)
In general, younger officers/detectives are more receptive to using technologies than older officers/detectives.	3.18 (88%)	3.05 (81%)	3.13 (78%)*	3.09 (81%)	3.17 (88%)	3.36 (93%)
The use of technology has led to a less trusting atmosphere inside of my agency.	2.54 (43%)	2.43 (39%)	2.40 (40%)	2.50 (44%)	2.31 (30%)*	2.23 (23%)*
My agency prioritizes the acquisition of the newest technologies.	2.61 (60%)	2.59 (60%)	2.64 (62%)	2.59 (59%)	2.72 (71%)*	2.98 (80%)**
Technology makes my agency's decisions more transparent to the community.	2.64 (60%)	2.61 (58%)	2.81 (69%)	2.63 (60%)	2.65 (59%)	2.91 (75%)
Up-to-date technology improves the image of my agency in the eyes of the community.	3.06 (81%)	3.00 (80%)	3.09 (85%)	3.01 (80%)	3.05 (82%)	3.20 (85%)
Technology increases the community's expectations of my agency to reduce crime.	3.15 (83%)	3.13 (86%)	3.15 (83%)	3.11 (83%)	3.17 (88%)	3.34 (89%)
In general, technology functions well in my agency.	2.93 (85%)	2.88 (81%)	3.01 (87%)	2.92 (83%)	2.89 (83%)	3.14 (95%)
In comparison to my fellow officers, I consider myself 'technology-savvy.'	2.92 (71%)	2.82 (71%)	2.85 (73%)	2.85 (72%)	2.88 (67%)	2.86 (80%)

Agency 2

I like to experiment with new technologies.	3.21 (85%)	3.08 (84%)	3.17 (87%)	3.13 (84%)	3.09 (79%)	3.23 (95%)
In my agency, officers who use technology in creative or innovative ways are more likely to be rewarded than those who do not.	2.50 (48%)	2.49 (46%)	2.59 (46%)	2.46 (43%)	2.64 (58%)*	2.69 (60%)*
My agency puts more value on officers making decisions based on data and analysis than on officers using their personal experience.	2.86 (64%)	2.72 (58%)	2.86 (67%)	2.78 (60%)	2.86 (65%)	2.89 (74%)
Technology has helped make decision-making more transparent to others in the agency.	2.62 (59%)	2.65 (61%)	2.75 (69%)	2.63 (60%)	2.69 (66%)	2.89 (77%)*
Scale Score **Overall Reliability:** α **= .770**	2.86	2.83	2.88	**2.82**	**2.85**	**3.03**

Statistical significance levels for differences: **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 580 to 616. The sample size range for assignment is 530 to 549.

Agency 2

TABLE 2. OFFICER SURVEY RESULTS FOR IMPLEMENTATION OF TECHNOLOGIES (AGENCY 2)

SCALE ITEMS	**ASSIGNMENT** Patrol Avg. (% agree)	Detective Avg. (% agree)	Other Avg. (% agree)	**RANK** Line Avg. (% agree)	1st Line Avg. (% agree)	2nd Line/+ Avg. (% agree)
Implementation						
My agency adequately prepares me to use new technologies.	2.59 (57%)	2.64 (65%)	2.66 (64%)	2.63 (63%)	2.54 (57%)	2.80 (73%)
Overall, supervisors and command staff in my agency work hard to generate the widespread acceptance of technology.	2.61 (59%)	2.66 (66%)	2.60 (63%)	2.61 (61%)	2.72 (69%)	2.91 (80%)*
I feel that my agency adopts technologies that are designed to meet important needs.	2.78 (74%)	2.78 (75%)	2.87 (80%)	2.78 (74%)	2.94 (86%)*	3.09 (89%)*
Before implementing a new technology, command staff work hard to get input from employees.	2.10 (30%)	2.12 (32%)	2.17 (35%)	2.11 (31%)	2.21 (33%)	2.41 (50%)*
After implementing a new technology, my agency seeks regular feedback from employees on how it is working.	2.23 (35%)	2.36 (44%)*	2.29 (38%)	2.30 (40%)	2.28 (35%)	2.43 (50%)
After implementing a new technology, my agency provides sufficient help and support to employees who are experiencing problems with it.	2.62 (62%)	2.64 (65%)	2.66 (66%)	2.64 (64%)	2.56 (57%)	2.67 (65%)
In general, I am satisfied with how new technologies are implemented in this agency.	2.58 (58%)	2.60 (63%)	2.62 (62%)	2.58 (60%)	2.63 (64%)	2.82 (73%)
The successful implementation of a new technology in my agency depends on supervisors and commanders requiring its use.	2.80 (70%)	2.74 (67%)	2.90 (74%)	2.79 (70%)	2.84 (77%)	2.91 (72%)
My agency tends to adopt technologies that are often not useful. [REVERSE CODED]	2.57 (59%)	2.46 (50%)	2.75 (72%)*	2.52 (55%)	2.62 (61%)	2.7277 (%)
Scale Score	2.51	2.55	2.57	**2.53**	**2.55**	**2.75**
Overall Reliability: α = .843						

Statistical significance levels for differences: *$p \le .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean

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differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 577 to 614. The sample size range for assignment is 535 to 551.

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TABLE 3. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND AGENCY RELATIONSHIPS (AGENCY 2)

SCALE ITEMS	**ASSIGNMENT** Patrol Avg. (% agree)	Detective Avg. (% agree)	Other Avg. (% agree)	**RANK** Line Avg. (% agree)	1st Line Avg. (% agree)	2nd Line/+ Avg. (% agree)
Relationships						
Information technology enhances the importance of my unit or division.	2.96 (79%)	3.02 (81%)	3.01 (75%)	2.97 (78%)	2.95 (75%)	3.31 (86%)
Information technology causes conflict between organizational units and staff. [REVERSE CODED]	2.78 (76%)	2.67 (67%)	2.78 (75%)	2.72 (71%)	2.69 (70%)	2.86 (76%)
Information technology improves cooperation across units and people in my agency.	2.82 (76%)	2.85 (77%)	2.89 (80%)	2.84 (76%)	2.80 (78%)	3.02 (87%)
Information technology creates more equality among ranks and units in my agency.	2.44 (44%)	2.46 (50%)	2.46 (48%)	2.45 (48%)	2.43 (46%)	2.57 (49%)
Information technology improves communication between me and my immediate supervisor.	2.88 (78%)	2.83 (74%)	2.87 (74%)	2.81 (73%)	2.97 (79%)	3.07 (83%)
Information technology improves communication that I have with the higher levels of command staff.	2.40 (44%)	2.49 (53%)	2.57 (54%)	2.42 (46%)	2.63 (60%)*	2.93 (73%)**
Information technology improves relationships between me and other officers/detectives/supervisors of my same rank.	2.85 (76%)	2.79 (74%)	2.92 (80%)	2.81 (75%)	2.86 (76%)	3.00 (77%)
Information technology improves relationships between sworn and civilian personnel in my agency.	2.63 (59%)	2.69 (67%)	2.84 (74%)*	2.66 (64%)	2.81 (72%)	2.84 (66%)
Scale Score **Overall Reliability: α = .830**	2.68	2.69	2.73	**2.67**	**2.71**	**2.91**

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 583 to 614. The sample size range for assignment is 524 to 548.

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TABLE 4. OFFICER SURVEY RESULTS FOR TECHNOLOGY, INTERNAL ACCOUNTABILITY, AND MANAGEMENT (AGENCY 2)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Internal Accountability & Management						
My immediate supervisor uses information technology to track and monitor my daily activities.	2.85 (75%)	2.84 (76%)	2.74 (69%)	2.85 (78%)	2.75 (63%)**	2.70 (57%)**
The command staff uses information technology to track and monitor my unit's daily activities.	3.07 (84%)	2.89 (78%)	2.87 (77%)	2.94 (82%)	2.92 (77%)	2.95 (69%)*
Commanders and supervisors use information technology to identify underperforming officers.	2.74 (65%)	2.73 (72%)	2.77 (70%)	2.73 (69%)	2.78 (69%)	2.72 (67%)
Information technology generates statistics that are valuable in assessing officer performance.	2.80 (72%)	2.67 (67%)	2.82 (72%)	2.71 (67%)	2.78 (74%)	2.91 (80%)
Information technology generates statistics that are valuable in assessing my agency's performance.	2.85 (79%)	2.82 (76%)	2.95 (84%)	2.83 (77%)	2.81 (77%)	3.05 (91%)*
My superiors expect me to use information technology systems to identify and respond to crime problems.	3.26 (92%)	3.07 (88%)	3.09 (88%)	3.09 (89%)	3.19 (90%)	3.61 (97%)
Information technology improves supervision and management within the agency.	2.69 (63%)	2.74 (69%)	2.80 (72%)	2.68 (65%)	2.86 (78%)*	3.14 (84%)*
Scale Score **Overall Reliability: α = .813**	2.80	2.78	2.81	**2.77**	**2.79**	**2.95**

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 582 to 613. The sample size range for assignment is 524 to 555.

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TABLE 5. OFFICER SURVEY RESULTS FOR TECHNOLOGY, DISCRETION, AND DECISION-MAKING AMONG OFFICERS (AGENCY 2)

To what extent do you use information technologies and analytic systems to do the following:	Never	Rarely	Sometimes	Often	Very Often	Mean (on 1 to 5 scale)
Provide information to citizens that is not related to a specific call or emergencies.	9%	19%	45%	19%	7%	2.96
Determine where to patrol when not answering a call for service.	8%	13%	32%	33%	14%	3.33
Locate suspects, wanted persons, and other persons of interest.	2%	5%	20%	42%	32%	3.98
Locate vehicles of interest.	8%	13%	32%	33%	14%	3.33
Collect and search for information during a field interview.	2%	7%	22%	33%	36%	3.94
Determine how to respond to a crime problem.	4%	10%	37%	29%	19%	3.49
Check the history of a specific location or person(s) before responding to a call for service.	4%	7%	30%	32%	27%	3.72

*The sample size varies for each item. The sample size range is 242 to 245.

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TABLE 6. OFFICER SURVEY RESULTS FOR TECHNOLOGY, DISCRETION, AND DECISION-MAKING AMONG SUPERVISORS AND COMMANDERS (AGENCY 2)

To what extent do you use information technologies and analytic systems to do the following:	**Never**	**Rarely**	**Sometimes**	**Often**	**Very Often**	**Mean (on 1 to 5 scale)**
Monitor the daily activities of officers, detectives, or supervisors who work for you.	12%	15%	30%	28%	15%	3.20
Identify crime trends and problems in your area of responsibility.	8%	8%	20%	23%	40%	3.80
Determine what to do about crime trends and problems in your area of responsibility.	9%	11%	29%	28%	23%	3.45
Focus the activities of my personnel on specific locations that have the most problems.	10%	9%	23%	30%	28%	3.59
Share information with community leaders or business owners.	9%	19%	32%	26%	15%	3.19
Identify problem behaviors of those who work for you.	16%	19%	40%	17%	9%	2.84

*The sample size varies for each item. The sample size range is 99 to 102.

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TABLE 7. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND AGENCY PROCESSES AND EFFICIENCIES (AGENCY 2)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Process/Efficiencies						
Generally, information technology in this agency is easy to use.	2.78 (75%)	2.83 (83%)*	2.83 (76%)	2.81 (79%)	2.79 (78%)	3.09 (87%)
I am satisfied with the quality of information I can access from our information technology systems.	2.87 (78%)	2.86 (80%)	2.86 (78%)	2.85 (79%)	2.88 (81%)	3.09 (86%)
The information technology my agency uses creates extra work for me. [REVERSE CODED]	2.43 (50%)	2.43 (46%)	2.48 (51%)	2.45 (48%)	2.42 (51%)	2.54 (54%)
Overall the information technology helps me be productive in my daily work.	2.98 (86%)	2.89 (82%)	3.01 (89%)	2.93 (83%)	2.95 (87%)	3.02 (85%)
Scale Score	2.74	2.74	2.78	**2.73**	**2.75**	**2.93**
Overall Reliability: α = .688						

Statistical significance levels for differences: *$p \leq .05$; ** $p<=.01$; *** $p<=.001$. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 562 to 609. The sample size range for assignment is 509 to 549.

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TABLE 8. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND POLICE EFFECTIVENESS (AGENCY 2)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Effectiveness						
Information technology makes me more effective in identifying and locating suspects, wanted persons, and other persons of interest.	3.34 (96%)	3.21 (92%)	3.31 (96%)	3.25 (94%)	3.36 (92%)	3.44 (100%)
Information technologies and crime analysis help me understand and respond effectively to crime problems.	3.08 (87%)	2.91 (80%)	3.08 (89%)	2.98 (82%)	2.97 (85%)	3.33 (95%)*
Information technologies improve the way I interact and communicate with citizens.	2.66 (58%)	2.54 (53%)	2.70 (62%)	2.58 (54%)	2.69 (61%)	2.79 (62%)
Information technology allows me to be more effective in helping victims.	2.93 (79%)	2.78 (73%)	2.90 (77%)	2.83 (74%)	2.87 (76%)	2.89 (69%)
It is important to citizens that I am knowledgeable about the latest information technologies.	2.87 (73%)	2.85 (75%)	2.97 (79%)	2.84 (73%)	2.85 (74%)	3.04 (78%)
Scale Score	**2.96**	**2.85**	**2.98**	**2.88**	**2.94**	**3.09**
Overall Reliability: α = .837						

Statistical significance levels for differences: *$p \le .05$; ** $p<=.01$; *** $p<=.001$. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 581 to 611. The sample size range for assignment is 526 to 548.

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TABLE 9. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND JOB SATISFACTION (AGENCY 2)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Job Satisfaction						
Using information technologies makes my work interesting.	2.93 (78%)	2.82 (78%)	2.88 (75%)	2.87 (78%)	2.79 (71%)	2.96 (79%)
Working with information technologies in my agency frustrates me. [REVERSE CODED]	2.63 (61%)	2.61 (58%)	2.68 (67%)	2.63 (61%)	2.65 (63%)	2.76 (71%)
The demands of using information technologies take time away from aspects of police work that I enjoy. [REVERSE CODED]	2.67 (65%)	2.54 (55%)*	2.72 (71%)	2.62 (62%)	2.59 (59%)	2.72 (70%)
Information systems enhance my job satisfaction.	2.80 (71%)	2.78 (73%)	2.80 (72%)	2.78 (71%)	2.74 (68%)	2.85 (72%)
Scale Score	**2.76**	**2.67**	**2.77**	2.71	2.71	2.78
Overall Reliability: α = .816						

Statistical significance levels for differences: **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 545 to 603. The sample size range for assignment is 498 to 540.

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TABLE 10. ADDITIONAL SURVEY ITEMS ON EFFECTIVENESS AND JOB SATISFACTION (AGENCY 2)

Patrol Effectiveness and Satisfaction	**Mean**	**% Agree**
Information technology increases my capacity to prevent crime on patrol when not answering calls for service.	2.89	77%
Information technology enhances my safety on the job.	2.98	80%

*The sample size varies for each item. The sample size range is 230 to 234.

TABLE 11. ADDITIONAL SURVEY ITEMS ON DISCRETION AND DECISION-MAKING (AGENCY 2)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Discretion/Decision-Making						
When making decisions about crime problems, I tend to rely more on my own experience than using information technologies.	2.68 (57%)	2.68 (61%)	2.66 (52%)	2.70 (60%)	2.76 (63%)	2.33 (33%)***
Information technologies help me to engage in proactive, self-initiated activities.	2.96 (84%)	2.80 (75%)*	2.97 (85%)	2.86 (78%)	2.89 (81%)	2.96 (96%)*

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 603 to 612. The sample size range for assignment is 542 to 551.

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TABLE 1. OFFICER SURVEY RESULTS FOR GENERAL VIEWS ON TECHNOLOGY (AGENCY 3)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
General Views on Technology						
Successful policing requires keeping up with new technologies.	3.79 (99%)	3.91 (100%)	3.81 (98%)	3.81 (98%)	3.95 (100%)	3.71 (96%)
My agency is generally open to implementing the latest technologies.	2.76 (72%)	2.69 (69%)	2.76 (73%)	2.64 (63%)	2.71 (71%)	2.97 (83%)
In general, younger officers/detectives are more receptive to using technologies than older officers/detectives.	3.51 (95%)	3.32 (95%)	3.39 (91%)	3.37 (92%)	3.48 (98%)	3.57 (96%)
The use of technology has led to a less trusting atmosphere inside of my agency.	2.43 (37%)	2.21 (28%)	2.31 (29%)	2.36 (32%)	2.40 (38%)	2.21 (31%)
My agency prioritizes the acquisition of the newest technologies.	2.25 (35%)	2.29 (40%)	2.33 (38%)	2.26 (36%)	2.22 (30%)	2.48 (44%)
Technology makes my agency's decisions more transparent to the community.	2.72 (71%)	2.45 (47%)**	2.80 (75%)	2.57 (59%)	2.74 (67%)	2.90 (83%)*
Up-to-date technology improves the image of my agency in the eyes of the community.	3.23 (93%)	3.21 (86%)	3.28 (93%)	3.19 (87%)	3.38 (98%)	3.25 (96%)
Technology increases the community's expectations of my agency to reduce crime.	3.21 (89%)	3.33 (91%)	3.20 (88%)	3.16 (84%)	3.47 (95%)	3.11 (93%)
In general, technology functions well in my agency.	2.29 (48%)	2.43 (45%)	2.41 (41%)	2.32 (41%)	2.34 (48%)	2.55 (55%)
In comparison to my fellow officers, I consider myself 'technology-savvy.'	2.68 (60%)	2.68 (53%)	2.64 (52%)	2.79 (63%)	2.64 (55%)	2.31 (34%)**

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I like to experiment with new technologies.	2.77 (66%)	3.09 (80%)	3.00 (79%)	3.04 (81%)	2.96 (76%)	2.48 (48%)***
In my agency, officers who use technology in creative or innovative ways are more likely to be rewarded than those who do not.	2.51 (54%)	2.45 (43%)	2.68 (55%)	2.58 (50%)	2.55 (55%)	2.72 (66%)
My agency puts more value on officers making decisions based on data and analysis than on officers using their personal experience.	2.46 (39%)	2.45 (39%)	2.64 (50%)	2.55 (43%)	2.39 (34%)	2.46 (43%)
Technology has helped make decision-making more transparent to others in the agency.	2.60 (61%)	2.47 (44%)	2.42 (42%)*	2.52 (50%)	2.56 (56%)	2.59 (55%)
Scale Score **Overall Reliability: α = .668**	2.78	2.78	2.83	2.79	2.82	2.81

Statistical significance levels for differences: **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 180 to 191. The sample size range for assignment is 165 to 175.

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TABLE 2. OFFICER SURVEY RESULTS FOR IMPLEMENTATION OF TECHNOLOGIES (AGENCY 3)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1^{st} Line	2^{nd} Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Implementation						
My agency adequately prepares me to use new technologies.	2.55 (60%)	2.45 (51%)	2.60 (62%)	2.54 (57%)	2.51 (56%)	2.66 (66%)
Overall, supervisors and command staff in my agency work hard to generate the widespread acceptance of technology.	2.51 (56%)	2.38 (46%)	2.52 (55%)	2.40 (47%)	2.56 (56%)	2.57 (64%)
I feel that my agency adopts technologies that are designed to meet important needs.	2.46 (57%)	2.38 (45%)	2.62 (67%)	2.37 (49%)	2.68 (70%)*	2.86 (83%)**
Before implementing a new technology, command staff work hard to get input from employees.	1.70 (14%)	1.64 (16%)	1.84 (14%)	1.59 (12%)	1.80 (15%)	2.10 (24%)
After implementing a new technology, my agency seeks regular feedback from employees on how it is working.	1.88 (21%)	1.81 (13%)	2.07 (23%)	1.84 (17%)	1.90 (20%)	2.24 (31%)
After implementing a new technology, my agency provides sufficient help and support to employees who are experiencing problems with it.	2.44 (52%)	2.40 (51%)	2.55 (59%)	2.45 (55%)	2.42 (47%)	2.55 (55%)
In general, I am satisfied with how new technologies are implemented in this agency.	2.20 (39%)	2.13 (32%)	2.11 (29%)	2.15 (35%)	2.11 (32%)	2.34 (38%)
The successful implementation of a new technology in my agency depends on supervisors and commanders requiring its use.	2.73 (72%)	2.74 (65%)	2.67 (63%)	2.67 (60%)	2.73 (70%)	2.86 (86%)*
My agency tends to adopt technologies that are often not useful. [REVERSE CODED]	2.26 (39%)	2.19 (34%)	2.58 (56%)	2.27 (37%)	2.22 (40%)	2.62 (62%)*
Scale Score	2.28	2.24	2.40	**2.25**	**2.33**	**2.53**
Overall Reliability: α = .864						

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Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 178 to 193. The sample size range for assignment is 168 to 177.

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TABLE 3. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND AGENCY RELATIONSHIPS (AGENCY 3)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Relationships						
Information technology enhances the importance of my unit or division.	2.94 (74%)	3.13 (78%)	2.95 (75%)	3.06 (76%)	2.81 (68%)	3.03 (86%)
Information technology causes conflict between organizational units and staff. [REVERSE CODED]	2.80 (80%)	2.98 (87%)	2.76 (73%)	2.84 (80%)	2.78 (78%)	2.69 (76%)
Information technology improves cooperation across units and people in my agency.	2.83 (79%)	2.98 (85%)	2.96 (89%)	2.94 (82%)	2.87 (83%)	2.93 (93%)
Information technology creates more equality among ranks and units in my agency.	2.35 (40%)	2.28 (26%)	2.59 (54%)	2.39 (41%)	2.36 (36%)	2.52 (48%)
Information technology improves communication between me and my immediate supervisor.	2.74 (67%)	2.78 (62%)	2.98 (83%)	2.81 (69%)	2.83 (72%)	2.90 (79%)
Information technology improves communication that I have with the higher levels of command staff.	2.43 (47%)	2.51 (47%)	2.64 (64%)	2.42 (45%)	2.55 (51%)	2.79 (72%)**
Information technology improves relationships between me and other officers/detectives/supervisors of my same rank.	2.69 (65%)	2.79 (66%)	2.88 (74%)	2.72 (66%)	2.85 (70%)	2.76 (66%)
Information technology improves relationships between sworn and civilian personnel in my agency.	2.51 (55%)	2.57 (51%)	2.74 (67%)	2.57 (57%)	2.65 (59%)	2.68 (61%)
Scale Score	2.66	2.75	2.81	2.71	2.71	2.79
Overall Reliability: α = .827						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 188 to 192. The sample size range for assignment is 172 to 176.

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TABLE 4. OFFICER SURVEY RESULTS FOR TECHNOLOGY, INTERNAL ACCOUNTABILITY, AND MANAGEMENT (AGENCY 3)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Internal Accountability & Management						
My immediate supervisor uses information technology to track and monitor my daily activities.	2.56 (54%)	2.34 (32%)*	2.33 (40%)	2.60 (55%)	2.43 (40%)	1.97 (14%)***
The command staff uses information technology to track and monitor my unit's daily activities.	2.78 (70%)	2.40 (42%)**	2.53 (51%)*	2.77 (69%)	2.60 (53%)	2.10 (24%)***
Commanders and supervisors use information technology to identify underperforming officers.	2.58 (56%)	2.26 (34%)*	2.39 (45%)	2.55 (56%)	2.35 (33%)*	2.31 (45%)
Information technology generates statistics that are valuable in assessing officer performance.	2.56 (61%)	2.35 (43%)	2.68 (70%)	2.59 (62%)	2.51 (53%)	2.59 (62%)
Information technology generates statistics that are valuable in assessing my agency's performance.	2.78 (74%)	2.61 (61%)	2.89 (82%)	2.74 (68%)	2.76 (76%)	2.86 (83%)
My superiors expect me to use information technology systems to identify and respond to crime problems.	2.87 (83%)	2.63 (57%)**	2.88 (81%)	2.77 (70%)	2.84 (77%)	2.89 (86%)
Information technology improves supervision and management within the agency.	2.59 (59%)	2.51 (51%)	2.67 (65%)	2.54 (54%)	2.60 (58%)	2.76 (76%)*
Scale Score	**2.68**	**2.44**	**2.62**	2.66	2.58	2.50
Overall Reliability: α = .786						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 183 to 190. The sample size range for assignment is 170 to 176.

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TABLE 5. OFFICER SURVEY RESULTS FOR TECHNOLOGY, DISCRETION, AND DECISION-MAKING AMONG OFFICERS (AGENCY 3)

To what extent do you use information technologies and analytic systems to do the following:	Never	Rarely	Sometimes	Often	Very Often	Mean (on 1 to 5 scale)
Provide information to citizens that is not related to a specific call or emergencies.	18%	30%	36%	11%	4%	2.52
Determine where to patrol when not answering a call for service.	20%	21%	30%	20%	10%	2.79
Locate suspects, wanted persons, and other persons of interest.	3%	11%	32%	33%	21%	3.57
Locate vehicles of interest.	20%	21%	30%	20%	10%	2.79
Collect and search for information during a field interview.	6%	18%	36%	26%	16%	3.28
Determine how to respond to a crime problem.	12%	25%	37%	16%	10%	2.87
Check the history of a specific location or person(s) before responding to a call for service.	1%	2%	16%	38%	42%	4.18

*The sample size varies for each item. The sample size range is 90 to 92.

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TABLE 6. OFFICER SURVEY RESULTS FOR TECHNOLOGY, DISCRETION, AND DECISION-MAKING AMONG SUPERVISORS AND COMMANDERS (AGENCY 3)

To what extent do you use information technologies and analytic systems to do the following:	**Never**	**Rarely**	**Sometimes**	**Often**	**Very Often**	**Mean (on 1 to 5 scale)**
Monitor the daily activities of officers, detectives, or supervisors who work for you.	11%	30%	44%	13%	2%	2.65
Identify crime trends and problems in your area of responsibility.	7%	15%	30%	35%	13%	3.31
Determine what to do about crime trends and problems in your area of responsibility.	7%	17%	41%	30%	6%	3.09
Focus the activities of my personnel on specific locations that have the most problems.	7%	13%	39%	35%	6%	3.19
Share information with community leaders or business owners.	17%	15%	30%	36%	2%	2.91
Identify problem behaviors of those who work for you.	24%	39%	22%	13%	2%	2.30

*The sample size varies for each item. The sample size range is 53 to 54.

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TABLE 7. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND AGENCY PROCESSES AND EFFICIENCIES (AGENCY 3)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Process/Efficiencies						
Generally, information technology in this agency is easy to use.	2.37 (51%)	2.33 (42%)*	2.50 (55%)	2.41 (51%)	2.31 (42%)	2.59 (62%)
I am satisfied with the quality of information I can access from our information technology systems.	2.54 (62%)	2.33 (49%)	2.51 (56%)	2.46 (56%)	2.56 (65%)	2.61 (64%)
The information technology my agency uses creates extra work for me. [REVERSE CODED]	2.02 (30%)	2.30 (48%)	2.25 (39%)	2.11 (36%)	2.18 (36%)	2.21 (34%)
Overall the information technology helps me be productive in my daily work.	2.73 (71%)	2.72 (67%)	2.87 (76%)	2.81 (73%)	2.66 (64%)	2.82 (82%)
Scale Score	2.42	2.43	2.54	2.45	2.42	2.55
Overall Reliability: α = .717						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 185 to 188. The sample size range for assignment is 171 to 173.

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TABLE 8. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND POLICE EFFECTIVENESS (AGENCY 3)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Effectiveness						
Information technology makes me more effective in identifying and locating suspects, wanted persons, and other persons of interest.	3.05 (85%)	3.29 (93%)	3.09 (84%)	3.18 (85%)	3.18 (89%)	3.07 (97%)
Information technologies and crime analysis help me understand and respond effectively to crime problems.	2.88 (79%)	2.90 (81%)	3.07 (89%)	2.92 (75%)	2.98 (91%)*	3.14 (100%)
Information technologies improve the way I interact and communicate with citizens.	2.46 (44%)	2.56 (51%)	2.69 (64%)*	2.45 (41%)	2.40 (45%)	3.00 (90%)***
Information technology allows me to be more effective in helping victims.	2.63 (57%)	2.76 (69%)	2.69 (69%)	2.70 (61%)	2.57 (54%)	2.89 (86%)*
It is important to citizens that I am knowledgeable about the latest information technologies.	2.80 (69%)	2.78 (67%)	3.05 (79%)	2.85 (68%)	2.75 (70%)	3.03 (83%)
Scale Score	2.77	2.86	2.92	2.82	2.77	3.03
Overall Reliability: α = .793						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 178 to 189. The sample size range for assignment is 164 to 174.

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TABLE 9. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND JOB SATISFACTION (AGENCY 3)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Job Satisfaction						
Using information technologies makes my work interesting.	2.76 (67%)	2.93 (80%)	2.98 (80%)	2.91 (73%)	2.83 (74%)	2.86 (76%)
Working with information technologies in my agency frustrates me. [REVERSE CODED]	2.14 (36%)	2.25 (41%)	2.38 (38%)	2.15 (36%)	2.38 (45%)	2.36 (43%)
The demands of using information technologies take time away from aspects of police work that I enjoy. [REVERSE CODED]	2.41 (54%)	2.64 (67%)	2.66 (57%)	2.53 (60%)	2.52 (54%)	2.57 (57%)
Information systems enhance my job satisfaction.	2.52 (50%)	2.55 (57%)	2.84 (67%)	2.66 (60%)	2.55 (52%)	2.72 (62%)
Scale Score **Overall Reliability: □□ .739**	2.08	2.30	2.42	2.23	2.27	2.37

Statistical significance levels for differences: *$p \le .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 180 to 188. The sample size range for assignment is 167 to 174.

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TABLE 10. ADDITIONAL SURVEY ITEMS ON EFFECTIVENESS AND JOB SATISFACTION (AGENCY 3)

Patrol Effectiveness and Satisfaction	Mean	% Agree
Information technology increases my capacity to prevent crime on patrol when not answering calls for service.	2.84	75%
Information technology enhances my safety on the job.	3.04	84%

*The sample size varies for each item. The sample size range is 88 to 91.

TABLE 11. ADDITIONAL SURVEY ITEMS ON DISCRETION AND DECISION-MAKING (AGENCY 3)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Discretion/Decision-Making						
When making decisions about crime problems, I tend to rely more on my own experience than using information technologies.	2.98 (76%)	2.89 (70%)	2.58 (51%)**	2.95 (77%)	2.83 (67%)	2.50 (43%)***
Information technologies help me to engage in proactive, self-initiated activities.	2.91 (79%)	2.86 (71%)	2.98 (84%)	2.92 (74%)	2.82 (746%)	3.04 (96%)*

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 185 to 186. The sample size range for assignment is 171 to 172.

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TABLE 1. OFFICER SURVEY RESULTS FOR GENERAL VIEWS ON TECHNOLOGY (AGENCY 4)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
General Views on Technology						
Successful policing requires keeping up with new technologies.	3.48 (92%)	3.65 (98%)	3.69 (97%)	3.56 (94%)	3.79 (98%)	3.77 (100%)
My agency is generally open to implementing the latest technologies.	2.58 (60%)	2.59 (57%)	2.56 (61%)	2.50 (54%)	2.71 (68%)	2.92 (79%)*
In general, younger officers/detectives are more receptive to using technologies than older officers/detectives.	3.28 (90%)	3.04 (73%)*	3.18 (84%)	3.16 (80%)	3.17 (88%)*	3.41 (95%)
The use of technology has led to a less trusting atmosphere inside of my agency.	2.67 (52%)	2.61 (55%)	2.41 (41%)	2.55 (48%)	2.62 (51%)	2.46 (46%)
My agency prioritizes the acquisition of the newest technologies.	2.08 (29%)	2.16 (30%)	2.31 (40%)	2.15 (31%)	2.16 (28%)	2.35 (43%)
Technology makes my agency's decisions more transparent to the community.	2.34 (42%)	2.50 (52%)	2.57 (60%)*	2.40 (46%)	2.49 (53%)	2.67 (67%)
Up-to-date technology improves the image of my agency in the eyes of the community.	2.68 (61%)	3.10 (85%)**	3.08 (83%)***	2.85 (71%)	3.23 (88%)	3.09 (91%)
Technology increases the community's expectations of my agency to reduce crime.	3.00 (79%)	3.16 (92%)	3.14 (89%)	3.03 (84%)	3.17 (85%)	3.19 (90%)
In general, technology functions well in my agency.	1.95 (23%)	2.08 (29%)	2.32 (40%)*	2.09 (30%)	2.16 (32%)	2.26 (35%)
In comparison to my fellow officers, I consider myself 'technology-savvy.'	2.73 (65%)	2.79 (69%)	2.80 (67%)	2.72 (66%)	2.92 (69%)	2.75 (58%)

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I like to experiment with new technologies.	2.89 (76%)	3.00 (82%)	3.00 (80%)	2.93 (77%)	3.07 (80%)	3.00 (88%)
In my agency, officers who use technology in creative or innovative ways are more likely to be rewarded than those who do not.	2.19 (31%)	2.51 (49%)*	2.38 (39%)	2.30 (34%)	2.49 (49%)*	2.33 (38%)
My agency puts more value on officers making decisions based on data and analysis than on officers using their personal experience.	2.52 (45%)	2.54 (48%)	2.46 (40%)	2.57 (48%)	2.43 (43%)	2.22 (26%)
Technology has helped make decision-making more transparent to others in the agency.	2.13 (28%)	2.27 (31%)	2.46 (46%)*	2.25 (31%)	2.39 (45%)	2.33 (42%)
Scale Score **Overall Reliability: α = .669**	**2.61**	**2.71**	**2.73**	**2.64**	**2.76**	**2.76**

Statistical significance levels for differences: **p* ≤ .05; ** *p*<=.01; *** *p*<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 251 to 263. The sample size range for assignment is 235 to 250.

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TABLE 2. OFFICER SURVEY RESULTS FOR IMPLEMENTATION OF TECHNOLOGIES (AGENCY 4)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Implementation						
My agency adequately prepares me to use new technologies.	1.77 (11%)	1.88 (20%)	2.13 (31%)**	1.87 (17%)	1.94 (23%)	2.26 (35%)
Overall, supervisors and command staff in my agency work hard to generate the widespread acceptance of technology.	2.03 (24%)	2.10 (24%)	2.32 (43%)**	2.13 (29%)	2.15 (30%)	2.27 (36%)
I feel that my agency adopts technologies that are designed to meet important needs.	1.98 (24%)	2.14 (35%)	2.42 (50%)***	2.11 (32%)	2.27 (39%)	2.33 (50%)
Before implementing a new technology, command staff work hard to get input from employees.	1.30 (4%)	1.46 (2%)	1.76 (18%)**	1.41 (6%)	1.60 (8%)	1.95 (27%)**
After implementing a new technology, my agency seeks regular feedback from employees on how it is working.	1.49 (9%)	1.63 (8%)	1.89 (22%)*	1.60 (11%)	1.79 (17%)	2.05 (27%)*
After implementing a new technology, my agency provides sufficient help and support to employees who are experiencing problems with it.	1.90 (20%)	1.94 (24%)	2.23 (40%)**	2.01 (28%)	2.04 (22%)	2.21 (38%)
In general, I am satisfied with how new technologies are implemented in this agency.	1.68 (10%)	1.76 (16%)	2.07 (27%)**	1.79 (17%)	1.91 (17%)	2.00 (17%)
The successful implementation of a new technology in my agency depends on supervisors and commanders requiring its use.	2.53 (53%)	2.84 (68%)	2.88 (74%)**	2.69 (62%)	2.87 (71%)	2.71 (71%)
My agency tends to adopt technologies that are often not useful. [REVERSE CODED]	1.67 (16%)	1.90 (23%)	2.04 (27%)	1.76 (17%)	1.95 (25%)	2.22 (39%)*
Scale Score	**1.80**	**1.97**	**2.20**	**1.93**	**2.05**	**2.23**
Overall Reliability: α = .874						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean

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differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 242 to 254. The sample size range for assignment is 236 to 244.

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TABLE 3. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND AGENCY RELATIONSHIPS (AGENCY 4)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Relationships						
Information technology enhances the importance of my unit or division.	2.51 (52%)	2.73 (67%)	3.00 (75%)**	2.76 (64%)	2.76 (59%)	2.82 (73%)
Information technology causes conflict between organizational units and staff. [REVERSE CODED]	2.39 (50%)	2.51 (57%)	2.47 (54%)	2.44 (53%)	2.47 (53%)	2.50 (54%)
Information technology improves cooperation across units and people in my agency.	2.37 (44%)	2.47 (51%)	2.64 (66%)**	2.43 (49%)	2.55 (59%)	2.67 (67%)
Information technology creates more equality among ranks and units in my agency.	1.90 (11%)	2.08 (18%)	2.25 (33%)***	2.03 (18%)	2.11 (26%)	2.25 (29%)
Information technology improves communication between me and my immediate supervisor.	2.34 (43%)	2.49 (51%)	2.65 (65%)**	2.46 (51%)	2.48 (54%)	2.67 (54%)
Information technology improves communication that I have with the higher levels of command staff.	2.05 (28%)	2.21 (33%)	2.44 (48%)**	2.16 (34%)	2.34 (39%)	2.58 (46%)
Information technology improves relationships between me and other officers/detectives/supervisors of my same rank.	2.39 (44%)	2.47 (51%)	2.68 (69%)***	2.52 (56%)	2.54 (56%)	2.54 (50%)
Information technology improves relationships between sworn and civilian personnel in my agency.	2.20 (25%)	2.24 (34%)	2.44 (48%)***	2.28 (34%)	2.31 (39%)	2.38 (33%)
Scale Score **Overall Reliability: α = .855**	**2.27**	**2.41**	**2.56**	2.39	2.45	2.55

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 252 to 265. The sample size range for assignment is 240 to 250.

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TABLE 4. OFFICER SURVEY RESULTS FOR TECHNOLOGY, INTERNAL ACCOUNTABILITY, AND MANAGEMENT (AGENCY 4)

SCALE ITEMS	ASSIGNMENT			RANK		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Internal Accountability & Management						
My immediate supervisor uses information technology to track and monitor my daily activities.	2.52 (55%)	2.61 (63%)	2.56 (53%)	2.66 (64%)	2.47 (49%)*	2.17 (25%)***
The command staff uses information technology to track and monitor my unit's daily activities.	2.65 (63%)	2.48 (52%)	2.71 (64%)	2.66 (62%)	2.58 (56%)	2.54 (58%)
Commanders and supervisors use information technology to identify underperforming officers.	2.42 (44%)	2.37 (45%)	2.53 (54%)	2.47 (48%)	2.58 (58%)	2.22 (30%)
Information technology generates statistics that are valuable in assessing officer performance.	2.19 (33%)	2.43 (55%)*	2.69 (67%)***	2.40 (46%)	2.45 (52%)	2.58 (67%)
Information technology generates statistics that are valuable in assessing my agency's performance.	2.44 (50%)	2.49 (61%)	2.80 (75%)***	2.51 (56%)	2.65 (65%)	2.87 (87%)**
My superiors expect me to use information technology systems to identify and respond to crime problems.	2.66 (66%)	2.87 (74%)	2.76 (72%)	2.69 (66%)	2.80 (78%)	2.78 (70%)
Information technology improves supervision and management within the agency.	2.11 (32%)	2.13 (29%)	2.53 (57%)***	2.17 (36%)	2.54 (54%)*	2.54 (54%)
Scale Score	**2.42**	**2.47**	**2.66**	2.51	2.58	2.53
Overall Reliability: α = .787						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 248 to 261. The sample size range for assignment is 240 to 246.

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TABLE 5. OFFICER SURVEY RESULTS FOR TECHNOLOGY, DISCRETION, AND DECISION-MAKING AMONG OFFICERS (AGENCY 4)

To what extent do you use information technologies and analytic systems to do the following:	Never	Rarely	Sometimes	Often	Very Often	Mean (on 1 to 5 scale)
Provide information to citizens that is not related to a specific call or emergencies.	13%	31%	46%	5%	5%	2.56
Determine where to patrol when not answering a call for service.	21%	26%	29%	19%	5%	2.61
Locate suspects, wanted persons, and other persons of interest.	8%	8%	30%	39%	16%	3.48
Locate vehicles of interest.	21%	26%	29%	19%	5%	2.61
Collect and search for information during a field interview.	11%	19%	33%	24%	13%	3.11
Determine how to respond to a crime problem.	17%	28%	36%	15%	4%	2.61
Check the history of a specific location or person(s) before responding to a call for service.	10%	18%	30%	23%	18%	3.20

*The sample size varies for each item. The sample size range is 104 to 106.

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TABLE 6. OFFICER SURVEY RESULTS FOR TECHNOLOGY, DISCRETION, AND DECISION-MAKING AMONG SUPERVISORS AND COMMANDERS (AGENCY 4)

To what extent do you use information technologies and analytic systems to do the following:	Never	Rarely	Sometimes	Often	Very Often	Mean (on 1 to 5 scale)
Monitor the daily activities of officers, detectives, or supervisors who work for you.	10%	16%	26%	35%	13%	3.25
Identify crime trends and problems in your area of responsibility.	7%	17%	26%	38%	12%	3.29
Determine what to do about crime trends and problems in your area of responsibility.	13%	18%	33%	30%	6%	2.97
Focus the activities of my personnel on specific locations that have the most problems.	10%	10%	34%	36%	9%	3.22
Share information with community leaders or business owners.	16%	24%	27%	21%	12%	2.88
Identify problem behaviors of those who work for you.	22%	26%	25%	22%	4%	2.60

*The sample size varies for each item. The sample size range is 67 to 69.

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TABLE 7. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND AGENCY PROCESSES AND EFFICIENCIES (AGENCY 4)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Process/Efficiencies						
Generally, information technology in this agency is easy to use.	1.88 (20%)	1.96 (26%)	2.13 (37%)**	1.96 (29%)	2.02 (22%)	2.09 (26%)
I am satisfied with the quality of information I can access from our information technology systems.	1.98 (27%)	2.12 (33%)	2.25 (43%)*	2.10 (33%)	2.10 (33%)	2.36 (50%)
The information technology my agency uses creates extra work for me. [REVERSE CODED]	1.60 (17%)	1.68 (17%)	1.90 (24%)***	1.70 (21%)	1.69 (18%)	1.86 (5%)
Overall the information technology helps me be productive in my daily work.	2.31 (43%)	2.49 (57%)	2.73 (72%)***	2.49 (55%)	2.50 (54%)	2.68 (68%)
Scale Score	**1.94**	**2.07**	**2.27**	2.06	2.12	2.26
Overall Reliability: α **= .755**						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 242 to 250. The sample size range for assignment is 233 to 240.

Agency 4

TABLE 8. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND POLICE EFFECTIVENESS (AGENCY 4)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Effectiveness						
Information technology makes me more effective in identifying and locating suspects, wanted persons, and other persons of interest.	2.75 (73%)	3.09 (89%)*	2.96 (84%)	2.92 (81%)	2.83 (77%)	2.88 (79%)
Information technologies and crime analysis help me understand and respond effectively to crime problems.	2.54 (59%)	2.72 (66%)	2.81 (78%)**	2.63 (64%)	2.87 (76%)	2.82 (73%)
Information technologies improve the way I interact and communicate with citizens.	2.14 (26%)	2.25 (24%)	2.51 (54%)***	2.21 (28%)	2.51 (51%)**	2.52 (52%)*
Information technology allows me to be more effective in helping victims.	2.24 (35%)	2.45 (45%)	2.57 (61%)***	2.35 (42%)	2.61 (59%)*	2.50 (54%)
It is important to citizens that I am knowledgeable about the latest information technologies.	2.44 (45%)	2.57 (53%)	2.84 (72%)***	2.52 (50%)	2.84 (70%)*	2.64 (68%)
Scale Score	**2.42**	**2.60**	**2.74**	**2.52**	**2.75**	**2.65**
Overall Reliability: α **= .828**						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 249 to 256. The sample size range for assignment is 236 to 240.

Agency 4

TABLE 9. OFFICER SURVEY RESULTS FOR TECHNOLOGY AND JOB SATISFACTION (AGENCY 4)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Job Satisfaction						
Using information technologies makes my work interesting.	2.47 (50%)	2.59 (57%)	2.90 (73%)**	2.61 (57%)	2.78 (67%)	2.71 (67%)
Working with information technologies in my agency frustrates me. [REVERSE CODED]	1.74 (18%)	2.08 (29%)	1.96 (26%)	1.85 (22%)	1.83 (19%)	2.14 (36%)
The demands of using information technologies take time away from aspects of police work that I enjoy. [REVERSE CODED]	1.89 (23%)	2.33 (47%)**	2.30 (44%)**	2.12 (34%)	2.08 (35%)	2.33 (43%)
Information systems enhance my job satisfaction.	2.19 (34%)	2.22 (37%)	2.54 (53%)**	2.30 (39%)	2.44 (45%)	2.38 (46%)
Scale Score	**2.08**	**2.30**	**2.42**	2.23	2.27	2.37
Overall Reliability: α = .807						

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). Scale scores were tested for overall mean differences across assignment groups (patrol, detectives, other) and rank groups (line level, first line supervisors, and second line supervisors or higher ranks). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 242 to 253. The sample size range for assignment is 231 to 242.

Agency 4

TABLE 10. ADDITIONAL SURVEY ITEMS ON EFFECTIVENESS AND JOB SATISFACTION (AGENCY 4)

Patrol Effectiveness and Satisfaction	Mean	% Agree
Information technology increases my capacity to prevent crime on patrol when not answering calls for service.	2.28	43%
Information technology enhances my safety on the job.	2.51	54%

*The sample size varies for each item. The sample size range is 99 to 102.

TABLE 11. ADDITIONAL SURVEY ITEMS ON DISCRETION AND DECISION-MAKING (AGENCY 4)

SCALE ITEMS	**ASSIGNMENT**			**RANK**		
	Patrol	Detective	Other	Line	1st Line	2nd Line/+
	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)	Avg. (% agree)
Discretion/Decision-Making						
When making decisions about crime problems, I tend to rely more on my own experience than using information technologies.	3.15 (82%)	2.67 (56%)***	2.62 (53%)***	2.89 (70%)	2.89 (67%)	2.46 (42%)**
Information technologies help me to engage in proactive, self-initiated activities.	2.61 (64%)	2.69 (69%)	2.80 (75%)	2.63 (56%)	2.87 (79%)*	2.74 (74%)

Statistical significance levels for differences: *$p \leq .05$; ** p<=.01; *** p<=.001. For individual survey items, statistical tests show differences in the percentages that agreed or strongly agreed relative to patrol officers (for tests across assignment groups) and line-level staff (for tests across rank groups). The sample size varies for each item and for each group (rank vs. assignment). The sample size range for rank is 253 to 256. The sample size range for assignment is 240 to 241.

Appendix D. Hot Spots Log Sheet for Technology Experiment in Agency 1

HOT SPOT LOG

INSTRUCTIONS: Fill out one log <u>each time</u> you visit a hot spot. Each day a hot spot should be visited at least 3 times (so you would have at least 3 logs per day per hot spot). Hot spots should be visited for a short period (15-30 minutes) with at least 1-2 hours between each hot spot visit. Try to carry out activities in at least two proactive categories (below) per visit. See more instructions on the back of this log.

Officer(s):	
Date MM/DD/YY:	
Time entering hot spot:	
Time leaving hot spot:	

Please check which hot spot you are visiting.

☐ 4: [redacted]	☐ 5: [redacted]	☐ 6: [redacted]
☐ 7: [redacted]	☐ 11: [redacted]	☐ 13: [redacted]
☐ 19: [redacted]	☐ 20: [redacted]	☐ 22: [redacted]

PROACTIVE TACTICS CHECKLIST CATEGORIES

EXTRA PROACTIVE VISIBILITY	USING INFORMATION TECHNOLOGY	OFFENDERS AND VICTIMS AT PLACES	PROACTIVE PROBLEM SOLVING
☐ Foot or bike patrol in a store, apartment area, complex, parking garage, or other location	☐ Conduct deeper investigation of specific individuals or addresses (see back for tips)	☐ Conduct knock and talks with offenders (arrestees, probationers, parolees, other known offenders/suspects) or repeat victims	☐ Engage with property managers, business owners, private security, or other government agencies about causes of problems, finding solutions (e.g., improving security measures at a location)
☐ Car patrol, including slow roaming and obtaining access if needed into hard-to reach areas	☐ Examine recent calls, incidents, and other events in hot spot (see back for tips).	☐ Provide OR receive information from gang, drug, DV, and other units	☐ Write self-initiated reports on graffiti, alcohol violations, drugs, destruction of property, issue citations
☐ Surveillance in prominent location (sit and observe in area where people can see you)	☐ Check license plates of moving or parked vehicles (with or without LPR)	☐ Using drunk in public enforcement, trespass enforcement, narcotics violations, etc.	☐ Conduct traffic stops and field interviews on suspicious vehicles and persons, engage in other order maintenance activities (e.g., giving warnings or citations)
☐ OTHER: please describe below:	☐ Use LINX to check suspects stopped	☐ Follow up on incidents already reported (e.g., DV, burglaries, assaults, etc.)	☐ OTHER: please describe below:
	☐ Use AFIS to check suspects stopped who do not have identification	☐ OTHER: please describe below:	

Write a quick synopsis of the reports, stops, interviews, and actions you took (for example, "1 traffic stop", "spoke to manager", or "did foot patrol through store or apartment complex"). Note the results of any computer searches run on people or vehicles that were stopped. Also, note any arrests or other significant information.

HOT SPOT LOG– Instruction and Tips

INSTRUCTIONS FOR HOT SPOT FORM/STUDY	OTHER IMPORTANT TIPS IN HOT SPOTS
1. Fill out a log EACH TIME you visit a hot spot. Each officer or unit will therefore fill out 3 sheets each day per hot spot. For the bike units, since each team is assigned two hot spots per day, you will be filling out at least 6 sheets. 2. We recommend officers stay in spots for only 15-30 minutes, unless a problem-solving activity takes longer. 3. For bike units assigned to two hot spots, alternate your visits to each spot. Staying in 1 hot spot for 1 hour does not count as two visits. 4. Please use the technology available to you (see tips below) to help you address problems at that hot spot. This could involve simply running a tag or name on your mobile computer units, or finding patterns and problem addresses or people on RMS or LINX. Document as much as you can on the log regarding specific activities you do, even if they seem "ordinary". 5. If you have access to LPR, see if you can use the LPR units at times for this intervention. 6. Each day, put your sheets in the manila envelope that is located on Lt. [redacted] door marked "Hot Spots Log Sheets"	In addition to the instructions and activities on this log, here are some other ideas on what to do in hot spots that have been shown to be effective in reducing crime: 1. Be unpredictable in when you visit hot spot visits (don't visit hot spots at the same time every day). 2. Use specific information and problem-solving strategies that are tailored to the problem you see. The more tailored your approach, the more effective you can be. Ideas on dealing with specific problems can be found at http://www.popcenter.org/guides/ 3. Obtain information on probationers and parolees linked to the hot spot, work with probation and parole officers to meet with these individuals to reinforce to them that offending will not be tolerated. 4. Consider working with other government agencies about problems at a location (e.g., public works to fix lights or deal with CPTED issues; agencies that carry out code enforcement and nuisance abatements; other social service agencies). 5. Check out summaries of effective interventions. See the black dots in the Matrix slabs entitled "micro places" or "neighborhoods". www.policingmatrix.org
TIPS FOR USING RMS AND CAD PROACTIVELY	**DOMESTIC VIOLENCE CHECKLIST**
1. To problem-solve at specific locations, you may need to obtain recent calls/incidents at that location. To do this on your MCU - Go to Query / Events and enter in the address in question to search for prior events. Via RMS - Open the Locations Module and search on a location. This will bring up all Involvements for a particular address to include CFS, Incidents, Arrests, Citations, and Field Contacts. 2. To search for people or find out about alerts linked to these hot spot go to the Persons Module in RMS and perform a search using "Alerts" and the location in question. 3. LInX is an excellent system for finding people associated with a subject, vehicle, or a location. You need to have received training on LInX to use this system. To access it via the MCU, go to Program Files / [redacted]. Launch the [redacted] neighborhood. The username and password required are the same as the County logon. Once logged into [redacted], launch one of the Internet Explorer apps and go to http://www.linxncr.us/Linx to connect. Once in LInX, you can search for people linked to an address or a vehicle. You can also search for a person and then search for associates related to that person. 4. Crime analysts often collect specific trend information about hot spots. Talk to your station's crime analyst or examine the maps or list of repeat offenders they produce for your station. These analyses combine RMS information to create useful patterns to better understand crime problems at hot spots.	Hot spots often correspond to residential locations where domestic violence can be a substantial problem. Here are some tips to improve your response to domestic violence situations. 1. Take photos of the victim, suspect and scene if possible. 2. Speak to all parties, including the suspect and try to lock in their version of the events. 3. Obtain from the victim a clear background and history of abuse, rather than only what happened in the particular incident to which you have responded. Add to the report any call history you can obtain from RMS or CAD that provide more information about this victim or suspect. 4. Make sure to obtain a working phone number(s) from the victim and update it in RMS if necessary so the detective can follow up with the individual later. 5. Obtain the names and ages of children present so the information can be forwarded to Child Protective Services. 6. Remember: The forensics nurse is available or can be called at the hospital to fully document the victim's injuries and account of what happened. 7. Ask if any of the assaults took place while the victim was calling 911 and include that information on the report so that the detective can pull the 911 call for court. 8. Leave a copy of the Emergency Protective Order with the domestic violence unit.