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REPORT

Tracking Inmates and Locating Staff with Active Radio-Frequency Identification (RFID)

Early Lessons Learned in One U.S. Correctional Facility

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Safety and Justice

A RAND INFRASTRUCTURE, SAFETY, AND ENVIRONMENT PROGRAM

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Preface

This report represents the second and final publication supported by Award No. 2005-IJ-CX-K062, awarded by the National Institute of Justice (NIJ), Office of Justice Programs, U.S. Department of Justice (the first was Hickman, Eisman, and Davis, 2008). The opinions, findings, and conclusions or recommendations expressed in both publications upon this award are those of the authors and do not necessarily represent the official position or policies of the U.S. Department of Justice. This award is the result of NIJ's interest in helping inform the correctional field about the potential implications of the use of active radio-frequency identification (RFID) technology in correctional facilities. NIJ selected the RAND Corporation to explore this issue. The first phase of this effort was completed in November 2008. It involved the development of a feasible research design to assess the implementation and impacts of RFID use within a large, urban jail setting. This research design was presented in a report titled *Evaluation Design for the District of Columbia Department of Corrections' Use of Radio Frequency Identification (RFID) Technology with Jail Inmates* (Hickman, Eisman, and Davis, 2008).

The present report represents the culmination of the second phase of this award. Its goals are twofold. The first is to identify and describe the universe of all correctional institutions in the United States that had already purchased or installed active RFID systems. The second goal is to provide an objective source of information about the advantages and the challenges of using RFID in correctional settings, drawn from the experiences of those institutions that have already obtained or implemented the technology. To date, most information about how well RFID technology works and its cost-effectiveness has been produced by the product vendors—a source with a vested interest in promoting the adoption of RFID. Given the significant expense of purchasing and the cost of operating the technology, the findings of the present report are expected to benefit state and local jurisdictions in that it presents some the early lessons learned from jurisdictions already using RFID.

This research was conducted under the auspices of the Safety and Justice Program within RAND Infrastructure, Safety, and Environment (ISE). The mission of RAND Infrastructure, Safety, and Environment is to improve the development, operation, use, and protection of society's essential physical assets and natural resources and to enhance the related social assets of safety and security of individuals in transit and in their workplaces and communities. Safety and Justice Program research addresses occupational safety, transportation safety, food safety, and public safety—including violence, policing, corrections, substance abuse, and public integrity.

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Introduction

Managing correctional populations is a challenging and expensive task for state and local jurisdictions. In recent years, a new technological tool has been offered to jurisdictions as a method of improving the efficiency and effectiveness of correctional management. This technology, active radio-frequency identification (RFID), consists of a device (or "tag") fitted with a programmable chip. This chip continually emits a signal to communicate, in near-real time (i.e., with a one- or two-second delay), radio waves within a network of RFID sensors, receivers, and monitors. The sensors' monitors record and display the tag's unique identity and location. This location information can then be displayed on computer monitors and can trigger near-real-time alerts if one of any number of preprogrammed conditions is triggered. The location information is also archived so it can be played back later for use in postincident investigations.

Active RFID technology has been marketed in the United States to correctional institutions to date primarily by two companies: TSI PRISM and Elmo-Tech. It has been offered as a tool to track the precise location of inmates and pinpoint staff location in duress situations, rather than just inventory. When fitting inmates with active RFID-tagged wristbands or ankle bracelets, RFID technology promises to provide near-real-time, centralized monitoring of inmate locations and movements throughout correctional institutions. Parameters for individual inmates can be set via programming for each wristband or ankle bracelet to generate an alert when its wearer moves into an unauthorized area or comes near inmates wearing specifically designated wrist or ankle bands. The latter function is offered as a way to help keep specific inmates or groups of inmates separate from each other within the institution. The real-time feature of the active RFID technology also promises to automate the time-intensive process of inmate head counts, which otherwise involve correctional officers visually confirming the presence and location of all inmates at regular intervals. The RFID bands are constructed with antitamper technology, which is designed to generate alerts if they are cut or if they lose contact with the skin.

Active RFID-tagged devices may also be worn on a belt by correctional officers and staff within the correctional institution. These devices allow near-real-time monitoring of staff location, and some contain an officer-down feature that will generate an alert if a staff member falls to a horizontal position during monitoring. These units also come enabled with a manual alarm function that staff can use to alert a central monitoring station of an immediate need for assistance. In addition to their use for increasing staff safety, tracking of real-time alerts may offer the possibility of more rapid deployment of staff to developing incidents within the facility or otherwise improve the efficiency of population management. Active RFID systems

also store inmate and staff location information over time for later playback. This function was designed primarily for use in investigation of incidents that may occur within the institution.

While active RFID technology has been offered as a correctional facility management tool, most of the accessible information about how well it works and its cost-effectiveness has been produced by the vendors, a source with a vested interest in promoting the adoption of their RFID products. Given the significant expense of purchasing and operating the technology, state and local jurisdictions could greatly benefit from an objective assessment of the early lessons learned in a jurisdiction already using RFID technology. The goal of the present report was to collect some of these early lessons learned to inform the corrections field.

Expectations for the Use of Active Radio-Frequency Identification Systems

Vendors of active RFID systems assert that adoption of the technology will produce a number of benefits within correctional environments when used for monitoring inmate and staff locations. Since there have been no independent evaluations of the outcomes of active RFID systems in correctional environments, there is no empirical foundation on which to make statements about the technology in practice.[1] Nonetheless, RFID vendors assert that the technology will increase the efficiency of managing inmate populations, thus saving staff time and increasing safety for both inmates and staff. By accomplishing these goals, active RFID systems are also purported to produce cost savings over the long term. Specifically, the vendors described benefits of active RFID systems that can be divided up into the following categories:

- improve monitoring and control of inmates and reduce staff time
- reduce violence and injuries
- reduce actual and attempted escapes
- reduce the number of investigations and improve investigative capabilities
- reduce inmate grievances, disciplinary actions, and lawsuits.

Correctional Facilities Currently Adopting or Using Active Radio-Frequency Identification

The extent to which U.S. correctional facilities have acquired active RFID technology is not readily accessible information. As part of the present study, we set out to document the current use of active RFID in U.S. correctional facilities. In this effort, we conducted an extensive Internet search seeking references to (1) prisons or jails that had acquired or were in the process of acquiring active RFID systems and (2) specific vendors selling active RFID systems within the United States. We contacted the two identified vendors of active RFID technology, TSI PRISM and Elmo-Tech, to obtain a list of U.S. prison or jail facilities to which they had sold active RFID systems. In this process, we also sought to verify and update a list of RFID facilities provided in an appendix of the 2007 NIJ Criminal Justice Technology Evaluation solicitation for proposals (NIJ, 2007). We identified 14 U.S. correctional facilities, with five systems used for tracking inmates, three systems used for locating staff, and six systems used

[1] One exception is the Urban Institute's recent evaluation of the implementation of RFID in a women's prison (the Northeast Pre-Release Center, or NEPRC, in Cleveland, Ohio). Although the technology was not fully implemented at the NEPRC, later in this report, we comment on some worthwhile lessons learned about the implementation process.

for monitoring the locations of both inmates and staff. The first installation took place in 1997. This was one of only four systems installed prior to 2004. Of the 14 total facilities identified, at the time of this writing, the three adopting the technology in 2008 and 2009 were in the process of installing or testing the systems prior to full operation.

Case Study of the Early Implementation of Active Radio-Frequency Identification in One Facility

We conducted a case study of one large jail facility in the process of installing an active RFID system to manage its inmate population. This case study capitalized on an opportunity to gather contemporaneous information about the issues and lessons learned of a facility in the process of designing, installing, and preparing the system for operation. At this facility, we conducted a site visit to observe the retrofitting of the existing facility to accommodate the installation of the RFID equipment, as well as semistructured interviews with key staff involved in all phases of the acquisition, installation, training, and other activities in preparation for system's operations.

Specifically, the case study site was the Central Detention Facility (CDF) operated by the District of Columbia Department of Corrections (DC DOC). The CDF has a full-time correctional staff of nearly 700 officers and a male-only population that averages 1,900 inmates per day. We first conducted initial semistructured telephone interviews with senior leadership and project managers to collect some general information about the overall effort. For example, we asked about the overall goals and expected benefits of implementing an active RFID system in the facility, overall strategy and timelines for implementation of the technology, and how the technology fits into the facility's existing and planned safety and security strategies. We conducted these initial interviews after the department had decided to adopt an active system but before it had moved forward to select an RFID vendor and issue a contract to purchase the system. Approximately 12 months after the department had issued a contract, we then conducted a two-day site visit to the CDF. At the time of the site visit, the "design" phase, involving the detailed development of the facility installation plan, was complete, and actual installation of software and equipment was substantially under way.

DC DOC intends to use the RFID system as an inmate management tool and as a tool for enhancing the security of correctional officers and other staff in the jail. When the RFID system is ready for launch, DC DOC intends to fit each inmate with a tamper-resistant wristband containing an RFID transmitting device during the jail booking process. Communication between the jail's information management system and the RFID system software allows the signals from a specific bracelet to be linked to a specific inmate. The bracelet is removed from each inmate at the time of facility discharge. Each correctional officer is also required to wear, on his or her belt, an RFID device during his or her shift that will help in identifying his or her location and generate safety-related alerts. The RFID monitoring function will be integrated into a correctional surveillance center, or CSC, which is being established in the facility. The sole function of the CSC personnel will be to monitor the RFID signals and alerts, as well as other surveillance technology, such as the closed-circuit television (CCTV) system and a telephone monitoring system.

Overall Findings

Implementation Timeline. At the time of our data-collection window (June 2009 site visit), the department was in the network installation process. At that time, the following were the key milestones for the system:

- June 2008: The contract was awarded to TSI PRISM (completed).
- June 2008–November 2008: Design phase (completed)
- August 25, 2008–May 1, 2009: Construction phase (completed)
- June 2009: Network installation phase (under way at the time of the site visit)
- Future plans
  - Late summer 2009: Integration, calibration, and testing of system
  - Late 2009/early 2010: Full system operation.

The original plan called for the design phase to last several months, with construction beginning in August 2008. However, for several reasons, the design phase took substantially longer than was originally anticipated, lasting until November 2008. For example, the inmate housing component ended up taking the longest to design and configure. A key reason was that the vendor's initial time estimate did not account for the unique architecture of the facility's 18 individual housing units. The patchwork nature of the facility's construction meant that the installation of the RFID equipment needed to be tailored to each of the 18 housing units' unique construction materials and floor space layouts. The department also desired a relatively high level of accuracy, with the ability to identify, in real time and in a multistory facility with two-tiered housing units, the location of an inmate within 2 to 5 feet indoors (and within 10 to 15 feet outdoors). The initial design produced an unacceptable level of accuracy, leading to the need to conduct a series of tests of modifications until the desired level of accuracy could be achieved.

Anticipated Staffing Needs. The planned use of the RFID system by DC DOC involves a number of administrative activities, including analysis of data and report generation, analysis of incident patterns to inform management decisions, analysis to inform investigations, and real-time tracking of inmate location. These activities will be largely conducted within a newly established CSC. Once the RFID is fully operational, the CSC will monitor and integrate this source of data into the range of other surveillance tools it has to monitor inmates' activities. Archived RFID records may also be subpoenaed for use in investigations. Some interviewees postulated that the new technology might result in "fishing expeditions" by prosecutors or defense attorneys. Most of the CCTV footage requests to date were based on active criminal cases. Aside from performing the monitoring and analysis tasks, the department also anticipates needing full-time staff for the work associated with maintaining the inmate- and officer-worn RFID devices. This is expected to be an ongoing and busy process, given the continual turnover of the jail inmate population and the large number of officers going through shift changes.

Anticipated Need to Develop RFID-Related Policies and Operating Procedures. The facility anticipated a need to develop written RFID policies and operating procedures, addressing such topics as when personnel are required to wear an RFID unit, procedures for using RFID to control access privileges to specific areas throughout the facility, directions for inmates wearing RFID devices, and how to report problems with the RFID units. Facility-specific response protocols will also need to be developed to provide decision rules as to whether, and what type

of, action should be taken when an RFID-generated alert is received. The written policies and procedures will represent the CDF's rules governing response decisions. Our interviewees reported that the vendor played an important role in offering some initial guidance on developing these written policies and operating procedures, drawing on its previous experience. The response protocols will need to be further developed and tailored by departmental staff for the CDF, particularly those involved in the operation of the RFID system and the technical staff providing analytic support in analyzing the volume of data generated by the system. The interviewees reported that, when the system was close to implementation, they would move forward in developing its initial set of protocols and refine them, with experience using the system.

Expected Staff Responses to the RFID System. DC DOC intends to use the RFID system as an inmate management tool and as a tool to enhance the security of correctional officers and other staff in the jail. A number of interviewees commented that some officers and union representatives were concerned that the RFID system would lead to excessive surveillance of officers in the performance of their duties. Thus, officers may resent the use of the system, resist compliance with RFID-related procedures, and even try to circumvent the system. On the other hand, some interviewees expected the RFID experience to be comparable to the staff acceptance of other technology upgrades. There was initial resistance to previous upgrades, but these additions came to be seen as positive, as they actually proved to be useful in identifying inmate and officer misconduct and in investigations. Our interviewees also anticipated that the reliability of the system after implementation will be critical to staff acceptance. If the system has a number of false alerts or stops functioning, it could undermine the staff's confidence in the system and affect their willingness to rely on it. In order to help promote staff acceptance of the RFID system, several interviewees underscored the importance of education and training, as well as gaining the support of key staff members within the department to champion the technology and its benefits.

Expected Response of Inmates to RFID. When the RFID system is fully installed and wristband devices are fitted to inmates, our interviewees expect inmates to initially "test" the system, including attempts to remove or destroy the RFID wristbands and the antennae and to try to identify "dead zones" where the RFID signals may not be transmitted. This inmate testing activity is expected to produce a large number of alerts initially, but the interviewees expect that these alerts will diminish over time. From management's perspective, the initial rollout phase will be important for training staff and monitoring of inmate movements and for gaining insights on what attempts inmates may make to circumvent the system. This initial period was seen as critical in order to establish the system's credibility to both staff and inmates. Following the initial "testing" period, interviewees hoped that inmates would soon begin to see the RFID system as adding a layer of protection for them, especially for those individuals who feel particularly at risk for violence from other inmates.

Costs of Implementing and Operating the RFID System. The RFID system was purchased on a fixed-priced contract.[2] We were unable to quantify the potential costs of operating the system because the RFID system was still in the implementation phase. Interviewees did discuss the issue of costs based on their experience to date and offered advice for other jurisdictions to consider if they are deciding whether to acquire an active RFID system. For example, a department may need to take into account the possibility of an extended design phase in

[2] The initial estimate for the RFID fixed-price contract was $2.3 million, which DC DOC requested through the budget process. The department also received a $440,000 grant from the U.S. Department of Justice.

order to tailor the RFID system to the unique architecture of the correctional institution or the amount of system testing needed to ensure the level of accuracy desired. For the case study of the department, adjustments were needed to the initial design to take into account differences in the materials of the various housing units versus the vendor's initial assumption of uniform construction throughout the facility. Upon full implementation, one senior interviewee advised that it would also be easy for other jurisdictions to underestimate the resources and staff needed to actually operate the system, particularly in a high-turnover jail environment. Another potential cost concern is a facility's computerized inmate data management system and the ability to merge the RFID data with that system. This potentially can be a costly prospect if the institution does not have the resources needed to implement such a data merger or software that is compatible. Among the potential costs that our interviewees pointed out that other facilities should consider are the long-term maintenance and upgrade costs for hardware and software, costs for maintaining an adequate staff to monitor and analyze RFID data, and resolving software compatibility issues that may arise with upgrades to other surveillance and information systems in use.

Summary and Conclusions

The recent experiences described in this report highlight some key lessons that may be of interest to other jurisdictions considering the use of active RFID systems in a correctional institution. Among these observations are that it is important for correctional administrators to clearly identify their objectives and the type of system that will best meet these objectives. Moreover, it seems most beneficial for a correctional facility to consider having its own in-house expertise or contracting with outside expertise (preferably with corrections experience) to give the facility the guidance (independent of the vendor) it will need to specify the requirements and details of its intended use of the technology, oversee the design process, and facilitate the implementation of the technology. This may be an area in which the National Law Enforcement and Corrections Technology Center can play a role in providing guidance and expertise that correctional facilities can tap into as part of the design and implementation process. In the installation process, RFID contractors and subcontractors need to have a good understanding of the environment of the correctional facility and know what is appropriate in it, especially when considering the materials and techniques for installation of an RFID system.

Training and education of staff will be critical to the successful implementation of the RFID system. Staff will require training on what to expect, on the actual implementation of the technology, on how to use the system, and on how to fine-tune alert response protocols and whether and how to analyze the data to inform management decisions. There is also a clear need to ensure successful integration of an active RFID system with the inmate management and other information technology systems (both software and hardware infrastructure) that a department currently uses or anticipated upgrades. Incompatibility can significantly increase the cost of the RFID project or limit its utility. Getting the buy-in of departmental leadership and of high-level government officials is crucial to getting the project funded initially and fully implemented as intended.

Lastly, and if at all possible, a pilot study in one area of a facility is important to undertake in order to understand how the RFID system can be effectively utilized and how to fine-tune the system and response protocols, train staff on monitoring RFID signals, understand

inmates' reaction to RFID wristbands, and determine what outcome measures will be valuable to track over time. Implementation of RFID systems is expensive, so a pilot-test will allow a facility to understand how RFID technology can meet their overall goals and gather the information and data necessary to inform decisions regarding full implementation within the facility.

An active RFID system appears to hold promise as a valuable correctional tool in ensuring that a prison or jail population is both safely and appropriately managed and in contributing to the improved safety of the correctional staff and inmates. The lessons identified in this report are informative as to the types of issues that a correctional facility may want to take into account when considering whether to deploy an active RFID system within the institution. Because the experience of correctional institutions with RFID is still fairly limited, this report represents an early look at the experiences of one of the few facilities that have invested in active RFID. It provides important information and insights on issues to consider in the conceptualization, design, and implementation of an RFID system in a correctional setting. Yet, more independent assessments of RFID systems' impacts are needed to fully assess the promise and limitations of this technology and to understand how it can be most cost-effectively utilized in correctional facilities.

Acknowledgments

We would like to thank the National Institute of Justice for its support of this research project, particularly our project officer, Jack Harne, for his assistance with our work. We would also like to thank representatives of both TSI PRISM and Elmo-Tech for helping us identify correctional facilities using or currently acquiring active RFID. We also thank the staff and leadership of the District of Columbia Department of Corrections for their generosity in sharing their time and their invaluable cooperation with our work. Their willingness to actively participate made this study possible. Lastly, we wish to thank the peer reviewers both of the RAND Corporation and NIJ for their contributions to overall quality of this report.

Abbreviations

CCTV	closed-circuit television
CDF	Central Detention Facility
CSC	correctional surveillance center
DC DOC	District of Columbia Department of Corrections
DEU	data extension unit
EMT	electrical metallic tubing
FTE	full-time equivalent
GPS	Global Positioning System
IT	information technology
NEPRC	Northeast Pre-Release Center
NIJ	National Institute of Justice
NLECTC	National Law Enforcement and Corrections Technology Center
PASS	personal activated security sensor
PREA	Prison Rape Elimination Act of 2003
PSD	personal safety device
RFID	radio-frequency identification

CHAPTER ONE

Introduction

Managing correctional populations is a challenging and expensive task for state and local jurisdictions. In recent years, a new technological tool has been offered to jurisdictions as a method of improving the efficiency and effectiveness of correctional management. This technology, active radio-frequency identification (RFID), consists of a device (or "tag") fitted with a programmable chip. This chip continually emits a signal to communicate, in near-real time (i.e., with a one- or two-second delay), radio waves within a network of RFID sensors, receivers, and monitors. The monitors record and display the tag's unique identity and location. This real-time location information can then be displayed on computer monitors and can trigger near-real-time alerts if one of any number of preprogrammed conditions is triggered. The location information is also archived so it can be played back later for use in postincident investigations. While active RFID technology has been offered as a correctional facility management tool, most of the accessible information about how well it works and its cost-effectiveness has been produced by the vendors, a source with a vested interest in promoting the adoption of their RFID products.

Given the significant expense of purchasing and operating the technology, state and local jurisdictions could greatly benefit from an objective assessment of the early lessons learned in a jurisdiction already using RFID technology. The goal of the present report was to collect some of these early lessons learned to inform the corrections field.

In the remainder of this chapter, we present a brief orientation to the two primary forms of RFID technology (passive and active RFID) used for tracking objects and people and contrast active RFID technology in correctional institutions with technologies used to track inmates in other settings.

Passive Versus Active Radio-Frequency Identification

The use of radio frequency for tracking originated with so-called passive RFID. Passive RFID technology involves the use a reader or antenna that generates radio waves. A tag is attached to the object to be tracked. This tag is passive in the sense that it merely reflects radio-wave signals back to a reader or antenna rather than generating signals itself. The reflected radio waves contain information encoded in the passive tag, which is received and recorded by the RFID reader. Passive tags do not contain a battery, as the power source is generated by the reader. Thus, passive tags can be very small (e.g., about the size of a grain of rice) for unobtrusive insertion into objects and devices, are relatively inexpensive to manufacture, and can operate for up to several decades.

The communication between tag and reader, however, occurs only when the passive tag is in relatively close range to the RFID reader (from one to several feet). Thus, passive RFID technology is often most useful for such applications as monitoring the movement of objects (including those worn by people) moving past or through a specific location.

Passive RFID technology has been in use for more than three decades, mostly in the context of inventory tracking. Over the past decade, its use has grown exponentially with both commercial customers—Walmart requires its top suppliers to place passive RFID tags on all pallets and cases being shipped to its warehouses—and by the Department of Defense. The latter requires containers shipped outside the United States to have RFID tags identifying content and point-of-origin information. The use of RFID technology in supply chains is generally intended to improve the visibility of the movement of inventory; increase the efficiency of shipping, receiving, and stocking; and reduce costs for labor, storage, and inventory losses. While there have been numerous law-enforcement uses proposed, such as controlling property (firearms, laptop computers, and vehicles) and documenting evidence chain of custody, the passive RFID technology does not yet appear to have been adopted by U.S. law-enforcement agencies ("Technology Primer," 2005).

In contrast to passive RFID, active RFID technology involves the use of battery-operated tracking devices that both receive signals and actively transmit information back to a reader or antenna. Compared with passive RFID tags, active RFID tags are necessarily larger (to house the battery), can transmit signals over a much greater distance (in excess of 300 feet), and can initiate signals to the reader/antenna, rather than only receive them. Active RFID systems can be used to monitor the near-real-time movements (i.e., with a one- or two-second delay) of objects or people within any space where radio waves can be sent and received without significant interruption or interference. This typically involves the installation of a network of readers/antennas throughout the space to be monitored. The movements of objects or people with the active RFID devices can be actively monitored from a central location, as well as recorded for historical playback of date, time, and location.

Correctional Institution Applications of Radio-Frequency Identification

Chapter Two provides a more in-depth discussion of the capability and expected function of active RFID in correctional institutions. Here, we present a brief overview. Active RFID technology has been marketed in the United States to correctional institutions to date primarily by two companies: TSI PRISM and Elmo-Tech. It has been offered as a tool to identify the precise location of inmates and staff, rather than just inventory. When fitting inmates with active RFID-tagged wristbands or ankle bracelets, RFID technology promises to provide near-real-time, centralized monitoring of inmate locations and movements throughout correctional institutions. Parameters for individual inmates can be set via programming for each wristband or ankle bracelet to generate an alert when its wearer moves into an unauthorized area or comes near inmates wearing specifically designated wrist or ankle bands. The latter function is offered as a way to help keep specific inmates or groups of inmates separate from each other within the institution. The real-time feature of the active RFID technology also promises to automate the time-intensive process of inmate head counts, which otherwise involve correctional officers visually confirming the presence and location of all inmates at regular intervals. The RFID

bands are constructed with antitamper, technology, which is designed to generate alerts if they are cut or if they lose contact with the skin.

Active RFID-tagged devices may also be worn on a belt by correctional officers and staff within the institution. These devices allow monitoring staff to identify the exact location of an officer, and some contain an officer-down feature that will generate an alert if a staff member falls to a horizontal position during monitoring. These units also come enabled with a manual alarm function that staff can use to alert a central monitoring station of an immediate need for assistance (Reza, 2004). In addition to its use for increasing staff safety, real-time monitoring of staff locations may offer the possibility of more rapid deployment of staff to developing incidents within the facility or otherwise improve the efficiency of population management. Active RFID systems also store inmate and staff location information over time for later playback. This function was designed primarily for use in investigation of incidents that may occur within the institution. Chapter Two provides a more detailed discussion of these issues.

Passive RFID systems may also be used within correctional facilities to manage and record the location of inmates in a more general way than active RFID systems. For example, some passive RFID systems fit inmates with a wristband that must be presented to a wall-mounted reader. These readers can be used to control the entry and exit of individual inmates through doors in specific areas of a facility (such as the dining hall or in specific restricted areas). Staff may also wear passive RFID devices to facilitate their access to designated areas within a facility.

Offender-Tracking Technologies in Other Settings

Active RFID systems within correctional facilities differ from technologies used to track offenders in other settings. For example, so-called electronic monitoring may be used with offenders who are under supervised release within a community. This typically involves the attachment of tamper-detecting device to an offender's ankle or wrist. This device communicates with a reader/receiver in a specific location, such as within the offender's home. The receiver records when an offender wearing the device is present at or absent from that location. The receiver may also contain a feature that generates alerts to a monitoring agency if the device has been tampered with or if the offender is not within receiving range during specific curfew hours. The specific technology used in these devices may include passive RFID systems.

Recent developments have also incorporated Global Positioning System (GPS) technology into monitoring community-supervised offenders once they leave home (or other location) and move throughout the community. Different forms of the GPS-enabled equipment are available. This includes technology that simply records movements for later download and review by supervising agencies, as well as a more active version that regularly relays, in near-real time, offender movements throughout the community (Hyde and DeJarnatt, 2005). While this form of tracking shares some similarities with the function of active RFID within correctional facilities, GPS tracking is not possible inside correctional facilities because the fortified nature of their construction prevents uninterrupted continuous transmission of satellite-to-ground communication of navigation and position-location signals to GPS receivers within the facilities (Brown, McCabe, and Wellford, 2007).

Organization of This Report

The remaining material presented in this report is organized into four chapters. Chapter Two presents background information about RFID and expectations for its deployment within correctional facilities and presents the results of our search for U.S. correctional institutions utilizing active RFID systems. We also summarize the lessons learned from a women's prison that recently acquired RFID systems. Chapter Three presents the results of an in-depth site visit with a correctional institution that is in the process of implementing RFID systems as part of a range of surveillance options within a large jail system. Chapter Four presents our overall summary and conclusions, including a discussion of the key observations and recommendations for consideration by other jurisdictions weighing their options for deploying this technology.

CHAPTER TWO

Expectations for the Use of Active Radio-Frequency Identification Systems

For some time, private companies have been marketing active RFID systems for correctional applications, asserting that the many potential benefits will offset the costs of acquiring, installing, maintaining, and operating the technology. In this chapter, we begin with a description of the expected function and benefits of the active RFID systems in correctional environments, as marketed to jurisdictions by the technology vendors.[1] We then present the results of our search to identify correctional facilities in the United States that have acquired active RFID systems. We also discuss preliminary information on the experience of three correctional facilities using RFID and the key lessons learned from an evaluation of the implementation of RFID in a women's prison.

Vendor-Described Operation of Active Radio-Frequency Identification Systems

While the capability of active RFID technology continues to develop, at present, there are several key features of the technology that are marketed to correctional facilities.[2] Active RFID systems offer a wrist- or ankle-worn device for inmates and a belt-worn device for staff. Facilities can elect to purchase systems for monitoring just inmates, just staff, or both groups. The systems allow for central monitoring of inmate and staff locations, which can be configured to display on screens at multiple workstations. The location information is displayed in near-real time, defined as an expected delay of up to two seconds. This display can take the form of a virtual map of the facility, showing the precise X-Y-Z coordinate positions of each tracked individual (where Z indicates a vertical floor location in a multifloor facility).

Inmate-worn devices are designed to be very durable and to contain tamper-detecting technology to prevent intentional and unintentional damage to the monitoring function. If tampering or damage does occur, an alert is relayed to the central monitoring station providing the identity and location of the inmate involved. The system promises not only to monitor movements but also to identify in near-real time whether inmate movements are authorized. For example, location signals from individual inmate-worn RFID devices would be automati-

[1] This report is not intended to represent a buying guide that contrasts and compares the specific systems offered to correctional facilities by the two established U.S. RFID vendors. Instead, it discusses the general capabilities of the available active RFID systems overall but not vendor-specific details about their respective systems' operation, features, and capability.

[2] Depending on the specific RFID vendor and the contract negotiated between the vendor and buyer, some features may come as standard equipment of the system (such as centralized monitoring capability), and some features require additional purchases, such as the officer-down function available for staff monitoring devices.

cally and continually matched against the preprogrammed authorized locations for that particular inmate. If an inmate moves into an unauthorized housing area or other location, an alert would occur at the central monitoring station, providing the identity of the out-of-place inmate and his or her precise location. Active RFID systems are also designed to allow perpetual head counts of all inmates. The system would issue an alert if the number of inmates within the facility did not match an expected number of inmates (taking into account authorized entrances and exits).

Staff-worn devices may also be equipped with a feature that detects and alerts the central monitoring station if the wearer falls into a horizontal or near-horizontal position for more than a few moments. The device can also send out an automatic alert if no movement is detected within 15 minutes. These safety features were designed to automatically detect that a staff member is in need of assistance, perhaps as the result of an assault. Staff devices may also be equipped with a duress button, allowing an officer to manually generate an alert to the central monitoring station. This call-for-assistance alert signal displays the precise location of the staff member involved.

The near-real-time monitoring function of active RFID systems is supplemented with an archive function. This allows for date- and time-stamped playback of the events that happened over a specified period of time. This playback can be for the purpose of identifying the individual inmates or staff who were in or near a specific location at the time of a known incident (such as a disturbance, theft, or assault). It may also be used for determining where specific individuals were in the facility at any given time.

Vendor Expectations of the Benefits of Active Radio-Frequency Identification Systems in Correctional Environments

Vendors of active RFID systems assert that adoption of the technology will produce a number of benefits within correctional environments when used for monitoring inmate and staff locations.[3] Since there have been no independent evaluations of the outcomes of active RFID systems in correctional environments, there is no empirical foundation upon which to make statements about the technology in practice.[4] Nonetheless, RFID vendors assert that the technology will increase the efficiency of managing inmate populations, thus saving staff time and increasing safety for both inmates and staff. By accomplishing these goals, active RFID systems are also purported to produce cost savings over the long term. Specifically, the vendor described benefits of active RFID systems that can be divided up into the following categories (Hickman, Eisman, and Davis, 2008).

Improve Monitoring and Control of Inmates and Reduce Staff Time. The vendors expect RFID technology to reduce staff time spent manually counting and controlling inmates, maintaining separation among them, and monitoring their movements, requiring fewer staff members to achieve the same (or higher) level of inmate surveillance. Moreover, it is expected to improve the egress and ingress control and tracking of inmates leaving the facility. This is expected because RFID systems can provide automated, real-time inmate head counts, identi-

[3] This report focuses on the use of active RFID for tracking inmates and monitoring staff locations, though these systems can be expanded to also track inventory and supplies. The purported benefits of the latter are not discussed here.

[4] One exception is the Urban Institute's recent evaluation of the implementation of RFID in a women's prison (the Northeast Pre-Release Center, or NEPRC, in Cleveland, Ohio). Although the technology was not fully implemented at the NEPRC, later in this report, we comment on some worthwhile lessons learned about the implementation process.

fication and location information, and alarms alerting staff to developing problems. Also, since RFID systems are expected to reduce the level of violence, they would thereby reduce staff time in physically monitoring activities and establishing order and in investigating and responding to acts of violence. Another major source of reduced staff time would be the increased efficiency and effectiveness of investigations. For example, in the cases of violence or property theft in the institution, investigators could use archived monitoring data to identify all individuals near the incident's location during the window of time in which it occurred. This is expected to substantially shorten the time and improve the quality of investigations.

Reduce Violence and Injuries. The vendors expect active monitoring of inmates using RFID tags to reduce inmate-on-inmate and inmate-on-staff assaults. First, it is expected to reduce violence by deterring this behavior because inmates would be aware that their exact locations are constantly being monitored. Second, violence may be reduced by greater officer awareness of (and thus more rapid response time to) developing incidents, such as when inmates congregate or certain inmates move into restricted zones. This, in turn, is expected to result in fewer and less serious inmate injuries from assaults. The technology could be expected to also increase safety by providing a way to identify violent inmates without relying on reports from victimized inmates or inmate witnesses, who may be at risk of retaliation for identifying assailants. Finally, RFID systems are expected to reduce violence by helping to ensure that certain individual inmates or groups (e.g., rival gang members, individuals [witnesses and perpetrators] involved in the same court case) do not come in contact with each other.

Reduce Actual and Attempted Escapes. RFID vendors assert that attempted escapes will be reduced through deterrence and through alarms indicating the identity and location of an inmate tampering with his or her RFID device. Also, alarms indicating that an inmate has moved into an unauthorized area would allow for quicker detection and more rapid response to the precise location of the attempted or actual escape.

Reduce the Number of Investigations and Improve Investigative Capabilities. Vendors expect RFID use to deter rule and law violations, thus yielding fewer incidents in need of investigation. Investigations could also be more efficient, requiring far less time to identify (or rule out) involved individuals and document the evidence supporting (or refuting) allegations of inmate or staff misconduct.

Reduce Inmate Grievances, Disciplinary Actions, and Lawsuits. Vendors of RFID systems also assert that the systems can reduce inmate lawsuits by preventing incidents that may give rise to grievances and legal action, such as inmate-on-inmate assaults. Moreover, disciplinary actions could decline through a reduction of incidents that lead to disciplinary actions.

Table 2.1 summarizes these vendor claims about the potential benefits of RFID systems and how effective these systems are at realizing these benefits and expected cost savings. The latter savings would be realized primarily through reduced requirements for, and more efficient use of, staff time; reduction in need for staff and inmate medical treatment; and fewer expenses related to inmate lawsuits.

Correctional Facilities Currently Adopting or Using Active Radio-Frequency Identification

The extent to which U.S. correctional facilities have acquired active RFID technology is not readily accessible information. As part of this study, we set out to document the present use of

Table 2.1
Vendor-Expected Long-Term Active Radio-Frequency Identification Outcomes, Mechanisms of Impact, and Categories of Cost Savings

Vendor-Expected Outcome	Vendor-Expected Mechanism of Impact	Vendor-Expected Category of Cost Savings
Improve inmate monitoring/control; reduce staff time	Surveillance and control of inmate movements from centralized location; reduction of need for in-person head counts, lockdowns, and escort	Reduced staff time
Reduce violence; improve safety	Deterrence; reduction/early warning of high-risk inmates congregating or inmates entering restricted areas; quicker staff response time; reduce escalation of inmate property disputes; reduction in need for inmate victims/witness to identify assailants (thereby reducing threat of retaliatory violence)	Inmate-on-inmate: fewer and less serious injuries requiring medical treatment; fewer investigations; less staff time recordkeeping and administering disciplinary sanctions; fewer inmate lawsuits Inmate-on-staff: fewer and less serious injuries requiring medical treatment; less time in recordkeeping; less time in investigation and administering disciplinary sanctions; fewer workers' compensation claims; less overtime to replace injured staff; less staff turnover from safety concerns
Reduce actual and attempted escapes	Deterrence; early warning of inmates entering restricted zones	Reduced staff time in search, investigation, and prosecution
Reduce number of investigations; improve investigative capabilities	Deterrence of rule/law violations; early warning of and increased response time to certain types of rule/law violations; time-coded electronic record of inmate and staff movements to identify suspects/witnesses and to support or refute accusations	Fewer rule/law violations requiring investigation; reduced time in conducting investigations; reduced time in recordkeeping
Reduce grievances, lawsuits, and disciplinary actions	Reduction in the incidents that lead to grievances, lawsuits, and disciplinary actions	Reduced staff time in investigation and response, recordkeeping, and court appearance; reduced attorney time; fewer settlements; fewer awards

active RFID in U.S. correctional facilities. In this effort, we conducted an extensive Internet search for references to (1) prisons or jails that had acquired or were in the process of acquiring active RFID systems and (2) specific vendors selling active RFID systems within the United States. We contacted the two identified vendors of active RFID technology, TSI PRISM and Elmo-Tech, to obtain a list of U.S. prison or jail facilities to which they had sold active RFID systems. In this process, we also sought to verify and update a list of RFID facilities provided in an appendix of the 2007 NIJ Criminal Justice Technology Evaluation solicitation for proposals (NIJ, 2007).

Table 2.2 represents the results of our search for active RFID correctional facilities. We identified 14 U.S. correctional facilities, with five systems used for tracking inmates, three systems used for locating staff, and six systems used for locating both inmates and staff.[5] The first installation took place in 1997. This was one of only four systems installed prior to 2004. Of the 14 total facilities shown in Table 2.2, at the time of this writing, the three adopting the

[5] Table 2.2 does not include one installation prior to 2004 because it was a beta-test by TSI PRISM of its active RFID system. This system, in California's Calipatria State Prison, was decommissioned after the beta-test was completed.

Table 2.2
U.S. Correctional Facilities That Have Acquired Active Radio-Frequency Identification Systems

Facility Name	Location	Vendor	Installation Began	Specific Use
Riverside Regional Jail	Hopewell, Va.	Elmo-Tech	2009[a]	500 staff
Sacramento County Probation and Parole Services, Youth Detention Center	Sacramento, Calif.	TSI PRISM	2009[a]	450 staff
DC DOC CDF	Washington, D.C.	TSI PRISM	2008	2,000 inmates and 700+ staff
Minnesota Department of Corrections, Minnesota Correctional Facility, Lino Lakes	Lino Lakes, Minn.	TSI PRISM	2007	1,300 inmates
Marion County Superior Court Juvenile Division, Marion County Juvenile Detention Center	Indianapolis, Ind.	TSI PRISM	2007	150 inmates and 200 staff
Ohio Department of Rehabilitation and Corrections, NEPRC	Cleveland, Ohio	Elmo-Tech	2006	580 inmates
Southern Nevada Correctional Center	Jean, Nev.	Elmo-Tech	2006[b]	500 inmates and 100 staff
Virginia Department of Corrections, Marion Treatment Center	Marion, Va.	TSI PRISM	2006	225 inmates and 180 staff
State of Minnesota Department of Human Services, St. Peter Regional Treatment Center[c]	St. Peter, Minn.	Elmo-Tech	2005	75 inmates
Ohio Department of Rehabilitation and Corrections, Ross Correctional Facility	Chillicothe, Ohio	TSI PRISM	2004	350 inmates
Illinois Department of Corrections, Logan Correctional Center	Lincoln, Ill.	TSI PRISM	2003	1,900 inmates and 100 staff
Michigan Department of Human Services, W. J. Maxey Training School for Boys	Whitmore Lake, Mich.	TSI PRISM	2002	240 inmates and 200 staff
Minnesota Correctional Facility, Faribault	Faribault, Minn.	Elmo-Tech	2002	95 inmates
California Department of Corrections and Rehabilitation, California State Prison, Corcoran	Corcoran, Calif.	TSI PRISM	1997	200 staff

NOTE: DC DOC = District of Columbia Department of Corrections. CDF = Central Detention Facility.

[a] Full operation expected in 2010.

[b] Facility closed due to state budget cuts in 2008.

[c] This secure mental health facility is included because it houses sex offenders.

technology in 2008 and 2009 were in the process of installing or testing the systems prior to full operation.[6]

[6] U.S. Immigration and Customs Enforcement within the Department of Homeland Security recently announced plans to adopt active RFID in 19 federal immigration detention facilities. At the time of this study, installation had not yet begun in any facility.

Lessons Learned from a Recent Evaluation of Radio-Frequency Identification Implementation in One Women's Prison

In this section, we summarize findings from a recent Urban Institute study of RFID implementation in a women's prison. We discuss these findings at length because, as previously noted, there have not been other objective evaluations of RFID implementation and impact. Our purpose here is to highlight the key lessons learned from this study that correctional facilities in other jurisdictions might find helpful when considering this technology. In Chapter Three, we discuss in-depth our case-study findings for a large correctional facility in the process of implementing RFID in a jail environment.

The Urban Institute undertook a recent evaluation of the implementation and impact of active RFID at a women's prison (NEPRC) in Cleveland, Ohio (La Vigne, Halberstadt, and Parthasarathy, 2009). The prison had a population of 594 inmates and a security staff of 96 officers. Fifty-six percent of the inmates were minimum security, and 44 percent were medium security. Funds for the RFID technology came from the Prison Rape Elimination Act of 2003 (PREA) (Pub. L. 108-79), so the primary purpose of the system was to reduce inmate-on-inmate sexual assaults and to aid in the investigation of alleged assaults. Thus, the purpose of the evaluation was to understand the factors that facilitated or hindered the implementation of the technology and the use of RFID technology to deter sexual and related acts of violence and to assess whether the use of RFID technology aids in the investigation of alleged incidents. In this prison, the RFID system was never fully operational, for a variety of reasons.

The RFID system was originally activated in August 2006; however, the system experienced signal interference problems, and, as a result, some of the installed data extension units' (DEUs') chips did not function properly, leaving some "blind" spots where inmates' ankle bracelets could not be detected. The vendor was called in to work on the problem because the NEPRC experienced transmission problems over a period of time. Because the prison did not have on-site technical expertise to maintain the RFID system, when units malfunctioned, the prison had to rely on the vendor to fix them. However, the out-of-state vendor was not always able to return to the prison immediately, so the faulty DEUs became inoperable for periods lasting from a week to several months.

Moreover, the RFID system itself became inoperable between November 2007 and July 2008. This outage was related to upgrades of the prison's information technology (IT) infrastructure and control station monitors, although the report does not describe precisely how or why this affected the RFID system. Nonetheless, it suggests that jurisdictions interested in RFID systems should carefully explore the issue of the system's compatibility with existing control station monitors' software and hardware infrastructure and coordination with planned upgrades. As a result of this problem, the facility decided to stop equipping newly entering inmates with RFID ankle bracelets; about 25 percent of the inmates did not wear these bracelets during this time. Consequentially, the inmate population surmised that the system was inoperable. Thus, any deterrent effect that the mere presence of the RFID equipment might have had on the other 75 percent of the inmates during the first 13 months of implementation was lost.

As originally envisioned, the RFID system would be used to detect inmates in "exclusion zones," such as prohibited housing units or close proximity to other inmates with whom they had conflicts or sexual relationships. However, due to budgetary constraints, these zones were

not programmed for use. Thus, the RFID system did not generate alerts when inmates moved into prohibited locations, thus limiting the use of this technology.

Moreover, only a small number of correctional officers were trained on how to use the system; one officer was trained on how to maintain and operate the system; and several line staff learned how to equip inmates with anklets. Because extensive training of the NEPRC staff was not undertaken initially, most staff did not have an understanding of the capabilities or purpose of the system. Further, there was some evidence early on that written protocols for using the RFID system were not available. Furthermore, the RFID system's six remote monitoring terminals were not easily accessible to most correctional officers while they supervised inmates. Consequently, officers reported that trying to locate inmates using the RFID system was too difficult because of the length of time it took to contact a senior staff member who would then seek to determine inmate locations. Further, the RFID system had a 30- to 60-second time delay in relaying location information to RFID-monitoring computers. These operational delays hampered the staff's ability to track and locate inmates in real time. Because of these obstacles, the Urban Institute researchers reported that correctional staff did not rely on the RFID system to locate inmates but instead resorted to using the facility's pre-RFID method of calling inmates to report to a specific location via the prison's intercom system.

Last, in terms of the benefits of using RFID systems to aid in investigations, the Urban Institute report noted that, according to interviewees, RFID use appeared to help improve the efficiency of investigations by reducing the number of incident investigation cases closed due to insufficient evidence.

In summary, the NEPRC's early experience with RFID suggests the following potential lessons for other jurisdictions:

- Educate and train staff early on in the use of the RFID technology to get their buy-in on the utility of the system.
- Ensure that the RFID-gathered information is easily accessible or transmitted to staff who are expected to use it.
- Understand the implications of RFID compatibility issues with existing IT infrastructure or planned control monitor hardware and software upgrades.
- Have in-house trained expertise instead of relying solely on the vendor for technical support. If the system is unreliable (or inoperable at times), its credibility among staff and potential deterrent value for inmates will be undermined.
- Finally, in acquiring and implementing the technology, be very concrete (internally and contractually with the RFID vendor) about the desired functions of the RFID system, and ensure that the budget allows for acquiring or enabling those desired functions.

CHAPTER THREE

Case Study of the Early Implementation of Active Radio-Frequency Identification in One Facility

In this chapter, we discuss some of the early lessons learned through a case study that we conducted of one large jail facility in the process of installing an active RFID system to manage its inmate population. This case study capitalized on an opportunity to gather contemporaneous information about the issues and lessons learned at a facility in the process of designing, installing, and preparing the system for operation. We conducted a site visit to observe the retrofitting of the existing facility to accommodate the installation of the RFID equipment, as well as semistructured interviews with key staff involved in all phases of the acquisition, installation, training, and other activities in preparation for the system's operations. In this chapter, we first present the case-study methodology and then present the case-study findings.

Methodology

For the case study, we examined the DC DOC–operated CDF jail facility that was in the process of installing an active RFID system to manage its inmate population. While the unique status of the District of Columbia as a federal district means that the CDF is technically a federal detention facility, in effect, the facility's function and inmate population are typical of U.S. jails in large urban settings. The CDF has a full-time correctional staff of nearly 700 officers and a male-only population that averages 1,900 inmates per day and cannot exceed 2,164. The median length of stay for inmates is 25 days. We provide more details about the facility in subsequent sections.

In executing the case study of the adoption of the RFID system within this facility, we first conducted initial semistructured telephone interviews with senior leadership and project managers to collect some general information about the overall effort. For example, we asked about the overall goals and expected benefits of implementing an active RFID system in the facility, overall strategy and timelines for implementation of the technology, and how the technology fits into the facility's existing and planned safety and security strategies. We conducted these initial interviews after the department had decided to adopt an active RFID system but before it had moved forward to select an RFID vendor and issue a contract to purchase the system.

Approximately 12 months after the department had issued a contract, we conducted a two-day site visit to the CDF. At the time of the site visit, the design phase, involving the detailed development of the facility installation plan, was complete, and actual installation of software and equipment was substantially under way.

The site visit itself consisted of semistructured interviews with 11 individuals (correctional officers, managers, and technical staff) who were involved in the design, implementation, or operation of the technology and related surveillance technologies. We also toured the CDF, including the administrative areas; the Correctional Surveillance Center (CSC), a surveillance monitoring center; the receiving area; and one housing unit. The in-person tour was conducted to help us understand how the RFID system was being implemented, as well as some of the technical and design issues.

The interviews were conducted using a standardized, semistructured protocol. The specific questions were tailored to the role and job responsibilities of the specific interviewee within the institution. The overall protocol contained the following questions about the implementation of RFID in the facility, with other follow-up questions used for clarification:

- What are the expected benefits and outcomes from deploying RFID?
- How does RFID fit into the continuum of existing surveillance technologies and policies in the facility?
- How is RFID expected to affect the way in which officers are deployed or other aspects of the facility's operations?
- What type of training will officers and staff receive on RFID?
- How do officers perceive the role of RFID in ensuring their safety and helping them to better manage the inmate population?
- What concerns, if any, do the officers and staff have regarding the implementation and use of RFID technology? How are these concerns being addressed?
- How are inmates expected to respond to RFID?
- What factors were important in selecting the vendor for this contract?
- What technology issues have arisen during the design phase and are anticipated for the implementation phase?
- What types of adjustments were made during the design phase? How, if at all, did these adjustments affect the plans for deployment of RFID within the facility's housing units?
- What factors either facilitated or hindered the design or implementation process?
- What are some suggestions for other jurisdictions considering adoption of active RFID in a correctional facility?

Along with the interviews, we collected relevant documentation, including planning documents, the RFID call for proposals issued to select a vendor, and the timelines developed for RFID adoption. Such written documentation was used to contextualize and enhance the information gathered from the semistructured interviews, as well as identify any discrepancies that required additional clarification.

Overview of Planned Deployment and Operation of the Radio-Frequency Identification System

We begin with an overview of the major plans for RFID implementation, with more details discussed in subsequent sections. When the RFID system is ready for launch, DC DOC intends to fit each inmate, during the jail booking process, with a tamper-resistant wristband containing an RFID transmitting device.[1] Communication between the jail's information manage-

[1] The technology vendor refers to its inmate-worn device as a personal activated security sensor (PASS) unit.

ment system and the RFID system software will allow the signals from a specific bracelet to be linked to a specific inmate. The bracelet will be removed from the inmate at the time of facility discharge.[2] It will then be cleaned and prepared for use with the next new inmate. All correctional officers will also be required to wear on their belts an RFID transmitting device that resembles a pager during their shift.[3] The correctional officer devices purchased by DC DOC have three safety features: (1) a duress button that can be manually pressed if the wearer needs to call for assistance, (2) an officer-down feature that automatically sends off an alert if the wearer falls to a horizontal position, and (3) a feature that generates an alert if the wearer has not moved in 15 minutes (suggesting that he or she might need assistance). Software programming will also associate unique signals from a specific device to each designated officer. At the end of a shift, each officer will be required to return the RFID device to a designated location within the facility.

The RFID monitoring function will be integrated into the CSC, which is being established in the facility simultaneously with the operations of the RFID system. The CSC will be staffed with personnel whose sole function will be to monitor the RFID signals and other surveillance technology. This other technology used within the CSC will include an updated version of the facility's closed-circuit television (CCTV) system[4] and a telephone monitoring system. Our interviewees described the planned CSC as state of the art and believed that their facility will be the first in the country to integrate the monitoring of active RFID signals into its facility's overall centralized CSC.

Staff in the CSC will monitor the movement of inmates and respond to alerts from inmate- and officer-worn devices based on a predetermined response protocol. Since the RFID system will continuously monitor all inmates and be able to pinpoint the exact position of officers in the event of an alert, the monitoring staff may become overwhelmed with the amount of data being produced. The potential increase in the detection of prohibited behaviors and the sheer amount of data generated could make it difficult to know what signals require specific officers' responses. Therefore, facility-specific protocols need to be developed that provide decision rules as to whether and what type of action needs to be taken. For example, signals that detect unauthorized movement into an exclusion zone might require that the monitoring center staff notify an officer in that area so that he or she can immediately investigate and possibly prevent an incident (e.g., inmate-on-inmate assault) from occurring. In general, response protocols are a set of rules that will govern the officers' responses to a set of alarms generated by the RFID system. With more experience and time operating the RFID system, these protocols will inevitability require revisions and refinements.

DC DOC also employs analytic staff who will be tasked with analyzing recorded RFID signal information to identify patterns that may help to inform inmate population management or to increase facility safety and security. For example, the CSC analytic staff could be tasked with identifying whether certain patterns of inmate (or staff) movements are associated with early indications of violent or disruptive incidents. This information would then be used to adjust inmate management practices. In addition to this more general analysis, DC

[2] Even though it will not function outside of the facility, to minimize logistical challenges, the bracelet will remain on inmates who leaving the facility under temporary release, unless the individual has been admitted to the hospital.

[3] The technology vendor refers to the RFID device worn by correctional officers as a personal safety device (PSD).

[4] Currently, the department has 210 cameras in place; full implementation of the expanded CCTV camera system calls for a total of 900 cameras.

DOC intends to use the RFID system for investigation of specific incidents within the facility, including establishing which individuals were in the proximity of a known incident or establishing the location of specific individuals at the time of an alleged incident.

Reasons for Adopting an Active Radio-Frequency Identification System

In its written documents released to solicit bids from vendors, DC DOC stated that its goals for an active RFID system were "to increase inmate management and accountability, to improve productivity and efficiency, to reduce jail operational costs, and to significantly enhance the safety of correctional officers and staff" (DC DOC, 2007). These outcomes were anticipated through the technology's capability to identify, locate, and track inmates in real time and to offer advanced safety and security features for officers and staff.[5]

During our interviews, we asked the respondents to discuss their views of the reasons for adopting an active RFID system and its potential utility. In response, they described multiple issues. One reason that the respondents identified was to help increase safety and security within the facility by more closely tracking inmate movements. In the CDF, jail staff are required to allow inmates to have eight hours outside of their cells, so there are large numbers of inmates moving around within the facility at any one time. On average, there are two correctional officers supervising 80 inmates. Inmates may move from their designated housing unit to areas throughout the facility unescorted with only a hall pass (e.g., for religious gatherings, programming and work details, or medical reasons). Given the correctional staff–to-inmate ratio, it was not possible for correctional officers to directly observe all inmates, at all times, in all parts of the facility. Thus, tracking and identifying inmates in real time with an active RFID system was seen as a means of improving security (e.g., ensuring that inmates do not escape the facility) and safety (e.g., protection of inmates and personnel inside the facility).

For example, the RFID system also will add a layer of protection for those inmates who have so-called enemies within the jail. Currently, the only way for the facility to do so is to manually register the cellblocks of the respective parties and restrict access to these areas. This manual system requires close and continuous monitoring by correctional officers. The RFID system would essentially automate the process of restricting access, so that alerts would sound if known enemies come into the proximity of a restricted cellblock or of an individual inmate.

An active RFID system was also seen as a way to quickly respond to developing or violent incidents by rapidly identifying and alerting the correctional officers who are in the immediate vicinity.

The interviewees with whom we spoke expressed other expected outcomes as well:

- Enable more efficient deployment of personnel and resources, especially as the RFID system is integrated with the other surveillance technologies (namely, CCTV cameras).
- Enable more accurate inmate head counts and reduce staff overtime costs involved in doing manual head counts to reconcile discrepancies.
- Improve documentation of services and programming that inmates receive while incarcerated and reduce the amount of time required to produce individual and summary reports on programs and service use.

[5] If an alert is sounded, RFID will allow the CSC to pinpoint the exact location of a correctional officer. The system will allow the department to also review staff movement as part of the investigative process for an incident or suspected incident.

- Increase the pace, efficiency, and quality of investigations by rapidly providing accurate and objective information.
  - Allow for identification of inmates involved in incidents.
  - Increase the percentage of prosecutions and convictions obtained following inmate-on-staff assault incidents.
  - Reduce the number of fraudulent charges leveled against officers because inmates will be aware that the exact location of individual officers can be pinpointed at any given time in the facility and officer locations can be identified in real time.
- Result in an overall reduction in both inmate-on-inmate and inmate-on-staff assaults.
  - Curb future violence; inmates will now know they will be able to be positively identified.
  - Increase surveillance of the interiors of cells, including which and how many inmates are present inside particular cells.
  - Increase officer safety by identifying officers in need of assistance and by increasing response time to incidents.
- Allow analysis of data to identify patterns and to more accurately identify the locations of potential incidents more quickly than officer surveillance and monitoring processes currently in place. For example, the CDF experienced an escape three years ago. One interviewee postulated that, if the facility had had records of where everyone was at the time or the correct deployment of officers, it would have been able to prevent the escape.

Overall Findings

In this section, we summarize the key findings from the case study. Although we focus primarily on RFID, where appropriate, we also capture the lessons learned from this department's implementation of the other surveillance technologies and the new CSC, since DC DOC intends its RFID system to complement and work in conjunction with these other technologies.

Upper Management Support. Getting the buy-in of departmental leadership and of high-level government officials is crucial to getting a project funded, started, and completed. For this department, there was high-level support among upper management for implementing the RFID system along with other new surveillance technologies. In addition, and crucial to getting the funding, the project had the support of local officials. Senior correctional officers also were supportive of this project, which was important in gaining buy-in from line staff.

Upper management support is also crucial for guiding the development of policy regarding the chain of command in notification, the response protocols when an alert is triggered, and setting expectations for both staff and inmates and policy for addressing noncompliance.

Design and Construction Issues. In considering the adoption of and, later, plans for utilizing RFID, the department sought to draw on the experience of other institutions that were using active RFID. They concluded that the application of active RFID in the United States was in its infancy, relative to its use in international correctional facilities. Thus, department staff made phone calls and looked for written materials about the RFID experiences of institutions in various countries, including Singapore, New Zealand, and the United Kingdom. In considering the best strategies for designing the RFID system for the CDF, the department also drew on the experience of one member of its technical staff who had previously worked with RFID systems in an industry setting. While it was a different setting and application, the prior experience of internal staff was thought to be helpful in the department's preparation for acquiring RFID systems.

The department's key criteria in selecting an RFID vendor were that it wanted to implement an active (versus passive) RFID system and to work with a vendor that had correctional experience. The department also wanted to be able to track inmates' exact locations in real time. It was not interested in a zone-based system, which has the ability to track inmates within specific areas of the facility but would not allow tracking of individuals from one zone to another throughout the facility. The ability to track inmates' exact locations throughout the facility and having an RFID vendor with the most correctional experience were important factors in the final decision. As noted by one interviewee involved in the technical aspects of the system, the vendor indicated that it had solved some of the issues with RFID systems raised by past clients in the past few years. Assurances from TSI PRISM about recent technological advancements helped to ease the uncertainty in the minds of the decisionmakers within the department about whether the RFID system would operate as expected in the CDF.

Implementation Timeline. The overall timeline for the adoption and implementation of RFID began in June 2008, when the contract was awarded to the chosen vendor. Full operation of the RFID system is expected to be under way in 2010. First, we present an overall timeline of milestones, and then we discuss issues that delayed the timeline as it was initially planned. At the time of our data-collection window (June 2009 site visit), the department was in the network installation process. At that time, the following were the key milestones for the system:

- June 2008: The contract was awarded to TSI PRISM (completed).
- June 2008–November 2008: Design phase (completed)
- August 25, 2008–May 1, 2009: Construction phase (completed)
- June 2009: Network installation phase (under way at the time of the site visit)
- Future plans
  - Late summer 2009: Integration, calibration, and testing of system
  - Late 2009/early 2010: Full system operation.

On June 6, 2008, the RFID contract was awarded, and, within one week, the vendor conducted a review of the facility and informed DC DOC management of its initial system design. As discussed earlier, the original plans were for the design phase to last from June 2008 to August 2008. However, a number of design issues arose, as discussed in this section, that lengthened this phase by three months, through November 2008. Although the construction phase began in August 2008, the installation of RFID equipment in the housing units did not take place until January 2009 and was completed in May 2009.

Our site visit took place in June 2009, at which time the department was beginning the network installation phase. This involved installing the server and computers and then calibrating and testing the system.

The department hoped to begin fitting inmates with RFID devices in the spring of 2010, while simultaneously developing the procedures for routinely fitting new inmates and for removing devices from inmates being discharged. After an initial period of focusing on the procedures for fitting inmates with the RFID devices, the department also planned for the CSC to begin tracking the movements of inmates, at least within several housing units, and use this experience to begin fine-tuning the monitoring center's procedures and response protocols.

In early 2010, after the initial experience with fitting the inmates with RFID devices, the department planned to begin issuing RFID devices to correctional officers on duty.

Last, in the late fall of 2009 and early 2010, full operation of the RFID system was anticipated, including all staff trained, RFID devices fitted to inmates and staff, and monitoring operating as planned. An exact timeline for this was not available at the time of our site visit.

Next, we summarize some of the key challenges the department has experienced during the initial phases of the project, some of which contributed to schedule delays.

The original plan called for the design phase to last several months, with construction beginning in August 2008. However, for several reasons, the design phase took substantially longer than was originally anticipated, lasting until November 2008. The inmate housing component ended up taking the longest to design and configure. A key reason was that the architecture of the individual housing units was unique, with the different units constructed at different times using different materials and floor space layout configurations, including two-story housing units. Because RFID operates via radio waves, physical barriers (e.g., the thickness of the walls, the amount of steel, and other factors) can attenuate the signal's strength. Thus, the post-award detailed design for the placement of the RFID components (e.g., exciters, transmitters, and conduit) took longer than anticipated because the vendor's team had to redesign the plan when it discovered that its initial assumption (that wall materials and thickness were standard throughout the CDF) was incorrect. The redesign had to take this variation in construction into account. In effect, the vendor needed to tailor the installation of the RFID equipment to each of the 18 housing units' unique construction materials and floor space layouts. Delays resulted because the vendor did not fully appreciate the complex nature of the CDF's construction and physical layout until the project was under way.

The department also desired a relatively high level of accuracy, with the ability to identify, in real time and in a multistory facility, the location of an inmate within 2 to 5 feet indoors (and within 10 to 15 feet outdoors). The initial design revealed an unacceptable level of accuracy, leading to the need to test different customized solutions and modification of the overall RFID system design. For example, the original plan did not call for the installation of RFID antennae in the individual cells. However, it was discovered that, when the cell doors were shut in the housing units, the accuracy of the system was compromised because the amount of steel in the doors interfered with the radio-wave signal. This problem took weeks to solve. Ultimately, the solution was to place antennae in every fourth cell, which would allow the department to still get the level of accuracy it desired in placing each inmate in three-dimensional space. Because the antennae are large, boomerang-shaped objects, one challenge was how to mount them on the cell walls so that inmates could not remove or tamper with them. Testing materials to house the antennae (and other infrastructure) to minimize tampering by inmates also contributed to project delays. The vendor arrived at an installation solution using epoxy material that was acceptable to the department. After this step was completed, the department required the vendor to do additional testing to verify that the location accuracy of the system met the specifications set out in the original contract.

Another complication was that the subcontractor had installed lower-grade conduit (i.e., electrical metallic tubing, or EMT) instead of rigid conduit. The solution was to strap the conduit at shorter intervals to give it more rigidity. This issue was discovered well into the installation process. This issue illustrates the ongoing requirement to inspect all materials and equipment prior to installation to ensure that the contractor has met all the specifications set out in the statement of work.

Another problem was the accuracy of the location information in the multistory facility with two-tiered housing units. On occasion and if, for example, an inmate were sitting on the floor of the second story, an RFID receiver on the first floor could detect the signal generated by that inmate's RFID device. The result would be an inaccurate location reading, placing that inmate on the first story instead of the second story. It was determined that the problem was due to the installation location of RFID signal repeaters (so-called exciters). These exciters amplify and help relay the signal of the inmate- and officer-worn RFID devices to the RFID receivers.[6] Since the exciters on the second story were installed very near the floor, the RFID signals were being relayed through the floor to the receivers below. To resolve this issue, the vendor elevated the exciters on the second story approximately 3 feet off the floor. This solution meant that the signals relayed by the second-story exciters were in better range of the second-story receivers than of those below.

Another source of delay was related to the design of the inmate RFID bracelet's fastener—originally designed for prison, in which inmates have longer stays in a correctional facility than in jails (with a high turnover rate in the inmate population), the department found that the bracelets were so secure that they were difficult to remove. Thus, before training of staff could occur on fitting and removing bracelets from inmates, the bracelets' fasteners had to be redesigned.

Another issue was that project management personnel and subcontractors changed during the project implementation phase. This meant that new project personnel coming onboard midstream had a steep learning curve, which also contributed to delays.

Anticipated Staffing Needs. DC DOC's planned use of the RFID system involves a number of administrative activities, including analysis of data and report generation, analysis of incident patterns to inform management decisions, analysis to inform investigations, and real-time tracking of inmate location. These activities will be largely conducted within a newly established CSC. This surveillance center consists of various divisions for its staff, including camera watchers, analysts, internal affairs, a telephone analyst, and staff to deal with outside requests for surveillance information (such as from prosecutors or defense attorneys). One manager commented that it would be easy to underestimate the amount of staff needed for this type of surveillance center, given the large amount of data generated by all the surveillance technologies (eventually), including RFID.

To help ensure that the staffing of the CSC remains adequate on any given day, nonuniformed staff will fill the monitoring positions. The department reasoned that, if correctional officers performed the monitoring functions, there was the possibility of these officers being reassigned inside the facility when others called in sick or when an emergency arose. Thus, the department felt that the CSC needed dedicated nonuniformed staff members who were not dual-positioned. As one interviewee commented, it would be unacceptable for the department

[6] RFID systems include one or more RFID receiver systems that are associated with a number of distributed transmitters, referred to as RFID tag exciters. According to one patent application (Sadr et al., n.d.),

> The exciters can act as signal repeaters from the RFID receiver system that enable transmission of a tag signal to a distant exciter, which in turn filters, amplifies and re-transmits the signal to the intended collection of RFD tags within the line-of-sight view of the exciter.

to make a substantial investment in an RFID system and surveillance monitoring center and then have this function understaffed or closed at times.[7]

The CCTV camera, telephone monitoring, and RFID systems will also generate a large amount of data that can be useful for investigation purposes and for creating summary reports. In the case of the surveillance cameras, once the U.S. attorney and other attorneys realized that these data existed, a large volume of requests came in to see videotape from the cameras to determine what inmates were doing at specific time periods. This also resulted in a number of requests for information regarding the phone records of specific inmates, to aid in investigations. Once the RFID is fully operational, the CSC will monitor and integrate this source of data into the range of other surveillance tools it has to monitor the activities of inmates. If the U.S. Attorney's Office, for example, has reason to believe that some criminal activity is happening within the jail, it may obtain a subpoena for RFID records in order to aid in an investigation. According to one interviewee who believes that the CSC is now fully staffed, it now has enough trained analysts to handle these requests. One interviewee in a management position was not concerned that this new technology might result in fishing expeditions because most of the requests to date had been based on ongoing investigations.

Aside from performing the monitoring and analysis tasks, the department also anticipates needing full-time staff for the work associated with maintaining the inmate- and officer-worn RFID devices. For example, someone needs to ensure that the RFID devices are properly accounted for and that routine maintenance is done. The batteries of the RFID devices need to be charged and the devices cleaned, reissued, and removed from both inmates and officers as they enter and exit the jail. This is expected to be an ongoing and busy process, given the continual turnover of the jail inmate population and the large number of officers going through shift changes.

Anticipated Need to Develop RFID-Related Policies and Operating Procedures. The facility anticipated a need to develop written RFID policies and operating procedures. These entailed establishing guidelines that employees, contract personnel, nonuniformed CSC staff, and others need to follow in using the RFID system to help ensure increased safety, security, and accountability within the CDF. DC DOC's written documents address such topics as when personnel are required to wear a RFID unit, procedures for using RFID to control access privileges to specific areas throughout the facility, directions for inmates wearing RFID devices, and how to report problems with the RFID units.

As noted earlier, facility-specific response protocols have been developed to provide decision rules as to whether, and what type of, action should be taken when an RFID-generated alert is received. For example, an alert could be generated by close proximity of two inmates who are designated enemies. Written policies and procedures would then dictate the response of the operators in the CSC as they observe the alert generated by the RFID system. For example, written policies would direct them to locate the area of the facility and, at the same time, look at the CCTV monitor to determine whether the contact appears to be brief and

[7] This decision also has other potential implications with respect to command and control. The expectation was that having nonuniformed personnel doing the monitoring would add a level of independence for the unit, with the CSC reporting up through investigative services versus operations. However, in operation, this has meant that, when the CSC calls down to the housing units with surveillance information, the correctional officers want to take orders from a commander rather than from nonuniformed personnel. Therefore, this has required an added level of reporting, at which the nonuniformed staff in the CSC first send the information to the command center and then command center staff direct the unit officers on how to respond.

inadvertent or whether a situation is developing that warrants alerting correctional officers to intervene. Not all alerts require that an action be undertaken. In short, written policies and procedures specify the CDF's rules governing response decisions.

Our interviewees reported that the vendor played an important role in offering some initial guidance on developing these written policies and operating procedures, drawing on its previous experience. This has meant that the department did not have to begin from scratch in developing these internal policies. However, the interviewees reported that the response protocols will need to be further refined and tailored by departmental staff for the CDF, particularly those involved in the operation of the RFID system and the technical staff providing analytic support in analyzing the volume of data generated by the system. The interviewees reported that, when the system was close to implementation, they would move forward in more fully developing its initial set of protocols and that they expected to refine them as the department gains experience using the system.

Expected Staff and Inmate Responses to Radio-Frequency Identification

DC DOC intends to use the RFID system as an inmate management tool and as a tool for enhancing the safety of correctional officers and other staff within the jail. A key issue with the implementation of the active RFID system is the response of both staff and inmates to the new technology. Each issue is discussed in this section in turn.

Expected Staff Responses to the RFID System. Some staff may be accepting of the technology because it offers them PSDs and a greater level of safety while conducting their routine work in housing units. In fact, this is the primary motive for implementing the technology. Combined with positive identification of inmates who engage in spitting, throwing projectiles, or other acts against officers, and the improved rate of conviction of inmates for staff assaults, DOC expects the rate of inmate-on-staff assaults to decrease significantly over time.

In discussing issues surrounding the implementation and use of the RFID system, our interviewees most frequently raised staff acceptance of this new surveillance technology. A number of interviewees commented that some officers and union representatives were concerned that the RFID system would lead to excessive surveillance of officers in the performance of their duties. Thus, officers might resent the use of the system, resist compliance with RFID-related procedures, and even try to circumvent the system.

On the other hand, some interviewees expected the RFID experience to be comparable to the staff acceptance of the recent installation of a more sophisticated CCTV camera system in the new CSC. There was initial resistance to these upgrades, but these additions came to be seen as positive, as they actually proved to be helpful in identifying inmates involved in assaults and in aiding in investigations. These interviewees felt that some officers saw these episodes as a positive outcome of adding the new technology. The interviewees expected that addition of the RFID system would similarly gain acceptance if it is able to demonstrate its practical utility.

Another issue potentially affecting officers' acceptance of RFID is that the department introduced a number of technological innovations within a short period of time. These began with a new timekeeping system, a more sophisticated CCTV camera surveillance system and a new surveillance center, an enhanced telephone system for monitoring inmate calls, and finally the addition of active RFID. The collective set of technology innovations represents a significant cultural change for facility personnel, so general resistance to the changes, including RFID, might be expected. Indeed, technology enhancements made to the timekeeping system alone reportedly met with some officer opposition. At the same time, the department

had experienced a high turnover in staff due to the retirement of a large number of its older staff. The influx of new staff might work to counter some of the resistance to the technological changes in that several interviewees commented that the newer staff seemed to be more comfortable with technology in general and, therefore, more accepting of the range of newly introduced surveillance technologies.

A final issue discussed by our interviewees on the topic of staff acceptance was the importance of the reliability of the system. Several interviewees stated that, once the system is installed, if the system has a number of false alerts or stops functioning, it can undermine staff confidence in the system and affect their willingness to rely on it. For this reason, one interviewee felt that it was important to have the contractor readily available after the system is installed to do repairs.

In order to help promote staff acceptance of the new technology, several interviewees underscored the importance of education and training, as well as getting peer leaders' support. Several interviewees felt that it was necessary to have both initial training when the system first becomes operational and ongoing training. The training needs to occur in several steps, including initial general information and specifics on helping personnel understand the technology, using it appropriately, and its expected benefits. Several interviewees also commented that, in terms of staff acceptance, it was important to gain allies for implementing this technology, especially senior officers who are widely respected within the jail. They emphasized that the training sessions ought to focus on the safety and security benefits of the RFID system and not on its potential for identifying officer noncompliance with policies and procedures.

Expected Inmate Responses to the RFID System. When the RFID system is fully installed and wristband devices are fitted to inmates, our interviewees expect inmates to initially test the system, including attempts to remove or destroy the RFID wristbands and the antennae and to try to identify dead zones where the RFID signals might not be transmitted. According to one senior manager, the wristbands are probably the weakest link in the RFID system. That is, they are the most accessible part of the system to inmates and, therefore, the most likely target of tampering. This inmate testing activity is expected to produce a large number of alerts initially, but the interviewees expect that these alerts will diminish over time. The interviewees expect this outcome because, in turn, they expect the RFID system to function according to plan and that the staff response to alerts will be consistent and appropriate.

From management's perspective, the initial rollout phase will be important for training staff on the placement of the RFID wristbands, monitoring of inmate movements, and strategies inmates might use in attempts to circumvent the system. This initial period was seen as critical in order to establish the system's credibility with both staff and inmates. Following the initial testing period, interviewees hoped that inmates would soon begin to see the RFID system as adding a layer of protection for them, especially for those individuals who feel particularly at risk of violence from another inmate.

Costs of Implementing and Operating the Radio-Frequency Identification System

The cost of the RFID fixed-price contract was $3.3 million. DC DOC was granted the necessary funds through the budget process and a U.S. Department of Justice grant. Additional costs included $42,000 for staff to provide initial RFID training and $60,329 in overtime expenditures. The latter covered 1,440 hours of staff time, primarily for security escorts. Anticipated future costs are $194,000 annually for ongoing maintenance and support for the RFID system, including replacement parts and equipment. The ongoing staffing costs for RFID-

related operation and maintenance include seven full-time equivalents (FTEs) and one contractor FTE to support operations on site.

The CSC was a separate project and could have been implemented without the RFID. Since DC DOC believes that the CSC will play a key role in RFID surveillance, however, we provide the reported CSC costs here as guidance for other jurisdictions considering this approach. Initial construction and staffing of the CSC required an additional $3.05 million. The anticipated ongoing cost to support the CSC (including staff and equipment) is $1.05 million annually after the first year.

During the case-study data collection, we were unable to quantify the potential costs of operating the system because the RFID system was still in the early stages of implementation. We asked the interviewees to discuss the issue of costs based on their experience to date. In particular, we asked that they offer advice for other jurisdictions to consider if they are deciding whether to acquire an active RFID system.

In response, one interviewee pointed out that it is very easy to underestimate the true cost of an active RFID system. For example, a department may need to take into account the possibility of an extended design phase in order to tailor the RFID system to the unique architecture of the correctional institution and the amount of system testing needed to ensure that the level of accuracy desired is attained. Even though a fixed-price contract may be in place, the longer installation and testing period can produce greater costs to the jurisdiction. One example in the DC DOC facility was the staff time involved in moving inmates during installation of RFID within the housing units. During the initial phases of installation, inmates were moved out of the housing units—three units at a time in order to speed up the installation process. Extra staff were needed to manage the elaborate inmate movement process and to provide security for the contractor's work crews, which resulted in some overtime expenses being incurred. At the same time, DOC's contractual housing allotment was retroactively reduced (in a budgetary adjustment unrelated to RFID). Thus, the installation process contributed in part to the department exceeding its contractual housing budget by $1.2 million during the fiscal year of RFID implementation.

Upon full implementation, one senior interviewee advised, it would also be easy for other jurisdictions to underestimate the resources and staff needed to actually operate the system. For example, full-time administrative staff will be needed to maintain the RFID wristbands and PSDs and to issue the PSDs to officers. Inmates will be issued RFID bracelets during the receiving and discharge processes. Given the transient nature of a jail with a high turnover in the inmate population, staff levels are expected to be higher than in a prison. DC DOC estimated that at least two mid-management staff members (i.e., sergeants) would need to be dedicated to maintaining the RFID wristbands for staff and other activities.

As one interviewee noted, any institution that is considering implementing RFID needs to have an offender management system and the ability to link the RFID data with that system. This potentially can be a costly prospect if the institution does not have the resources needed to develop the interface to synchronize the two systems[8] or have software that is compatible.

In addition to these costs mentioned, our interviewees advised that other jurisdictions contemplating the adoption of active RFID should consider the following potential costs:

[8] That is, individuals need to be simultaneously (or near simultaneously) registered in both systems and removed from both systems or, in the event of a temporary absence from the facility, deactivated from the systems.

- In the design and construction phases, officers will be needed to protect the contractors while they are installing the system, which may entail overtime costs.
- Long-term maintenance costs of the system also need to be considered.
- If the jurisdiction intends to fully use all the system's capability and the data that it produces for inmate and officer facility management, the cost of hiring full-time monitoring and analytic staff (e.g., for a CSC) will need to be included.
- The added cost of procuring potentially expensive hardware and resolving software compatibility issues may need to be addressed in integrating the system with existing surveillance and information systems.
- Once attorneys and outside stakeholders realize the value of the data, the cost of additional staff time could be consumed by a potentially large number of requests for RFID-generated information for investigations and reports on services received (such as medical care or access to programming).

The department is still early on in the process of implementing RFID, so this summary captures the department's experience primarily in the design and construction phases of the project. The interviewees also described the challenges they might encounter and expected benefits when the system is fully operational.

It is important to note, however, that this department is implementing the RFID system at the same time that it is implementing a range of other surveillance technologies, as well as a new surveillance monitoring CSC, which may make it difficult to separate out the effects of RFID itself. One unexpected benefit of the delays in implementing RFID is that the department has been able to collect some data on the impact of the new camera surveillance system on inmate and staff behavior and so might be able to look at the incremental effect of adding in RFID to the range of surveillance options the department is deploying.

When it is fully deployed, it will be challenging for the department to isolate and assess the effects of RFID alone versus an increase in surveillance technology in general. For example, some outcome measures are unique to RFID (e.g., improving the accuracy of head counts), whereas, for other outcomes, it might be harder to assess whether a decrease in violence, for example, is related to RFID or some combination of the different surveillance technologies. Further, because the department has a number of new staff coming onboard, it may be challenging to assess whether an increase in potential violence is related to the inmates testing new staff or inmates testing the new RFID system (and other surveillance technology).

One would also expect initially that incident frequency would rise as the department improves its ability to detect the occurrence of incidents. Indeed, this has been DC DOC's experience in implementing the CSC and having dedicated staff to monitor the CCTV system.

CHAPTER FOUR

Summary and Conclusions

In implementing any new technology, there are general lessons that are applicable to RFID systems as well (Upchurch, 2009; Davis and Jackson, 2005):

- Ensure upper management buy-in and support.
- Plan for adequate and continuous training.
- Conduct thorough vendor research and develop a detailed vendor contract.
- Identify and secure adequate personnel to implement and maintain the system.
- Develop a maintenance approach.
- Heavily involve the end users; identify all the key internal and external stakeholders and understand their different needs, concerns, and expectations.
- Talk to others and learn from their experiences.
- Assess the project risks, such as whether adequate funding will be available for maintaining the technology over the long run and staff acceptance of the new technology.

The recent experience of DC DOC and of the NEPRC site highlight some key lessons that will be of interest to other correctional facilities considering the use of RFID systems in their institution. In this chapter, we summarize the key lessons learned.

Lessons Learned

In making the decision whether to deploy a passive or active RFID system, it will be important for correctional administrators to clearly identify their objectives and what type of system will best meet these objectives. Passive RFID systems can store information and may be more appropriate in a correctional setting where it is less important to be able to actively monitor inmate movement in real time; instead, the goal may be primarily zone control to prevent unauthorized movement into a restricted area within the facility. A passive RFID system in general may be easier to implement in a prison setting because there is less movement and turnover in the inmate population than there is in a jail setting. In DC DOC's view, the maximum benefit of active RFID systems may be in the jail setting precisely because there is a lot of inmate movement and turnover in the jail population and not enough officers to keep track of all inmates in real time or to escort inmates as they move from location to location.

The correctional facility used for the case study appears to be unique in that it has a multidisciplinary technical staff comprised of a senior industrial engineer with prior RFID experience who designed the RFID system for DC DOC; an industrial engineering subcontractor

who served as the project manager for RFID installation; a Ph.D. statistician responsible for data analysis, reporting, and advanced problem-solving; an IT specialist who serves as chief of network operations; and a director of the correctional surveillance center. This in-house team of experts worked closely with the vendor on the design, implementation, and closely overseeing RFID implementation. DC DOC also plans to integrate the RFID system into a centralized CSC that it views as state of the art, with dedicated, trained staff. This department felt that having in-house staff with this kind of expertise was important to understand the strengths and limitations of the technology and to develop an effective strategy for its deployment in a correctional setting. Because most RFID vendors have limited experience with corrections, the department felt that such in-house staff and expertise were crucial to informing decisions about how to effectively use this technology in a correctional setting, rather than relying only on an outside vendor's assessment. For many correctional facilities, however, it would be unusual to have this type of in-house technical expertise, so they would have to rely on vendors for guidance and recommendations. After installation, the correctional facility will need staff to operate the software and hardware components of the RFID system and to incorporate its use into the facility's own policies and procedures. As one manager noted, having an RFID contractor that will be readily available after the system is installed to do repairs could be an important issue for the agency to deal with because, once the system is in place, the facility is dependent on the contractor, especially when the system goes down.

In the installation process, RFID contractors and subcontractors need to have a good understanding of the correctional facility's environment and know what is appropriate in it, especially when considering the materials and techniques for installation of an RFID system. One interviewee recommended that a correctional facility put a clause in the contract concerning (1) the approval of recommended locations of RFID equipment and (2) the level of the technology's location accuracy. These two issues were described as central to overall performance of the system.

In short, it seems most beneficial for a correctional facility to consider having its own in-house expertise or contracting with outside expertise (preferably with corrections experience) to give the facility the guidance (independent of the vendor) it will need to specify the requirements and details of its intended use of the technology, oversee the design process, and effectively implement the technology in the facility. In DC DOC's view, having engineering project managers (preferably with an industrial engineering background) with adequate project management experience in implementing capital technology projects is likely to greatly improve the likelihood of successful implementation. If a correctional agency does not have an in-house industrial engineering group, it may be worth considering hiring one or two FTEs (preferably with an industrial engineering background) as engineering project managers. Alternatively, this may be an area in which the National Law Enforcement and Corrections Technology Center (NLECTC) can play a role in providing guidance and expertise that correctional facilities can tap into as part of the design and implementation processes. Regardless, it is important to recognize that, once the vendor has put the system in place, the facility will need ongoing in-house staff expertise to operate the RFID system. It is also important to have a good understanding of the process flow of one's facility before undertaking an RFID project—specifically, understanding how inmates and staff move throughout a facility and which areas will be most critical to monitor.

Training and education of staff will be critical to gaining staff acceptance and readiness for the successful implementation of an RFID system. Implementing an RFID system will

likely represent a significant cultural shift for an institution, so it will be important to get buy-in from all the relevant stakeholders. The different stakeholders will require training on what to expect, on the actual implementation of the technology, on how to use the system, on how to fine-tune alert response protocols, and on whether and how to analyze the data to inform management decisions. As one interviewee noted, it is not possible to just flip a switch right away and expect the deployment of RFID to go smoothly. Like the launch of any complex technology, there is an involved process of trial and error, experiential learning and revision.

Both DC DOC's and the NEPRC experiences underscored the importance of recognizing the need to be able to integrate the RFID system with the offender management and other IT systems that a department may have. This can potentially be a costly prospect if the institution does not have the resources needed to implement such a data merger or have software that is compatible. In the case of DC DOC, it is currently in the process of integrating its RFID system with the other data systems. Because the RFID data will be passing through its surveillance monitoring center, as well as the data from the enhanced telephone system and CCTV camera system, the infrastructure needed is complex, with different databases and networks being involved. In the case of the NEPRC, system upgrades to the prison's IT infrastructure rendered the RFID system inoperable for an extended period of time. This experience in particular highlights the need to consider system compatibility with existing software and hardware infrastructure, as well as with planned upgrades.

As was the case in DC DOC, getting the buy-in of departmental leadership and of high-level government officials is crucial to getting the project funded initially and fully implemented. Also, early in the process, the department should meet with all staff to educate them about RFID technology and to gain the support of key staff members within the department to champion the technology and its benefits. This training is particularly important before the RFID system is implemented, as its potential value cannot be observed until it is fully operational. For this particular department, the implementation of multiple technologies within a short period of time may make it particularly challenging to gain acceptance of this new system.

Last, and if at all possible, a pilot study is important to undertake in order to understand how the RFID system can be effectively utilized and how to fine-tune the system and response protocols, train staff on monitoring RFID signals, understand inmates' reaction to RFID wristbands, and determine what outcome measures will be valuable to track over time. Implementation of RFID systems is expensive, so a pilot study will allow a facility to understand how RFID technology can meet the facility's overall goals and gather the information and data necessary to inform decisions regarding full implementation within the facility. Further, a pilot study that examines the effects of RFID implementation in several housing units may allow a facility to understand how differences in housing units' design and construction, wave transmission characteristics, lines of sight, and other important characteristics may affect inmate monitoring via RFID. In the case of DC DOC, funding for the full RFID system was available within a given period of time, so the department felt that it had to move forward with full implementation. However, interviewees recognized that, ideally, one would undertake a pilot study to first test and fine-tune the system, outcome measures, and procedures to optimize the benefits of the RFID system in a correctional setting.

Conclusions

An RFID system appears to hold promise as a valuable correctional tool for ensuring that a prison or jail population is both safely and appropriately managed and in contributing to the improved safety of the correctional staff and inmates. However, as with any new technology, there are factors that need to be considered in making the decision whether to invest in an RFID system and how it will fit into the overall processes and procedures of an institution.

The lessons identified in this report are informative as to the types of issues that a correctional facility may want to consider in contemplating the use of an RFID system within its institution. Because the experience of correctional institutions with RFID is still fairly limited, the detailed case study represents one large correctional facility's experience to date. While its scope is narrow, it contributes new information and insights on issues to consider in the conceptualization, design, and implementation of an RFID system in a correctional setting. Clearly, more independent assessments of RFID systems' impacts are needed to fully assess the promise and limitations of this technology in correctional settings. Unfortunately, as we have discussed in detail elsewhere (Hickman, Eisman, and Davis, 2008), outcome evaluations of this technology will be very challenging to conduct and require data collection over lengthy periods of RFID operation. Thus, it seems likely that individual jurisdictions will need to proceed in making decisions about acquiring active RFID without the benefit of objective analysis for some years into the future.

In the meantime, the National Institute of Justice's NLECTC (or some other national corrections organization) could potentially assist the field by facilitating discussions among representatives of facilities that have already acquired the technology and those interested in exploring it. These discussions could take the form of webinars, discussion forums, or conference presentations. It seems that interested jurisdictions are doing this to some degree individually as they seek to explore the possibilities of acquiring this technology. A broader effort, such as a webinar, would be more efficient for jurisdictions with RFID to share their knowledge and experience with the field of corrections and could be archived to ensure accessibility to other jurisdictions that may become interested in the future.

Moreover, other resources could be made available, such as worksheets helping jurisdictions clarify their expectations for the technology's capability, checklists that direct them to the issues that need to be resolved before entering into an RFID system contract, a tool kit that might help them identify the level and type of staffing needed for each type of RFID deployment, and perhaps basic contracting boilerplate language (to ensure that critical issues are spelled out in the contract). The development of these sorts of tools would probably be a challenge, given that there is so little experience with the technology to date and it continues to evolve over time. By the same token, there appears to be enough experience accumulating in the field to allow at least the distillation of some orienting information and tips that could be of value to jurisdictions exploring the potential use of RFID in the field of corrections.

Without question, the technology is expensive to purchase, install, and operate. Thus, a critical question for many jurisdictions is whether it will ultimately prove to be cost-effective over the long run. Again, a reliable answer to this question depends on the availability of rigorous outcome evaluation data for generating reasonable cost-effectiveness estimates. At this early stage of use of RFID in the field, there is still too little experience with the actual function and impact of active RFID in correctional settings to even roughly approximate whether it can

ultimately produce cost savings over the long run for institutions in general or for institutions of specific types.

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