Mapping and Corrections: Management of Offenders with Geographic Information Systems

By Jaishankar Karuppannan

The availability of geographic information systems (GIS) and global positioning system (GPS) technologies to modern criminal justice agencies represents a quantum leap in operational management and strategic planning capabilities. With GIS and GPS, modern criminal justice agencies now have a new array of tools for combating crime and managing offenders (Blair, 2000). GIS technology is a relative newcomer to the field of criminal justice, having made its debut less than 10 years ago. However, the technology found a niche in crime prevention/reduction and criminal rehabilitation via crime analysis maps (Rose 1998). As applications of GIS have grown, corrections have begun to explore ways in which computer mapping can expand its analytical repertoire (Cadora, Swartz, and Stoe 2000). However, few applications of GIS have been identified for use in the corrections field (Rich, 1995; Harris, Huenke and O’Connell, 1998; O’Connell and Fleury, 1999).

In recent years, U.S. correctional institutions have begun exploring ways GIS can assist their daily operations. California is one of the first states to create a GIS dataset [a part of the database] for corrections. It is a part of the California Environmental Information Catalog, which is a Web-accessible database of environmental data and information resources for California. It was developed through a collaborative effort with the California Geographic Information Association, CERES, and the Federal Geographic Data Committee to encourage data sharing by providing an easy way to create and share descriptions of data resources. It contains information about the California prison location and youth correctional facilities locations, including addresses, name of the city and the number of prisoners. California adult correctional facilities were mapped using GIS to aid local planning departments by providing the data on prisons and prisoners (Teale GIS Solutions Group, 1997).

The Mapping in Corrections Initiative (1999) is a phenomenal effort taken by the U.S. Department of Justice’s Crime Mapping Research Center (CMRC) (presently, Mapping and Analysis for Public Safety) to promote the use of GIS for research and practice in community and institutional corrections. In order to develop a baseline understanding of current GIS use in corrections, the CMRC has conducted listserv queries, Web searches, and reviews of the available literature. In conjunction with these scanning activities, we felt it was important to meet in a structured but open setting to discuss with corrections officials and researchers the ways in which mapping can be useful to them. As a result, the Mapping in Corrections Resource Group was convened at the American Probation and Parole Association’s Summer Training Institute on August 22, 1999, at the Marriott Marquis Hotel in New York, New York. The purpose of that meeting was to explore the utility of computerized crime mapping applications for the fields of community and institutional corrections (CMRC, 1999).

Some examples of the utility of GIS for corrections identified by the Mapping in Corrections Initiative include:

- Identifying areas prone to inmate violence in institutional settings;
- Assigning probation and parole officers by geographic location;
- Directing probationers and parolees to services and treatment centers; and
- Making site selection decisions for the placement of new facilities within a community.

From tracking the concentration of probationers in a neighborhood to gang members in an institution, GIS can be a great benefit to the corrections community. Institutional corrections and community corrections are two distinct areas in which GIS can be used (Russo, 2001). There are more applications of GIS in
community corrections than in institutional corrections. This is mainly because of the problems related to coordinates, geo-coding (Geocoding is the process that assigns a latitude-longitude coordinate to an address. Once a latitude-longitude coordinate is assigned, the address can be displayed on a map or used in a spatial search) and specific location address of prison or any other correctional facility (TechBeat, 2002).

GIS AND INSTITUTIONAL CORRECTIONS

Mapping tools can help with prison management in numerous ways, including tracking disciplinary incidents, visitation patterns and medical information, managing gangs and escape threats, and identifying personal information about inmates (Hart, 2003). GIS helps correctional officials to determine potential sites for building prisons by examining complex, seemingly unrelated criteria such as demographic characteristics and displaying them all in a graphical, layered, spatial interface or map. It also helps them map inmate populations, fixtures, and equipment to provide for the safety of inmates by separating gang members, identifying high-risk or potentially violent inmates, and identifying hazardous locations in a prison. It reduces the potential for internal violence by providing better command and control. Criminal intelligence information, including photographs, fingerprints, and documents can be included in this interactive graphical interface. Intranet/Internet capability enables the information to be shared within and between institutions. GIS "live map" (a map which is updated frequently with the help of Global positioning systems, such as movement of persons or vehicles) functions, when combined with capabilities of location identification devices (GPS, personal inertial guidance, etc.), facilitate tracking the movement of high-risk inmates or at-risk personnel throughout any facility or area.

Mapping Institutional Settings

Mapping for institutional purposes deviates from traditional mapping efforts in which officers tell inmates, where they will live, where they will go and what activities they may participate in. However, GIS technology for institutions is not used just for delineating space; mapping can be used to provide a geographic reference for placing, tracking and serving offenders (Geerken 1999). According to Geerken (1999), the primary purpose of GIS is for operational, management and control efforts. As examples of possible use, Geerken cites tracking inmates through real-time monitoring, classifying and housing inmates in accordance with security level and identifying patterns and relationships related to security or immediate change.

Generally, mapping and GIS data are thought of as addresses and locations in a community, but they also can be locations in a building or an institution. For GIS to be useful in an institutional setting, a map of the facility must be created. Once a layout is established, data such as inmate demographics, gang affiliations, locations of assaults and attempted escapes can be incorporated and analyzed. Displaying these data spatially can lead to a better understanding of the events and incidents within a facility. For example, if there has been a recent series of inmate-on-inmate assaults, GIS can be used to spatially and temporarily analyze the incidents in an attempt to predict or prevent future assaults (Russo, 2001).

This type of analysis can be done by a new technology developed by the National Law Enforcement and Corrections Technology Center. Correctional Mapping, or CORMAP, is based on GIS principles that are modified for use by prisons and other multistory buildings. CORMAP can be customized by the user to display many types of information such as escape threats, disciplinary history, medical tracking, religious affiliations, disciplinary incidents, visitation patterns and other data that would be of use to institutional or central office personnel. CORMAP is still in the testing phase but in the near future, it will be tested in “live use” situations and will then be made available to interested correctional agencies (Donlin, 2001). CORMAP project has been met with great enthusiasm when information about it was presented at
conferences and workshops. Many correctional institutions around US have started testing CORMAP. It is expected that, once the CORMAP design is complete, it will be taken into the field as quickly as possible" (Techbeat, 2002). Technologies like CORMAP can also be used for displaying or analyzing spatial data in courts. This type of display is called forensic cartography (Harries 1999).

The South Carolina Research Authority is integrating digital blueprints of prison facilities with GIS technology in order to provide high-resolution mapping functionality in a correctional setting. According to its Web site (www.scra.org), its mapping software creates a digital model of a correctional facility and can be used in mission-critical functions such as geographic reference of high-risk inmates, density maps of inmate concentration with gang affiliation, inmate segregation required for medical purposes, availability and location of prison beds, correctional officer deployment and general resource management.

**Prison Location Analysis**

Almost everyone agrees that prisons must be built, but proper location of prisons is needed to facilitate the reach of correctional officers, police officials, and inmates’ relatives. Prison location analysis is a specialized application of GIS. However, even before the advent of GIS Location modeling has actually been in use. The basic approach involves mapping vacant and useable land as possible sites for building, then adding filters of exclusions (terrain, prohibited land uses, lack of utilities and lack of adequate transportation links) to identify the sites with the greatest potential for development. These sites can then be reviewed and prioritized with further map analysis or field investigation. Other location criterion could be the site's distance from communities supplying the majority of inmates. Prisons far from their feeder communities make visitation difficult and fragment families. Minimizing travel time may be a consideration not only for families, but also for corrections and the courts because transporting inmates to and from remote courts will increase travel time and cost. The accessibility of a prison to a court can be evaluated using the Arcview’s (a GIS Software) extension, Network Analyst (Harries, 1999). GIS also allows detailed maps to be prepared on such factors as jail costs per diem and cell availability. The U.S. Marshals Service is now using GIS to help determine the best locations for housing its 32,000 inmates in 1,500 jails across the country (Murray, 1999). In due course, it is expected that about 100,000 prisoners will be moved with the help of GIS. GIS has allowed people at the Marshals Services to do their jobs faster and more efficiently, even at the initial phase of the project. For example, users can click on a prison location and immediately pull up information about the number and identity of Marshals Service prisoners housed there, how long they have been there, how much it is costing, and how much, if any, space is available (MapInfo, 2000).

**Mapping Prison expansion**

Lawrence and Travis (2004) have highlighted the utility of GIS in mapping prison expansion both on national and county levels. They have developed 10 state-level maps showing the number of additional prisons over a 21-year period. They found that in some states, such as California, Florida and New York, prison expansion has been geographically clustered, while in other states, such as Missouri and Ohio, prisons have opened throughout the state. They also found a mismatch between the places inmates consider home and the places they serve their time. A series of maps illustrates large disparities between the sentencing counties and the counties of imprisonment. Further questions that look at changes within states at the county level were developed. Do certain counties within a state account for a disproportionate share of the prison expansion? How many prisons have been added to each county? What are the similarities and differences across these states in terms of prison expansion? (Lawrence and Travis, 2004).

**Contagious Diseases**
Corrections mapping can be useful in situations in which contagious diseases are a problem. An analyst can list an inmate’s previous cell mates (primary contacts), with whom those previous cellmates lived (secondary contacts), and with whom those people lived (tertiary contacts) as far back as records allow. Given a known source, mapping can trace the course of the disease through the prison system and provide information to prevent further contamination (TechBeat, 2002).

**GIS AND COMMUNITY CORRECTIONS**

GIS technology can be very useful in working with individuals under community corrections supervision. Probation and parole officers, as well as the communities they serve, can benefit greatly from streamlined assignments and the strategic placement of resources facilitated by using mapping technology. GIS use in parole and probation activities means providing analysis through client mapping. It allows an agency to provide better, more efficient workload distribution based on user-defined criteria. Automated routing can provide a best route solution for an officer making residence checks or performing related activities. This saves hours of preparation time each week, enabling the agency to reduce lead-time for route planning and to monitor the cost per visit, including fleet costs (ESRI, 2004). In community corrections, mapping technology can be used to examine the residential locations of parolees in an effort to more efficiently allocate or assign correctional and social services. Furthermore, the same methodology can be useful for examining parole officer safety by estimating the number of officers who should be assigned to visit specific types of clients and/or places (Dine, 1997).

**Monitoring Probationers and Parolees**

Using GIS, an administrator can create a map that indicates where offenders live and assign cases based on location. Many benefits can result from assigning caseloads geographically. One such benefit is that a probation officer does not have to travel across the city or town to conduct home visits given that his or her entire caseload would reside in the same general area. In addition, many GIS software packages can plan the most efficient route to perform these visits (Russo, 2001). Caseload distributions can be managed by looking at the geographic location of probationers and parolees, and then using a mapping program, such as the *Arc View Network analyst*, to determine the most efficient route for sequencing visits to homes, should visits be part of the designated probation officer’s duties. If visits to individuals have to be made at specific times, a route can be designed to minimize time spent traveling from one address to the next. If time is not a factor, a route to minimize overall travel time can be determined (Harries, 1999).

With the development of community probation, officers are now more likely to be assigned to small community areas so that they have closer contact with probationers and community resources, including police. A program, such as *MapInfo Redistrictor*, could be used to draw (and periodically re-draw districts based on the distribution of caseloads. Similarly, districts could be drawn to evenly distribute workloads for serving warrants. Other applications in the field of probation could include mapping dangerous areas where probation officers should be accompanied by a police officer or mapping areas that probationers avoid (Harries 1999).
A Cleveland-based pilot study conducted by Alec Boros, project manager and graduate student in criminal analysis at Kent State University, Hudson, Ohio is demonstrating the benefits of assigning probation officers to parolees based on proximity to their homes. Services are more readily available for offenders because they do not have to travel outside their neighborhoods to meet with assigned officers. Additionally, proximity to employment, social services offices, schools and drug/alcohol rehabilitation centers are conducive to parolees’ rehabilitation (Rose, 1998). Another benefit is that probation officers can become much more familiar with the areas where their clients live because they only need to focus on that particular portion of the jurisdiction. This allows the probation officer more opportunities to understand the offender's environment, become more involved with local treatment providers, and develop closer, more collaborative relationships with local police departments. Focusing on a limited area also can enhance probation officers' enforcement role because they are more visible in the community (Russo, 2001).

Mixdorf’s (1999) work in applying mapping for probation in Wisconsin is one of the pioneering efforts in the United States. Harris (1999) mapped probationers according to zip code. The mapping of home addresses of parolees and probationers, along with their modus operandi (of their criminal act) data, enables police to quickly identify a local parolee as a potential perpetrator of particular crimes occurring in a neighborhood. This type of analysis is an integral part of the increasingly popular Comp stat (computerized statistics) process that originated with the New York Police Department in which police officers are questioned regularly about crime patterns in their areas. A big-screen monitor linked to a GIS can immediately show parolee locations in conjunction with crime locations. Recidivism could also be mapped to identify hot spots and mobilize resources necessary to deal with the issue (Harries, 1999).

Since probationers have tended to change addresses frequently, the mapping system's address verification function has helped probation officers of various states maintain contact with their clients. A map displaying probationers’ addresses with overlays showing potential risk areas (e.g., schools, high-crime areas) and service providers (e.g., employment training and drug treatment facilities) also has been helpful. Finally, supervisors have used the mapping package to manage probation officers' workloads by producing maps showing the locations of each probation officer's clients, color-coded by the required level of supervision (i.e., minimum, regular or intensive) (Rich, 1995).

Continuous monitoring of the location of the probationers can be done through GPS, which is a navigation tool that allows users to determine their location anywhere in the world at any time of the day. GPS systems use a network of 24 satellites to establish the position of individual users (Boesch, 2002). The cost of the receivers of the GPS system, although decreasing, is certainly a factor, because it will be difficult for any correctional program to provide individual receivers to every correctional official. However, Electronic ankle bracelets can be used to monitor probationers; typically, these devices will trigger a telephone call to the probation officer when the probationer moves more than a specified distance from a location. Such devices could, in theory, also be used to detect violations of restraining orders or other special conditions of probation or parole such as keeping a certain distance away from schools or child care facilities (Rich, 1995).

The Florida Department of Corrections is using GPS technology developed by Pro-Tech Monitoring Inc., to monitor parolees. The Satellite Monitoring and Remote Tracking (SMART) system incorporates Trimble Navigation Ltd.’s GPS board with an electronic tracking device into a 3.5-ounce ankle bracelet worn by offenders. SMART continuously tracks offenders wherever they are, a considerable improvement over conventional house arrest anklets, which set off an alarm only when the offender breaks the rules by leaving home during restricted hours. The system sends GPS location data to a central office, where the information is displayed on a digital map that is programmed with the offender's specified rules of release. SMART sends officers a message if the release rules are violated and a warning signal to the offender (Rose, 1998).
An additional way of mapping in community corrections is by using it to track probationers in terms of risk and need. The National Institute of Justice mapping in corrections resource group meeting (1999) highlighted the importance of tracking probationers in terms of their degree of risk and need for resources (Webb and Grobe, 1999). Mapping can also be useful to monitor offender’s patterns. Patterns of offender residences may inform and alter probation officer supervision practices.

**Halfway House Locations**

Much like prisons or groups for mentally disabled people, halfway houses are important in the process of rehabilitating inmates. Mapping demographics and housing types may help with site selection. In an example cited by Westerfield (1999), a Baltimore community needed to be persuaded that halfway houses were appropriate in its neighborhoods. The strategy developed involved geo-coding the home locations of all Maryland prison inmates originally from the community in question. Maps then showed where each inmate had lived. During community presentations, it became increasingly difficult for residents to oppose receiving people who originally resided in their neighborhoods (Harries, 1999).

However, publicity about the high number of escapes from halfway houses in some jurisdictions compounds the difficulty of establishing such facilities. One solution is to seek a zoning variance to permit residential facilities in what are otherwise industrial or commercial areas. Presumably, this is a last resort. A cynical solution suggests that poor, dysfunctional communities are likely to be incapable of mobilizing themselves politically, making the placement of halfway houses relatively free of opposition (Harries, 1999).

**Corrections Mapping and Community Justice**

In 1998, the Center for Alternative Sentencing and Employment Services established a new community mapping program, the Community Justice Project, that brought together three kinds of information about a neighborhood: locations and characteristics of crime and offenders; measures of neighborhood well-being, such as employment rates; and community assets, such as nonprofit services. The Community Justice Project employs community mapping to assess the correctional resources devoted to managing offenders on a block-by-block basis for any given neighborhood, help correctional administrators rethink their investment policies, and work with community constituents to plan more strategic, neighborhood-based correctional programs (Cadora et al., 2000). Specifically, the maps prepared by this project looked at numbers of available prison beds, proportions of males sentenced to prison in certain neighborhoods, densities of correctional facility admissions by block, and expenditure estimates. One example demonstrated the relationship between inmates’ residences and the allocation of corrections funding—the differences in this seemingly important relationship were striking. It was easy to see how this type of mapping for community justice would be informative and instructive for communities, local organizations, businesses, and decision-makers. The project aims to spur partnerships that are locally focused and target the community as a whole (Cadora and Clear, 1999.)

**Offender Mapping and Offender Access to Services**

Webb and Grobe’s research funded under a National Institute of Justice grant, is based on building a common offender-event database, which can be used for operational and strategic purposes. Using linked police and probation databases, GIS applications were used to promote problem solving and to evaluate the use and impact of joint problem solving in reducing burglaries. A potential application revealed by Dine (1997) concerns examining the neighborhood characteristics of the residences of offenders. Since
most offenders come from high-crime areas, mapping could help in anticipating the impacts of requiring parolees to reside in different, presumably less criminogenic, neighborhoods.

A Delaware study (Harris, et al., 1998) analyzed the availability of rehabilitative services for released offenders, looking at the spatial relationship among former inmate addresses, substance abuse treatment facilities, social service centers, mental health services, and unemployment offices. Nearly half of all released inmates in Delaware return to prison within three years, leading to the conclusion that post-prison rehabilitation services are inadequate, or at least inaccessible. Maps were used to justify the implementation of drug rehabilitation services in Kent County and the city of Dover (Harries, 1999).

Mapping has the potential to maximize opportunities for success: It can identify areas where offenders would be most successful at re-entry. Specifically, areas such as employment, treatment, and other critical services would be easily accessible to the parolee or probationer (Mixdorf, 1999).

**Offender Re-entry Mapping:**
The North Lawndale neighborhood and the University of Illinois-Chicago City Design Center collaborated to develop a mapping framework using GIS to map of social service density and social networks (e.g., neighborhood centers, churches). These collaborative efforts were utilized in the project on transition of a sample of African American from prison to an urban community in Chicago. The African American women who were over the age of 18 years, and reside in the North Lawndale neighborhood, and convicted of a drug offense or report using marijuana, cocaine or heroin and released from prison in the last three months were taken as samples and they were analyzed. The University of Illinois-Chicago City Design Center will be assisting with mapping density and proximity of social service agencies, treatment facilities, and informal resources such as thrift stores, food pantries, and churches (O'Brien and Lurigio, 2004). The Re-entry Mapping Network is an initiative of the Urban Institute in using GIS for mapping offender re-entry. Launched through the support of a planning grant provided by the Annie E. Casey Foundation, the Re-entry Mapping Network is a partnership between community-based organizations and the Urban Institute designed to create community change through mapping and analyzing neighborhood-level data related to re-entry and community well being. Partners use mapping to pinpoint neighborhoods that experience high concentrations of returning offenders and examine the extent to which such communities are equipped to address the challenges that inmate re-entry creates. Network partners then use the analytical findings from data that they collect to help mobilize community members and leaders to devise targeted responses to effectively address re-entry-related problems (Urban Institute, 2004).

**The Future of GIS in Corrections**
In the new millennium, GIS is finding applications in various fields. The criminal justice field though started late in using GIS have taken strides. In future, GIS applications in the field of corrections will become imminent.

According to a 2002 article in *TechBeat*, proponents foresee a time when GIS technology can be used to:

- Track and display inmate location and movement via electronic monitoring devices;
- Indicate whether a housing unit is balanced with regard to religion, group affiliation, age, race and ethnicity;
- Pinpoint the locations of gang members and link them to each inmate’s behavioral and criminal history, as well as the inmate’s rank in the hierarchy of the group. (This would allow for segregation or lockdowns as necessary, which is especially important because committing violent acts is how an inmate moves up in the rank structure of certain groups);
Pinpoint areas in a facility that are potentially dangerous such as hallways or blind corners where a number of assaults have occurred. (Identifying those areas might lead administrators to put additional officers in the area, increase the lighting or reroute foot traffic);

Incorporate aerial photos of the facility to check for possible security breaches and potential escape routes;

Provide a basis for proactive investigation and enforcement. (For example, mapping the flow of money in and out of a facility and then linking this information with data about visitation, telephone calls and corresponding addresses could show a potential drug problem); and

Link inmate data with the names, telephone numbers, and addresses of all the people the inmate had contact with during incarceration, in case of an escape.

**GIS: A Valuable Correctional Tool**

The increasing use of technology is an important aspect in addressing the needs of law enforcement and corrections communities. New technologies have also proved helpful in reducing costs and improving the effective management of facilities. Technologies like GIS and GPS can make prisons and jails safer for both corrections professionals and inmates (Hart, 2003). GIS technology is progressively accepted as a valuable tool for criminal justice organizations around the world, especially in the United States, United Kingdom, and Australia. Rapid developments in computer technology, resulting in reduced costs of GIS, have only increased the recent appeal of this technology to corrections. GIS applications in the United States have taken their roots. Now, correctional institutions of other countries should take their strides in GIS application. To achieve this, nodal agencies such as MAPS, NLECTC should be initiated in the developed and developing counties to implement and manage GIS in correctional institutions.

**REFERENCES**


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