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GEOSPATIAL MONITORING OF COMMUNITY-RELEASED OFFENDERS:

AN ANALYTICS MARKET SURVEY

Version 2.0

Harold I. Heaton

Prepared for:
The National Institute of Justice

NIJ | National Institute of Justice

STRENGTHEN SCIENCE. ADVANCE JUSTICE.

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EXECUTIVE SUMMARY

With the growing need for deriving actionable information from the burgeoning volume of offender tracking data, it is becoming progressively more essential to leverage analytics to enable Probation and Parole Officers to help manage their caseloads. This report summarizes information gathered from the responses provided by six companies to a Request for Information issued by the National Institute of Justice regarding the analytics features of their commercially available offender-tracking software. It also describes some of the capabilities of a seventh vendor's product, which were derived by synthesizing information from its Web site and insights provided by correctional departments that use that firm's services. These businesses include companies that currently provide integrated offender-monitoring services to correctional customers (BI Incorporated, Satellite Tracking of People, Track Group, 3M), an industry leader in big data predictive analytics (SAS Institute, Inc.), and vendors interested in adapting current products to community corrections that have been applied successfully to criminal justice and other applications (FMS, Uncharted Software). As such, it comprises a near-term resource for assisting correctional agencies that may be considering establishing or upgrading an analytics capability in support of their location-based monitoring mission prior to making purchasing decisions.

The report is structured topically to summarize and compare the analytics capabilities of these products in each of seven areas, and a separate chapter is devoted to each topic: (1) Demographic information for the company and point-of-contact; (2) Product purpose and installation; (3) Performance characteristics and validation approach; (4) Analyses performed by the product; (5) Data formatting and information exchange; (6) Requirements for host-agency computing systems; and (7) Operator/analyst education and training requirements.

Subsequently, an initial view of end-user needs is captured based on information provided by a small sample of state and county-level correctional departments comprising the California Department of Corrections and Rehabilitation; Oklahoma, Michigan, and Colorado Departments of Corrections; Maryland Department of Public Safety and Correctional Services; and Pretrial Services, City and County of Denver. These agencies also offered their current views on the most significant roles that analytics could play in enabling the effectiveness of each organization's mission. The departments selected and the questions posed regarding the analytics currently in use were not chosen to provide statistically meaningful results, but the knowledge acquired helped guide interpretations of the vendor responses.

Although the analytics capabilities of offender monitoring products do not appear to have been a strong motivator for vendor selection to date, analytical tools comprising various combinations of statistical analysis procedures (including crime scene analysis), data and text mining, social network analysis, and predictive modeling can enable the discovery of hidden behavioral patterns and the prediction of future outcomes. As analysis technology progresses and becomes more user friendly, the correctional agencies queried during this study indicated that analytics would become more of a consideration in any replacement systems that are contemplated in the future.

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1. INTRODUCTION

Various forms of electronic monitoring have been applied to community corrections for several decades, but the use of Global Positioning System (GPS)-based tracking has become much more widespread during the last 15 years following the military's decision to relax system-accuracy restrictions. As a result, many jurisdictions received directives to implement that approach as a condition for client release. GPS systems provide information for monitoring compliance with pre-trial release curfews and verifying that probation and parole conditions are being met, but they also generate a plethora of data. Without analytical aids to interpret those data, supervising agents can quickly become overwhelmed and unable to take advantage of these tools as they manage their daily caseloads. During the last decade, the National Institute of Justice (NIJ) has funded development of several geospatial software tools to address these issues for the law enforcement (LE) community; however, very few of them have been commercialized (Reference [1]) or applied to community corrections.

This report seeks to identify commercially available products that are suitable for use by correctional departments and agencies in deriving actionable information from GPS-based offender tracking systems as an aid to managing their offender populations[1]. Although the analytics capabilities of offender monitoring products do not appear to have been a strong motivator for vendor selection to date, analytical tools comprising various combinations of statistical analysis procedures, data and text mining, and predictive modeling can enable the discovery of hidden behavioral patterns and the prediction of future outcomes. Customizable dashboards (i.e., user-interfaces) that capture the most significant results will provide easily understandable information to a wide variety of professionals, allowing command staff, Probation and Parole Officers (PPOs), and crime analysts to view relevant content permitted by their roles, permissions, and information technology devices.

To assist correctional departments that may be considering procuring new or replacement analytics-enabled offender tracking systems in their assessments of relevant information, NIJ recently released a Request for Information (RFI) in the Federal Register in support of a new "Market Survey of Offender Monitoring Analytics (OMA) Technologies." This document noted, "whether an agency faces a mandate to monitor the habits of offenders released into the community, institute proactive policing by performing crime-scene correlation, or to more effectively allocate resources based on real-time planning, OMA technologies can provide cost-effective tools for quickly extracting actionable knowledge…" (Reference [2]).

The National Criminal Justice Technology Research, Test and Evaluation (RT&E) Center interpreted the responses to this request that were received from six companies. The analytics capabilities of a seventh vendor's product were synthesized from information on its Web site and insights provided by correctional departments that currently use their services. In addition, an eighth vendor provided a brief description of their offender (case) management software that is

[1] Although most offender tracking systems on the market today incorporate multiple location-sensing technologies [e.g., cell-tower trilateration, wireless local area networks (WiFi) or other Global Navigational Satellite Systems], the focus of this report was on interpreting the data provided by GPS-based systems. Nevertheless, the analytics capabilities identified should have wide applicability to deriving information from these enhanced systems.

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used by several state-level departments of corrections, which can be interfaced with the GPS-enabled tracking products. These vendors comprise companies that currently provide integrated offender-monitoring services to correctional customers, an industry leader in big-data predictive analytics, and businesses interested in adapting or applying current stand-alone products that have been successfully used for law enforcement and intelligence applications to the field of correctional analytics.

The information contained in this report was provided directly by these companies and it is offered solely to assist correctional departments and agencies in their evaluations of products that may meet their analytically oriented needs. However, systems evolve over time, capabilities change, and new products can appear in the marketplace. Accordingly, before making a procurement decision based on information included in this report, agencies should contact companies offering products that interest them to discuss their needs, determine whether any changes have occurred in product characteristics, and to verify pricing.

1.1 Prior Survey of NIJ-funded Geospatial Software Tools

Although this report focuses on the analytic capabilities of commercially available products, the potential impact of several geospatial software tools developed under NIJ sponsorship over the past decade was initially reviewed, based on a recent report by the RAND Corporation. RAND worked with NIJ to identify a set of 14 tools for inclusion in their assessment (Reference [1], see Summary Tables S.1 and S.2), which gauged whether those tools delivered new or improved capabilities for crime analysis, and how the capabilities offered were unique or different from similar systems.

RAND's report provides a technical description of each of these 14 geospatial software tools and the environment in which it operates. Each description includes a summary of the analytics performed by the tool, compatible data formats, requisite third-party software, and host-agency computer system and training requirements. An operational assessment of each tool is also provided, which characterizes its current and potential utility, and identifies end-users when possible. While the authors found that 12 of these 14 tools performed their intended function, none of them had been commercialized as of 2012 and only one of the developers was considering pursuing that approach.[2] The paucity of interoperable LE systems was identified by developers as a key barrier to commercialization because that meant that the tools often had to be tailored to individual agencies.

The RAND study recognized that these analytical engines provide "… access to new and enhanced geospatial capabilities to improve crime analysis," but made no comparisons between the actual capabilities of these developments and (then) existing commercial products. Furthermore, "there is no established source … for the law enforcement community to learn about the existence of geospatial software tools developed with NIJ funding…" (Reference [1]). Although RAND's report does not address corrections applications, a similar need exists to provide a reliable source of information on commercially available analytics products for use in monitoring offenders released into the community. The results presented herein from the Market

[2] Four of the other tools were available as of that time in the public domain.

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Survey provide an initial reference for that purpose, and its design benefited from the approach adopted by the cited RAND study.

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2. DESIGN AND PURPOSE OF THE COMMERCIAL MARKET SURVEY

The analytics market survey was organized to address seven categories of information:

- Name, address, and contact information for the company and point of contact (POC)
- Product purpose and installation information
- Performance characteristics and validation approach
- Analyses performed by the product
- Data formatting and information exchange information
- Requirements for host-agency computing systems
- Operator/analyst education and training requirements

Those broad categories were selected to inform the report's intended customers, which are procurement officials and technologists considering upgrading their current systems or implementing electronic monitoring for the first time. The market survey's design anticipates the types of information those officials would find useful as they conduct further needs-based assessments of these products.

Although the analytics-related topics included in the RFI were based in part on the categories explored by the RAND report, they also benefited from a 2012 white paper by the Standards, Methods and Technology Committee of the International Association of Crime Analysts (IACA). Considerable commonality exists among the analytical methodologies and technologies used in location-based correctional monitoring and those defined by that paper for crime analysis (Reference [3]). For example, as part of those efforts, the IACA committee addressed the LE requirements for crime analysis mapping software, outlined the necessary functionality of geographic information systems (GIS) for that application, and identified the (then) current state-of-the-art.

The notional architecture adopted by that IACA paper comprises both Data Processing and Crime Mapping & Analysis subsystems. The processing subsystem section discusses 11 recommendations germane to its three constituent Processes (Creating and Maintaining Map Layers, Updating Geocoded Files, and Downloading and Processing External Data). The mapping and analysis subsystem portion discusses eight additional recommendations pertaining to three additional Processes (Producing Regular Maps, Making Ad-Hoc Queries/Maps, and Conducting Advanced Analytics). While these recommendations and some of the particular analytical methodologies and mapping technologies used by crime- and community-corrections analysts might differ, inclusion of these topical areas in the RFI provided the opportunity to solicit corrections-specific information from offender-monitoring analytics vendors in these crucial categories.

The paper notes that a wide variety of advanced analytics tools are becoming available to crime analysts, citing examples such as time series analysis of crime trends and seasonality; crime-risk

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surface analysis (i.e., risk terrain modeling[3]); cluster analysis for data mining; hot spot methods including kernel density smoothing[4] and significance testing; and crime detection and forecasting methods. Nevertheless, since that white paper focuses on the core GIS software itself, most of these techniques are not considered further. Instead, it offers recommendations on only two of them that the committee felt should be expected of core GIS software: Density surface functionality and temporal animation.

The IACA paper concludes that "GIS should not be viewed as just a tool, but should be an integrated component of an agency's mission and daily operations," which is able to connect with the agency's Records Management System and allow analysts to share data with LE partners. As was the case in the RAND study, this paper also does not directly address corrections or community monitoring.

2.1 Preliminary Identification of Candidate Vendors

The RFI for this market survey that was released in the Federal Register provided the opportunity for any company to respond to NIJ's information needs regarding analytical products capable of deriving actionable knowledge from the GPS data obtained from community-released offenders. Both the American Probation and Parole Association (APPA, Reference [5]) and the American Correctional Association (Reference [6]) announced the publication of that RFI to their membership. The RT&E Center also identified and directly contacted nineteen companies that had come to our attention to gauge their willingness to participate in the current evaluation[5]. Thirteen responded positively, and most were provided with the final draft of the Federal Register Notice (FRN) in advance to guide their replies. In a few cases, companies were contacted after release of the FRN, and they received a copy of the publication.

Several approaches were used to identify companies for potential consideration when directly soliciting participants. After initially performing a Web-search that included the sites maintained by the IACA and the National Law Enforcement and Corrections Technology Center (NLECTC), the RT&E Center contacted the APPA, NLECTC, several state and county-level corrections departments, a former corrections officer at NIJ, and former law enforcement professionals within the Center itself. The APPA was also asked if they maintain a listing of vendors that offer offender-monitoring analytics products, or knew of any studies similar to the Center's market survey that were conducted in the recent past. The Association's Deputy Director indicated that the vendors they have contact with are the corporate members listed on their Web site (http://www.appa-net.org/eweb/DynamicPage.aspx?WebCode=IC_Corporate),

[3] Risk Terrain Modeling "is an approach to risk assessment whereby separate map layers representing the spatial influence of features of a landscape are created in a geographic information system … (that) are combined to produce a composite 'risk terrain' map." Values are assigned that account for the spatial influences of all features at every place throughout the landscape, which represent the compounded risk of that place (Reference [4]).

[4] Kernel density estimation is a data smoothing method for estimating the probability density function of a random variable, where inferences are made about the underlying population based on a finite data sample.

[5] Several additional companies have been identified since completion of the analytical phase of this market survey, which offer GPS-based offender monitoring products that may include analytics (e.g., Corrisoft, G4S, SuperCom, Ltd., SCRAM Systems). Although these companies were not contacted directly, each had the opportunity to respond to the RFI published in the Federal Register. However, products or product capabilities focused on remote alcohol monitoring were explicitly excluded from consideration at the outset, and were not pursued separately [e.g., SCRAM GPS Analytics™, https://www.scramsystems.com/products/scram-gps (accessed 6 Oct 2016)].

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many of which are involved in electronic monitoring (Reference [5]). This led to the identification of an additional company that was subsequently contacted, but no previous studies were mentioned. The former Director of the Community Corrections Center of Excellence at NLECTC was also contacted to determine whether he was aware of any previous market surveys that focused on location-based analytics. He responded negatively, and noted that if any had been conducted, they would probably have been directed to the larger law enforcement and/or (more likely) intelligence communities (Reference [7]).

The IACA Resource Center (Reference [8]) hosts a chronologically ordered listing of software product announcements relevant to crime analysis, which are posted by industry. While this site does not specifically address corrections and many of these entries are several years old, a subset of these companies were contacted to inquire about their product's relevance to corrections analytics. In addition, SCRA Applied Technologies has published a brief assessment of the number of online crime mapping companies[6] as of 2010 (Reference [9]). Although that report found only seven companies, it summarized the basic functions and services they provide, the accuracy to which their mapping tools reproduce local crime data from participating agencies, how they upload and validate data, how they secure archived data, and the analytical functions they provide.

While neither of these references directly addressed corrections applications, each was instrumental in identifying companies to be contacted in the context of this market survey's RFI and in suggesting categories of information to solicit in the Federal Register Notice. The SCRA report also indicated that the crime-mapping industry was entering a new stage where cloud computing and data-sharing were enabling crime mapping to evolve from desktop to online and mobile platforms. It surmised that the use of mobile platforms such as iOS and Android would permit officers to gather crime data in real time, avoiding the cost and delay of geo-coding. The types of analysis products offered varied among the seven companies considered in the SCRA study, but they were very basic. Only two vendors provided trend analyses and chart creation, and one offered density analyses (i.e., heat maps).

2.2 Commercial Vendors Contacted

The 19 vendors that were initially contacted, those that indicated a desire to receive a copy of the RFI from the RT&E Center, and those that subsequently provided information, are shown below[7]:

- Companies that responded to the RFI:
  - BI Incorporated, a GEO Group Company*
  - Satellite Tracking of People LLC*
  - Track Group*
  - SAS Institute, Inc.*

[6] An online mapping company is one that provides crime data arising from multiple geographic locations (rather than from a single local agency) to be viewed on a single site.
[7] The symbol * indicates that a pre-release version of the RFI was provided, which was followed by a post-release copy of the actual publication; use of ** indicates that only a post-release copy was sent.

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  - Uncharted Software (Canada)**
  - FMS Advanced Systems Group, FMS, Inc.*

- Companies that did not respond:
  - 3M Electronic Monitoring, Inc.*
  - LexisNexis Risk Solutions/Bair Analytics*
  - IBM Software Solutions/i2**
  - Numerex/Omnilink Systems, Inc.*
  - Buddi LLC
  - Marquis Software*
  - Geosatis Technology S.A. (Switzerland)
  - GeoSpatial Technologies, Inc.
  - Information Builders*
  - Sentient Information Systems BV (Netherlands)**
  - ESRI, Inc.
  - Palantir Technologies
  - Ned Levine and Associates

Only three of the initially contacted companies that chose not to respond to the RFI explained their reasoning: 3M Electronic Monitoring, Information Builders, and Ned Levine and Associates. 3M indicated that "[a]s we wish to maintain the security of these ground breaking technologies and ensure that confidential and highly sensitive information is not made publicly available, … our preferred course of action is for offender monitoring agencies to contact 3M Electronic Monitoring directly …." (Reference [10]). Information Builders noted that their product was more focused on predictive policing than on community monitoring and recidivism (Reference [11]), and that it does not meet the requirements of the Center's underlying application. The "product" developed by Ned Levine and Associates (CrimeStat IV, Ver. 4.02) focuses on the analysis of crime incident locations. It was developed under funding from NIJ and is available at no cost from NIJ's Web site (http://www.nij.gov/CrimeStat). As such, it is not available commercially.

2.3 Responses to the Market Survey

Six vendors that either provide or are interested in providing location-based offender monitoring analytics products/services to the corrections community responded to the RFI published in the Federal Register (see Table 2–1)[8]. In addition, the capabilities of a seventh vendor that already supports the community (but did not respond) were synthesized from information on its Web site

[8] The analytics product information received from vendors in response to the RFI came solely from companies that were contacted. The only additional correspondence received was a comment on the scope of the market survey from an attorney in Oregon.

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(Reference [12]) and information provided by two state-level departments of corrections. While the latter does not necessarily represent the most current or the full set of that company's analytics capabilities, it provides a basis for further evaluation by interested departments. Some of these solutions are part of integrated monitoring systems and some represent stand-alone analytics engines.

Table 2–1. Companies Offering Analytics Products Described In This Report

Vendor*	Location	Product	Years in Analytics Business***
SAS Institute	Cary, NC	SAS Targeting Framework	~40
FMS Advanced Systems Group	Vienna, VA	Sentinel Visualizer, Ver. 7	~10
Track Group	Romeoville, IL	INTELLITRACK, Ver. 1	6
Satellite Tracking of People	Houston, TX	VeriTracks, Ver. 11	11
BI Incorporated	Boulder, CO	BI Analytics: Risk-based Dashboard Analytics Suite	30
Uncharted Software	Toronto, ON**	GeoTime, Ver. 5.6	8
3M Electronic Monitoring	Odessa, FL	EM Manager	~20

* Contact and dates of information are provided in the reference list under References [10], [13]–[18].

** Information was provided by Uncharted Software's local office in Arlington, VA.

*** In some cases, the amount of time involved in corrections and/or offender monitoring is less.

While no other vendors provided responses that directly addressed the information categories included in the RFI, a few additional companies provided brief perspectives of their company's capabilities in the wider area of community monitoring. For example, Marquis Software noted that their eOMIS (electronic Offender Management Information System) offers three applications, including Community Supervision, which can be implemented as a single integrated system or used as standalone applications. Its Community Supervision application is used by six state-level correctional departments that include Florida and California. The Colorado Department of Corrections recently "chose Marquis to provide them with a Community Supervision Case Management Tool. … GIS-enabled mapping allow[s] Parole/Probation Officers the ability to efficiently monitor and manage offenders using mobile devices," and supervisors to "[v]isually analyze each PO's work load, [m]ap concentration of sex offenders/gang activity, (and) [a]nalyze current crime based on location of Offenders." Marquis' product is also "interfaced with GPS enabled tracking companies, such as, STOP and 3M," providing a "one stop shop for Case Management, Electronic Monitoring, and Data Analytics" (Reference [19]).

After acquiring demographic information about the six companies that responded and their respective points-of-contact, the RFI was structured to obtain data on product characteristics, capabilities, usage, and implementation and training requirements. The responses from each of

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the vendors are summarized below in separate chapters that address each of these categories. Each chapter concludes with an abbreviated tabular comparison of the information provided across all six of the companies. A separate spreadsheet was provided to NIJ that comprises a more complete aggregation of those data as well as the capabilities inferred in some cases for 3M Electronic Monitoring's product.

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3. PRODUCT PURPOSE AND INSTALLATION INFORMATION

This section summarizes the information received on the purpose and installation options for the analytics products identified by each of the six companies that responded to the RFI. It also briefly describes the general purpose of 3M Electronic Monitoring's product based on that vendor's Web site. In the first six cases, these summaries were prepared by integrating a lightly edited version of the individual text segments provided by the identified company in this category. The product purpose and installation responses are compared in Table 3–1.

3.1 SAS Targeting Framework

The SAS Targeting Framework is a product available from the SAS Institute that was designed for monitoring and targeting criminal activity for law enforcement. In adapting this product for offender monitoring purposes, SAS would employ a network solution augmented by a set of analytic clients that could operate in a stand-alone mode if required. No additional (i.e., tethered) software packages would be required to implement this framework. SAS indicated that its solutions match well the demands of cloud computing, and the company continues to invest in cloud technologies through "new cloud offerings, cloud enablement of existing offerings, partnerships with cloud providers and global expansion of SAS Cloud Analytics."[9]

The ability to customize the product for specific use cases permits several deployment options to be offered. If corrections officials prefer to avoid transmitting data outside of their processing environment due to security or other concerns, SAS can support a customer-hosted option. In that event, the customer would provide the necessary hardware and SAS would install the analytics software at that site. Alternatively, customers could choose a SAS-hosted model, with the complete environment hosted through SAS Solutions OnDemand using secure FTP transmission of all relevant data. A hybrid-hosting model could also be specified, whereby the software is installed at the correctional agency's site. In that case, SAS would maintain a development environment for customizing models using a subset of the data held at the corrections site.

The time required to install the network solution would vary according to "the number of data sources, users, and security configuration requirements. For full development, test and production network installation periods are one-to-two weeks typically but can be shorter or longer depending on customer requirements. SAS typically incorporates a phased implementation approach for delivering capabilities to end-users and analysts depending on the needs and priorities of the customer." The core analytic features can be in place in as little as 30 days with implementation phases occurring over longer intervals depending on the nature and complexity of the customer environment and customization requests.

Licensing requirements and costs depend on the customer's use case(s), desired infrastructure and the number of users. Specific numbers were not provided by the company. Although SAS warrants its software as set forth in the Master License Agreement that purchasers sign, it does

[9] Unless otherwise indicated, all quotes in each subsection of Sections 3-6 come from the RFI response provided by the company whose product is being described. The appropriate citation appears at the end of each subsection.

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not warrant the "systems" installed at customer sites due to variations, from customer to customer, over which SAS has no control. The warranties for current releases of the software remain in effect for as long as the customer maintains its license, for a cost that is included in the annual renewal licensing fee.

Solution upgrades typically occur on a six-month release cycle, but new releases can be obtained when requested as long as the customer's license is current. SAS offers annual support if desired, which provides for "24/7 customer support for issues and problems regarding SAS Software, access to online knowledge bases and software upgrades and bug fixes. Support is included for the first year but typically runs between 25%-28% of the first year fee in recurring years" (Reference [16]).

3.2 Sentinel Visualizer, Ver. 7

The FMS Advanced Systems Group's Sentinel Visualizer (Ver. 7) is designed to discover connections, relationships, and patterns within sets of structured data. The intended market comprises investigative organizations such as the FBI, Departments of Justice and Homeland Security, and police departments. The vendor's response did not indicate that it has been used for community corrections applications to date. The company offers potential customers the ability to purchase a perpetual license as well as to enter into a subscription arrangement for Software-as-a-Service. Three installation options are available, which respectively utilize a single user's local hard drive, a multi-user database residing on a shared Microsoft SQL Server network or cloud-based computing using Microsoft SQL Azure.

The time required to install the product is estimated to be approximately five minutes. For the Standard or Professional single-user (i.e., local hard drive) versions, Sentinel Visualizer includes Microsoft SQL Express. For the Premium and Enterprise Editions, the user(s) must have a Microsoft SQL Server network with the appropriate Microsoft licenses. If the user(s) want to use Sentinel Visualizer's built-in data-import tool, which is used to import data from a CSV file, an Excel spreadsheet, or an Access database, the user's computer must have Microsoft Excel (or, at least, the Excel driver). To use Sentinel Visualizer's geospatial tool, the user must install Google Earth.

The cost of the software ranges from $2,699 to $6,999 per license, plus costs for any required supplemental software. Warranty costs range from $499 to $1,299 per year per license, but there is no charge for upgrades as long as the license includes software support. No details were provided explaining what is included at various price levels within those ranges. Post-procurement technical support can be obtained over the internet for $200 per hour (Reference [17]).

3.3 INTELLITRACK, Ver. 1

INTELLITRACK (Ver. 1) is a product offered by the Track Group, which recently acquired the Canadian company G2 Research, Inc. It comprises a corrections version of G2's earlier icuSuite, which was focused on law enforcement applications and is still available from Track Group. INTELLITRACK is designed to help turn data into actionable intelligence. Its intended market is the corrections-oriented criminal justice community. The product, which can be purchased or

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leased, is a stand-alone package with some integration capabilities. In particular, it can be part of the Track Group's integrated Offender Tracking System (OTS), which can be agency owned and operated or offered under a Software or Analytics-as-a-Service arrangement. It also can be agency-procured as a stand-alone product that can be interfaced with any vendor's OTS.

Installation requires approximately one hour. No supporting software is needed, although Microsoft Office, ESRI, and Google Earth are optional packages that extend its capabilities. While no information was provided on the cost of the various deployment options, the product's license and warranties are included with service. Supplemental releases are made as necessary at no additional cost to the user, and post-procurement technical assistance can be obtained for a cost at various (unspecified) levels of technical and analyst support (Reference [15]).

3.4 VeriTracks, Ver. 11

VeriTracks (Ver. 11) is a product offered by Satellite Tracking of People (STOP), which provides a secure repository for all offender information (e.g., names, addresses, phone numbers, pictures, risk levels, physical characteristics, zones and zone schedules) and monitoring data (e.g., location points, violations). The application allows agency-authorized users to view the locations and movements of offenders 24 hours a day, 365 days per year. It identifies when monitored offenders gather, and compares the locations and movements of offenders with the locations of reported crimes and incidents. The intended markets for this location-based system are Federal, state, county and local agencies that supervise adult and juvenile offenders in the community. The offenders can have various classifications, such as parolee, probationer, pretrial defendant, or gang member.

VeriTracks is not a stand-alone product that agencies can procure. In its standard configuration it cannot be directly interfaced with any other vendor's Offender Tracking System and it must be used with BLUtag[10], which is STOP's one-piece location-monitoring device. However, when agencies that have been using another vendor's OTS begin contracting with STOP, STOP's software engineering team can create a secure Application Programming Interface (API) for transferring and integrating existing historical monitoring data into VeriTracks. Although the company owns, operates, maintains, and enhances VeriTracks, agencies own all of the information and monitoring data for every offender for the life of the contract.

VeriTracks is implemented as a Web-based application, eliminating the need to install software onto an Agency's information technology (IT) network or individual computers. Agency-authorized users access VeriTracks using any computer, smart phone or tablet that has a high-speed Internet connection. No additional software is required, and there are no licenses to

[10] BLUtag is STOP's "one-piece GPS monitoring device that immediately detects, records and reports four types of tampering to VeriTracks: case, strap, GPS signal jamming and GPS signal shielding. BLUtag reports events and monitoring data to VeriTracks by 3G nationwide cellular service using the CDMA (i.e., Verizon) and the GSM (i.e., AT&T) cellular networks. Its advanced GPS antenna receives signals from domestic and international satellite systems orbiting the earth. A single battery charge powers the device for 48+ hours without the use of a home-based receiver unit or receiving GPS location points at a rate of less than one per minute and reporting compliant data at least once every 10 minutes. Officers can find the immediate location of any offender at any time by initiating a Location Request, which instructs BLUtag to report its current location regardless of the last time it reported into VeriTracks" (Reference [14]).

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procure. Agencies enter into a (NASPO) contractual relationship with STOP, and receive unlimited access to the system. Contractual rates typically vary between $3.10 and $4.50 per day per monitoring device, which includes the use of VeriTracks. If large volume contracts are executed, the company indicated that the price may be reducible.

A detailed and controlled approach is taken to managing changes to the underlying software and hardware systems. Five basic steps are included in STOP's change-control process; Initiation, Planning and Design, Execution, Monitoring and Testing, and Completion. This process clearly defines the types of enhancements to be developed and the resulting benefits/impacts to customers including issues such as security, stability, and improved functionality. An in-house team of STOP's software engineers and developers thoroughly tests all enhancements to the functionality and security of the product. All agency-authorized users have unlimited access to STOP's Solutions Center, which provides technical support 24 hours a day, 365 days per year as well as to a secure online library that contains training guides, hints and tips cards, and videos (Reference [14]).

3.5 BI Analytics: Risk-based Dashboard Analytics Suite

The Risk-based Dashboard Analytics Suite is a product offered by BI, Incorporated, whose purpose is to improve the productivity of managing offender caseloads and provide deeper insight into offender behavior. A variety of analytic products is included to facilitate further analyses. The intended markets for this Suite are parole and pre-trial officers, and case managers. Since the product is completely integrated within BI's caseload management product, TotalAccess, the user does not have to perform any installation and no additional software is required.

In order to implement BI's Analytics Suite capabilities the user must also procure TotalAccess, and both products fall under the TotalAccess general license agreement. However, the customer does not have to use or purchase BI's monitoring equipment, and TotalAccess can be purchased with or without Analytics Suite. No cost information was provided for procuring Total Access, although the additional cost for including Analytics Suite within BI's case management system is $0.35 per active device day. An "active device day" refers to the product of the number of GPS/RF devices the customer has in service times the number of days those devices are in use. Inactive units placed in customer inventory do not incur that daily charge until they are placed in service.

Standard technical assistance is included in executed contracts at no additional cost, and in general, hardware procured from BI is upgraded on an as-needed basis at no cost to the customer. However, when significant revisions occur to the software (including the analytics product) they are offered on a cost-basis (Reference [13]).

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3.6 GeoTime, Ver. 5.6

GeoTime is a product offered for purchase by Uncharted Software (formerly Oculus Info, Inc.), a Canadian company, which provides visual analysis tools for both historical and live data analysis and reporting. It was designed and built for law enforcement and military personnel to quickly identify movement patterns, behaviors and anomalies within their location data, although its intended criminal justice markets include corrections.

GeoTime can be installed on a stand-alone basis or with network concurrent licensing, and requires the use of Java 8. The vendor estimates the installation time to be approximately 15 minutes. The cost for the product is $3,975 (U.S. currency – see http://www.geotime.com/Buying-GeoTime.aspx), which includes the initial procurement of a GeoTime perpetual license that is necessary to run the software. Major releases of the software occur yearly, with Point releases bi-yearly. There is no cost for upgrades while the customer's system is under active maintenance, which is a feature included in the initial base license purchase (Reference [18]).

3.7 EM Manager

EM Manager is a product offered by 3M Electronic Monitoring that comprises a "web-based system providing advanced, remote offender management tools that maximize the capabilities of our tracking system…." This software, which is intended for use in the law enforcement, corrections, and security markets, "… offers an impressive array of analytic and administrative management tools," which were "specifically developed to track and monitor a large number of offenders and to be utilized around-the-clock for accessing and reviewing their tracking data" (Reference [12]). However, since this company chose not to participate in the market survey (Reference [10]), no additional information is available on its purpose or installation options.

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Table 3–1. Product Purpose and Installation Information

Topic	SAS Institute	FMS	Track Group	Satellite Tracking of People	BI	Uncharted Software
Product name and version	SAS Targeting Framework	Sentinel Visualizer, Ver. 7	INTELLITRACK, Ver. 1	VeriTracks, Ver. 11	BI Analytics: Risk-Based Dashboard	GeoTime, Ver. 5.6
Product purpose	Monitoring and targeting criminal activity.	Discover connections, relationships, and patterns within sets of structured data.	Help turn data into actionable intelligence.	Provide a secure repository for data that allows offender locations and movements to be analyzed.	Improve the productivity of managing case loads and provide insights into offender behavior.	Provide visual analysis tools to identify patterns, behaviors and anomalies in location data.
Intended market	Law Enforcement.	Investigative organizations.	Corrections and Law Enforcement.	Supervise adult and juvenile offenders in the community.	Parole/pre-trial officers/case managers	Law Enforcement, Defense, and Intelligence
Method for accessing product	A customer-hosted, SAS-hosted, or hybrid environment.	Purchase perpetual license or software subscription	Agency owned and operated or leased software-as-a-service for use with any vendor's OTS.	STOP owns, operates, maintains VeriTracks, which must be used with BLUtag. Agencies own all data.	Purchase, completely integrated within BI's caseload management product (TotalAccess).	Purchase
Installation options	Networked solution augmented by a set of analytic clients that can operate in stand-alone mode.	Single-user, multi-user (database resides on a shared network), and cloud-based.	Stand-alone with some integration capabilities.	Web-based. Company-owned and operated, which requires use of STOP's GPS-monitoring technology.	This product will be offered within TotalAccess.	Stand-alone and network concurrent licensing
Time required for installation	Varies by number of data sources, users, security requirements. Core analytics can be in-place in 30 days.	5 min	Less than 60 minutes.	Software is not installable; accessed by high-speed internet from any computer, smart phone or tablet.	None. The product is integrated within TotalAccess.	15 minutes
Additional software packages needed	N/A	Standard Ed. (Excel); Professional Ed. (Excel, Google Earth); Premium Ed. (Excel, Google Earth, SQL Server).	Optionally: MS-Office, ESRI and Google Earth.	N/A	None.	Java 8
Licenses required to use product	Licensing varies depending on customer use case.	Software must be purchased from FMS. Single-user versions include Microsoft SQL Express. Premium and Enterprise Editions require a Microsoft SQL Server license.	Product license is included. Any others are optional.	Authorized users automatically receive unlimited access to VeriTracks.	BI's Analytics Suite must be used with its TotalAccess product, which requires a general license agreement.	Purchase of a GeoTime perpetual license, which is included in the MSRP.
Product cost, including license(s)	Varies depending on the customer's use case(s), desired infrastructure and users.	Ranges from $2,699 per license to $6,999 per license.	Pricing varies depending upon several factors, which were too numerous to list.	Agencies contract with STOP; rates are $3.10 to $4.50/day/ monitoring device and include use of VeriTracks. May be reducible for large volumes.	Analytics product costs $0.35 per active device day;TotalAccess must also be purchased. Use of BI's GPS/RF equipment is not required.	$3975 USD (see http://www.geotime.com/Buying-GeoTime.aspx)
Cost of any tethered software	N/A	Unknown	Pricing varies depending upon several (unlisted) factors.	N/A	None	N/A
Terms and cost of offered warranties	Included in annual renewal fee set by the Master License Agreement.	Ranges from $499 to $1,299 per year per license.	Included with service.	N/A	None	Not elaborated.
Software upgrade approach	Upgrades typically occur on a six month cycle. Upgrades to a new release provided when requested.	No charge for upgrades as long as the license is under software support.	Releases are made as necessary at no additional cost to the user.	A controlled approach is used for managing changes to underlying software and hardware systems.	When significant revisions occur to the software, they will be offered to customers on a cost-basis.	Major releases occur yearly (bi-yearly for Point releases) at no cost while on active maintenance (in base license).
Approach and cost for post-procurement technical assistance	Annual support is included for the first year; typically 25%-28% of the first year fee in recurring years.	$200 per hour over the Internet	Different levels of technical and analyst support are available to customers. Cost varies.	Unlimited access to the Solutions Center for technical support, and to an online library of guides, videos.	Standard technical assistance is included in the contract at no additional cost.	Included with purchase of base license
Date of Information (2015)	9/25, 10/5	9/16, 9/17	10/6	9/23, 9/24	10/2, 10/5, 11/4 and 12/15	9/29, 10/1

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4. PERFORMANCE CHARACTERISTICS AND VALIDATION APPROACH

This section summarizes the performance characteristics of the six analytics products identified by the companies that responded to the RFI, as well as the companies' software validation approaches. A brief comment is also included on the EM Manager product marketed by 3M Electronic Monitoring based on that vendor's Web site. These characteristics and the validation approaches taken by the six vendors that provided material are compared in Table 4–1.

4.1 SAS Targeting Framework

Four requirements were adopted by the SAS Institute in developing its Targeting Framework. First, the company sought to move from a retrospective view of crime dynamics to one that guides real-time responses and more effective officer deployment strategies by accessing structured and semi-structured data from any system. Second, it sought to deter, mitigate, and respond to crime more effectively by using predictive analytics to determine what is likely to happen. The two additional requirements were to proactively position police resources by using risk-based deployment strategies, and provide Web-based and desktop reporting tools that give decision makers options for conducting self-service queries and reporting.

The company described its product as a "white-box" solution that adds value to and differs from other commercial products by providing a flexible and customizable environment, which integrates well into virtually any user framework. "Unlike COTS products that typically have hard-coded user interfaces and limited ability to fit into existing processes …, SAS can complement existing … technological investments." The product allows varying levels of role-based access, and "[a]dministrator(s) can modify out-of-the-box roles or create new roles to map specific features to users." SAS noted that it is "the acknowledged industry leader in analytics with the dominant market share in this space and consistent top reviews from the leading independent technology research and advisor organizations …." In 2014, Forrester Wave™ placed SAS in the leader category for Agile Business Intelligence Platforms and Big Data Predictive Analytics. Gartner also placed SAS in the leader's quadrant for Advanced Analytics platforms.

In describing its product's impact on users, SAS cited its implementation of a (unnamed) "state-wide criminal justice information system on the east coast, which provides real time information across thousands of agencies within the State Government." Although not driven primarily by geospatial capabilities, the "initial need for the system stemmed from the state's inability to know where high-risk offenders were at any given time, visibility around a holistic record of the offender, and the ability to make fact-based decisions to protect citizens from violent individuals." The impact of that system was evidenced by the fact that the "state receives hundreds of accolades annually for the significant improvements made, the robust intelligence available that is easily accessed and understood, and the reduction of the lack-of-information critical to making significant decisions regarding criminal offenders" (Reference [16]).

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4.2 Sentinel Visualizer, Ver. 7

The requirements adopted by the FMS Advanced Systems Group in developing Sentinel Visualizer were to provide a solution that permitted discovery of links/connections within sets of data. For example, a police department that has thousands of rows of telephone call data could use Sentinel Visualizer to visualize connections between those phone numbers. However, no corrections-specific examples were provided. Configurable levels of administrative privileges are available in the firm's Enterprise Edition.

FMS, Inc. indicated that Sentinel Visualizer adds value to and differs from other commercial products in its pricing and customer service as compared to the leading supplier of link analysis software. The company claims that the product's price is a third to half the price of the leading link analysis tool. In addition, an evaluation copy of the software is provided to prospective customers at no charge. The product's validation approach and impact were addressed simply by noting that it has been used by "thousands of Users over the past years," and that its data-import tool allows users to import structured data quickly and easily for use in discovering connections between entities that narrow the "zone of interest" and reduce labor-costs in an investigation (Reference [17]).

4.3 INTELLITRACK, Ver. 1

The requirements adopted by the Track Group in developing a corrections version of its earlier icuSuite law enforcement product were to develop a device-agnostic product that: (1) promotes early intervention by identifying potential problems before they happen; (2) improves resource deployment, risk assessment and prioritization; (3) increases efficiency; and (4) reduces recidivism rates. The product adds value by offering the capability to "instantly aggregate and analyze massive amounts of seemingly unrelated GPS data and dramatically reduce the time required to identify associations, patterns and trends that enable faster and more accurate decision-making and resource allocation." Configurable levels of administrative privilege are also offered.

Track Group noted that its OMA tool has been validated by extensive field-use in law enforcement, global intelligence operations and corrections. It is a "proven intelligence and investigative asset that has been used to support counter-terrorism operations, investigate organized crime, and analyze serious criminal activity in multiple countries and continents over the past five years," including in several (unspecified) U.S. correctional programs. The approach taken to evaluating whether the product is meeting customer needs includes soliciting direct customer feedback through structured interviews as well as academic and technical reviews to ensure alignment with market needs and requirements.

The vendor provided several examples of the product's impact on users. Among these, it has been used to identify "new gang territories based on group congregation analysis, … rapidly identify new or suspicious destinations as possible drug distribution points, … (and) improve (the) probability of apprehension through predictive analysis." It has also been used to "identify networks of parolees that should not be associating with each other, (and) … to validate travel times and whereabouts of new entrants moving from one place to the other to improve (the) accuracy of zones and reduce alarms" (Reference [15]).

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4.4 VeriTracks, Ver. 11

VeriTracks was developed and continues to be maintained exclusively to meet the requirements of corrections and law enforcement. STOP noted that the product's functionality helps agencies record and track the locations and movements of offenders and any associations they may have with other monitored clients. Three types of user accounts are available in VeriTracks: restricted, normal and administrative. Restricted users have permission to view monitoring data. Normal users have permission to add, delete and/or edit as well as view data. Administrative users have permission to create users as well as add, delete, edit and/or view data. The agency decides which type of user account to enable for each user.

The company identified change requests as the approach taken to gauge whether the product is meeting user needs. Such requests are aggregated from multiple sources. These include customer tickets, sales and account-management interactions, customer training conferences, and systems maintenance personnel. Operational reviews are convened periodically to better understand system performance and Executive Meetings provide "an opportunity to coordinate across functional lines to better understand customer challenges and identify enhancement opportunities." STOP indicated that the detailed and controlled approach taken to managing changes to the underlying software and hardware systems clearly defines the types of enhancements to be developed and the resulting benefits/impacts to customers including issues such as security, stability, and improved functionality.

No examples were provided of the product's impact on users, and the company has not opened its software for outside validation (Reference [14]).

4.5 BI Analytics: Risk-based Dashboard Analytics Suite

BI Analytics was developed to allow users to increase their productivity when managing caseloads and provide deeper insights into their offender populations. The company indicated that the tool adds value by increasing productivity when managing offender caseloads, and creating an indicator to identify the highest-risk offenders based on their alert behavior. It also adds value by supplying users with more insight into offender management through the analysis of current and historical trends in offender behavior by alert category (behavior, equipment, travel), and seamlessly integrating into BI's alert management tool (TotalAccess). Various levels of administrative privilege can be assigned.

The approach to evaluating whether the product meets user needs is to conduct repeat-customer interviews and periodic satisfaction surveys, and by analyzing a Net Promoter Score to gauge the degree of product/company loyalty. The product has been successfully validated and verified by conducting a field trial that focused on its functionality and capabilities, but results were not provided.

As an example of the product's impact on users, BI noted that by using the Dashboard, users can easily identify high-risk offenders (based on their alert behavior) and prioritize their workload accordingly (Reference [13]).

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4.6 GeoTime, Ver. 5.6

GeoTime was developed by Uncharted Software to provide users with an easy to understand visual representation of locations over time for use in offender management, criminal investigations and prosecution. The company indicated that embedded capabilities such as automated tools for quickly finding meeting and frequently visited locations, as well as producing animated videos of target movement, have proven to be of great value to the law enforcement and criminal justice communities. The product provides an administrative control panel for controlling user access to data and reports on a case-by-case basis.

Uncharted Software believes that it is the only vendor on the commercial market that provides a tool to visualize and analyze movement data in a 3D viewer, which helps to ensure that everyone involved in the process, from parole officer to prosecutor, has an understanding of the location data and what it represents. Movement patterns, repeat visits and outliers were offered as examples of products simplified by the 3D viewer. A range of presentation options, from PowerPoint exports to the production of animated videos of a target's movement over time, permit users to produce visual materials quickly that all stakeholders can understand.

The company evaluates whether the product is meeting user needs by maintaining contact with its customers, supporting active investigations, assisting with trial preparations, and collecting feedback and test results for new capabilities being introduced into their products. Although specific examples were not provided, the RFI response indicated that GeoTime is accredited on various government networks and systems, meeting or exceeding their performance requirements. They also noted that its viewer has been proven to increase analytical performance, suggesting that potential customers view the evidence at https://uncharted.software/assets/pdfs/GeoTime_Method_Evaluation_TVCG_09_published.pdf. Supplemental information regarding GeoTime's impact on customers, including increasing the value of analysis within departments that had not made it a priority in the past, is available at http://www.geotime.com/Product/GeoTime/Customers---Case-Studies.aspx (Reference [18]).

4.7 EM Manager

Although 3M Electronic Monitoring did not provide specific information in response to the RFI, the company's Web site provided some information on the product's impact on users. For example, it noted that EM Manager "is used to perform an array of essential monitoring activities using clickable drop-down menus. This software tool allows officers to enroll (offenders), apply zones, rules (and) schedules, monitor (offenders) for compliance, (and) map, track, activate or deactivate their caseload as needed from any (desktop) or mobile computer or hand-held device (that has) internet access." It supports point analyses and offers a direct link to crime scene correlation software (Reference [12]).

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Table 4–1. Performance Characteristics and Validation Approach

Topic	SAS Institute	FMS	Track Group	Satellite Tracking of People	BI	Uncharted Software
Criminal justice (or other) requirements the product addresses	(1) Provide options for realtime responses to crime dynamics by accessing structured and semi-structured data from any system; (2) Prevent, deter and respond to crime more effectively using predictive analytics; (3) Proactively position police resources using risk-based deployment strategies; (4) Provide web-based and desktop reporting tools that support self-service queries by decision makers.	Discovering links/connections within sets of data through *visualization* .	(a) Identify problems before they happen; (b) Improve resource deployment; (c) Improve risk assessment and prioritization; (d) Increase efficiency; (e) Improve recidivism rates; (f) Device agnostic.	VeriTracks was developed and continues to be maintained exclusively for the corrections and law enforcement industry. Its functionality helps Agencies record and track the locations and movements of offenders and any associations they may have with other monitored offenders.	This product was created to allow users to increase their productivity when managing caseloads and provide deeper insights on their offender population.	GeoTime was developed to provide users with an easy to understand visual representation of locations over time, using automated tools for quickly finding frequently visited locations, as well as producing animated videos of target movement.
How the product adds value to and differs from other commercial products	SAS provides “white box” technologies that address complex needs and provide a flexible and customizable environment to fit into virtually any user environment.	Sentinel Visualizer is a third to half the price of the leading link analysis tool, and "provides superior service compared to the leading supplier of link analysis software".	This product can quickly batch and analyze massive amounts of seemingly unrelated GPS data and dramatically reduce the time required to identify associations, patterns and trends.	NR	Increases productivity when managing caseloads; indicates the highest-risk offenders based on their alert behavior; provides more insight into offender management by analyzing trends.	GeoTime is the only company on the market that provides a tool to visualize and analyze movement data in a 3D viewer, which simplifies pattern recognition.
Whether the product offers configurable levels of Administrative Privileges	The SAS solution provides varying levels of role-based access. Administrator(s) can modify out-of-the-box roles or create new roles to map specific features to users.	Yes, with the Enterprise Edition.	Yes.	Restricted users can view monitoring data. Normal users can also add, delete and edit data. Administrative users can additionally create users.	Yes	GeoTime Web provides an administrative control panel for controlling user access to data and reports, on a case-by-case basis.
Approach for evaluating whether the product meets user needs	Not specifically addressed.	An evaluation copy is provided at no charge.	The evaluation approach is based primarily on direct customer feedback through structured interviews as well as academic and technical reviews to ensure alignment with market needs and requirements.	Identify needs based on change-requests from Customer Tickets, Sales and Account Management Interactions, Customer Training Conferences/ Interactions, Operational Reviews, and Systems Maintenance Personnel.	(a) Repeat customer interviews; (b) Periodic satisfaction surveys; (c) Net Promotor Score analyses to gauge the degree of product/company loyalty.	The company is in constant contact with users, supporting active investigations, assisting with trial preparations, and collecting feedback on new capabilities being introduced into their products.
Whether and how the product has been validated and verified	Not directly answered. SAS is the industry leader in analytics with consistently top reviews from leading technology research organizations.	By thousands of Users over the past 8 years	Extensive field-level use in law enforcement, global intelligence organizations and corrections.	STOP has not opened its software for outside validation.	A field trial was conducted to validate and verify the product functionality and capabilities.	GeoTime’s 3D viewer has been proven to increase analytical performance, and the product is accredited on various government networks and systems.
Examples of the product's impact on users	Not directly answered. An example was cited of an information system that was not driven by geospatial components, which provided state-wide access to real time criminal justice information across a large number of agencies that receives numerous accolades annually for the significant improvements made.	Sentinel Visualizer’s data-import tool allows the User to quickly and easily import structured data in order to discover connections between entities, thereby narrowing the “zone of interest,” and reducing labor-costs in an investigation.	(a) Identifying new gang territories based on group congregation analysis; (b) Improving efficiency in compliance management; (c) Improving probability of apprehension through predictive analysis; (e) Identifying networks of parolees that should not be associating with each other.	NR	By using the Dashboard, users can easily identify high-risk offenders (based on their alert behavior) and prioritize their workload accordingly. Furthermore, users will gain new insights into their offender population which, will assist them in managing their caseloads.	This company has had many agencies and users speak on the positive impact GeoTime has had on their productivity and ability to quickly provide answers and insights, as well as on increasing the value of analysis within departments that had not made it a priority in the past.
Date of Information (2015)	9/25	9/16	10/6	9/23	10/2	9/29

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5. ANALYSES PERFORMED BY THE PRODUCT

Section 5 summarizes the information provided by the six companies that responded to the RFI regarding the analyses performed by their product. In addition, the analytic capabilities of 3M's EM Manager product were synthesized from information on its Web site (Reference [12]), and from more general discussions with the Oklahoma and Michigan Departments of Corrections (References [20] and [21], respectively). Although this synthesized view does not necessarily represent the most current or the full set of 3M's analytics capabilities, it provides a basis for further evaluation by interested departments. The analytical capabilities of these seven products are summarized in Table 5–1. Some of these solutions are part of integrated monitoring systems and some represent stand-alone analytics engines.

5.1 SAS Targeting Framework

The SAS Targeting Framework can be customized to provide analytical capabilities in most of the categories for which information was solicited by the RFI. For example, through the use of various clustering methods, SAS can model individual behavior to determine normal activities as well as deviations from that reference state. Real-time data accessed from multiple sources can be used to develop a holistic view of the individual and to identify high-risk indicators, and users can drill down to obtain additional detail such as criminal background data. Patterns of normal and abnormal behaviors can also be determined for groups of offenders based on peer-group analysis, which can be used to identify associations between entities based upon various common data elements, similar patterns of behavior, or inferred relationships between common entities. The company noted that the integration of high-quality data and entity-resolution provides a solid foundation for developing analytic solutions and recognizing patterns of activity.

Customized views can be developed based on user preferences that include differentiating client data points obtained on different days. Various colors, shapes, icons, charting types, and time-sliders can be employed to indicate variations visually in time and location. Location-based data can be geocoded through various methods such as appending data, integrating third-party information for data enrichment, or working in conjunction with a GIS application in a custom environment. Heat maps are among the many available visualization approaches. Nevertheless, the company's preferred approach is to rely on other geospatial technologies to address geocoding tasks. By using APIs, multiple GIS applications such as ESRI, Google Maps, and OpenMaps can be integrated to overlay point-of-interest on maps and imagery. Third-party geospatial visualization tools can be incorporated as plug-ins, similar to what is already done within the company's Social Network Analysis (SNA) Server interface.

Analytic methods are used to compute a variety of measures for identifying patterns and anomalies in geospatial and other data, and for deriving related insights. "SAS commonly uses such techniques in detecting fraud based upon certain demographic criteria combined with event time series and proximities." Geographic profiling and social network analyses can also be performed. The company noted that although tools for conducting the latter often identify known connections inherent in the data (such as telephone calls or money transfers), SAS SNA applies advanced analytics to both interpret existing relationships between data elements and to infer

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additional probable associations, based on the statistical significance of links. This can suggest the existence of missing data points or other reasons for a 'covert' relationship.

Although SAS did not indicate that the company has implemented an automated crime scene analysis feature in its products, it noted that analytical techniques such as cross-case analysis would support development of such a feature provided the requisite data were available. Its "solutions often deal with complex scenarios involving multiple aspects … over time and … locations to identify cause and effect, correlations, behaviors and other insights into contextual awareness," and user-driven inputs can be used to focus analysis within specific time and location windows.

The company indicated that curfews and zones (e.g., circles and regular or arbitrary polygons) can be established as part of the analytic process by using "business rules" and the product's basic geospatial capabilities to segment analyses or attribute data. However, its preferred approach would to interface with a third-party provider or to employ an open-source GIS application for those purposes. The Targeting Framework would then use the geospatial zone data created by the application for analysis and monitoring. Dynamic assignment of one-to-one or one-to-many rules could be used to apply those established zones to more than one type of client. Views can be provided that enable end-users to understand easily the results based on locations-of-concern, general movement, and behavioral outcomes.

One of SAS' strengths is in forecasting likely outcomes that can be applied to predicting behavioral trends. The company has been identified as "the leader in big data predictive analytics" by "The Forrester Wave™: Big Data Predictive Analytics Solutions" report (available at http://www.sas.com/en_us/news/analyst-viewpoints/2015-forrester-big-data-predictive-analytics.html). As such, the company expects these capabilities can be applied to a range of offender-tracking topics, such as using historical data to identify criteria that indicate whether individuals are high- or low-risk candidates for participating in a community monitoring program. Other examples include analytically suggesting next courses-of-action based on profiling historical data to accomplish next-event forecasting, and detecting offender anchor points based on analytical evaluation of movements over time.

In concluding its response to this category, SAS identified several other areas in which analytic capabilities could contribute to effectively monitoring community-released offenders:

1. Automated model development and deployment. "By building and retraining hundreds of predictive models across multiple segments and then automatically picking the best model for each segment," significant amounts of time can be saved when detecting emerging and/or previously undetected patterns within vast amounts of data;
2. Sentiment Analysis. i.e., "[e]valuation of an offender's rhetoric (from) social media, email and submitted reports to provide insight/scoring on whether the rhetoric might turn into actions. This software feature automatically extracts sentiments in real time or over a period of time with a combination of statistical modeling and rule-based natural language processing techniques;"

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3. Closed-loop, integrated, adaptive monitoring and tracking environment. The company noted that "[a]s soon as evasive patterns are discovered and managed, offenders will adapt and learn how to evade them." The SAS Analytic platform provides for adaptable self-learning using a unified architecture, which is inclusive of SAS based, third-party and open source analytic and GIS technologies;
4. Adaptive Case Management (ACM). Changing conditions and new information are "continuously analyzed and scored allowing investigative/case workflows and content to automatically adapt and change dynamically." SAS ACM can optimize the SAS Case Management Solution or interface with third-party or open source Case Management solutions (Reference [16]).

5.2 Sentinel Visualizer, Ver. 7

Sentinel Visualizer offers analytical capabilities in some but not all of the solicited categories. These capabilities were generally described in less detail than contained in the previous section, and it is not evident that this product has been applied directly to corrections. Nevertheless, FMS indicated that Sentinel Visualizer can track individual offenders and groups using an interface with Google Earth and user-provided location data. It also noted that offender stop- and drill-down analyses could "possibly" be done, provided the user imports (relatively granular) data, and Sentinel Visualizer's temporal analysis and geospatial tools are used to perform stop analysis. The user can drill-down from the link chart to display information on the Brief tab, Metadata, Notes, and Documents. Without amplification, FMS indicated that its product can identify patterns of activity, conduct association monitoring, and visually differentiate client data points obtained on different days.

The company indicated that its product can perform entity resolution and victim monitoring as well as social network analysis. The latter permits several measures of association to be formed, such as degree, closeness, and betweenness. It can also be used to perform crime scene analyses, although not in an automated fashion. Temporal (but not spatial) thresholds can be defined for bounding those analyses, and watch lists can be created using the software's data-import tool. That feature also is not automated.

Both aerial and street views can be provided for targeted scenes, and points-of-interest can be overlaid on maps and imagery as long as there is an established interface with Google Earth. A drill-down capability also exists in reference to particular map points. However, Sentinel Visualizer cannot perform geocoding and reverse geocoding, and it is unclear whether the product can be used to identify possible travel routes after commission of a crime. Furthermore, it is not capable of conducting geographic profiling, and the product does not provide analytic support for case management planning and implementation. Curfews cannot be defined and zones cannot be created. It also does not perform predictive modeling. No other analytic capabilities beyond those specifically included in the RFI were identified by FMS' submission (Reference [17]).

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5.3 INTELLITRACK, Ver. 1

INTELLITRACK provides analytical functionality in most of the categories for which information was solicited by the RFI. For example, its geospatial analysis capabilities permit both individual and groups of offenders to be tracked, and offender stop-analysis and association monitoring can be conducted to identify patterns of activity. Client data points from different days can be visually distinguished. Since the product performs both geocoding and reverse geocoding, and provides entity resolution, offender habits can be geo-contextualized on archived imagery and maps on which points-of-interest can be overlaid. Both aerial and street-views are available, and drill-down options exist.

Although Track Group's software does not include a social network analysis feature, it is capable of accomplishing geographic profiling and permits automated crime scene analyses. The product can analyze individual-offender habits as well as the habits of all offenders being supervised by a particular PPO in a single jurisdiction if desired, and it is capable of correlating the locations of all offenders monitored by that PPO with crime data gathered across multiple jurisdictions within a given period of time. Heat map displays facilitate pattern recognition. Offender watch-lists can be created and updated automatically, and users can identify possible travel routes after commission of a crime.

INTELLITRACK's features include the ability for PPO's to conduct caseload planning. Curfews and arbitrarily and regularly shaped zones can be defined, and monitoring parameters can be customized to individual offenders. Officers can review tracking points relative to these parameters, and approve acceptable behaviors. Monitoring is facilitated by the ability to apply established zones to more than one client and to create zone templates for certain classes of participants. The ability to implement mobile restriction zones and set warm zones around hot zones supports victim monitoring. Events are automatically configured as alerts and escalated when appropriate.

These features are supplemented by an ability to conduct basic predictive modeling, which includes the assignment of statistical significance to spatial-temporal crime-repetition probabilities. In response to other RFI categories, the company indicated that its product can predict behavioral trends and the location of serial-offender anchor points, as well as good candidates for community monitoring. In addition, it supports next-event forecasting based on linked-crime-incident locations (Reference [15]).

5.4 VeriTracks, Ver. 11

The VeriTracks product offered by STOP provides analytical functionality in most of the categories probed by the RFI. It permits both individual and groups of offenders to be tracked, and offender stop-analysis and association monitoring can be conducted. Pattern analyses by the software's Timeline feature provides a graphical view of enrollee activity for quick review and action, and entity-resolved data points from one or more clients obtained during the current or on different days can be visually distinguished on maps. The product performs both geocoding and reverse geocoding, and drill-down options exist.

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VeriTracks uses Google Maps to provide its mapping functionality. These maps offer multiple views with zooming capabilities, including standard, satellite, and StreetView. Points-of-interest can be overlaid. For example, these graphics can "display street names, points of interest, public transportation pick-up/drop-off locations and other landmarks. When Agency-authorized personnel identify the offender's home, the offender's place of employment (or school), a victim's home, a victim's place of employment, etc., all of these locations are marked on the map for the individual offender."

Although it does not provide social network analyses, and it is incapable of conducting geographic profiling, VeriTracks does support automated crime scene analyses. It can "receive data on recorded crimes and incidents from a local law enforcement agency's records management system and automatically compare those locations to the movements of all of the offenders under an Agency's supervision." When one or more offenders are in the vicinity of the crime or incident, "VeriTracks automatically notifies the designated recipient(s) about the correlation. Every correlation is ranked based on the length of time the offender(s) were in the vicinity and the time of day" they were in the area. The product permits comparisons of reported crime locations and incidents across multiple agencies as well as the movements of a single offender across multiple jurisdictions once the user provides appropriate spatial and temporal bounds. However, users cannot obtain more information about those events by hovering over map-points, nor can they automatically create offender watch lists or identify possible travel routes following commission of a crime.

The ability to implement mobile restriction zones and set warm (i.e., cascading) zones around hot zones creates multiple options for reporting an offender's approach to a restricted location. The company's Stalker Alert product provides former victims of an offender with the option to carry a device similar to that worn by their BLUtag-outfitted offender. Communications from those devices change when in close proximity, providing a warning of a potential encounter.

VeriTracks provides several caseload planning-related features. For example, the software "generates a Daily Summary Report that lists all of the events generated by the offenders in the officer's caseload during the preceding 36 hours. Officers can use this report as a starting point for managing (their) caseload for the day." Authorized users can create and assign new zones and/or zone schedules for any offender in their caseload and edit existing zones and/or zone schedules to meet evolving needs. Arbitrarily and regularly shaped zones can be defined, and monitoring parameters can be customized to individual offenders. Every offender in an officer's caseload "can have date- and time-sensitive zones and other monitoring parameters to meet each individual offender's evolving needs. Even if the same zone is assigned to multiple offenders, the schedule for each zone is customizable …." Thus, monitoring is facilitated by the ability to apply established zones to more than one client and to create zone templates for certain classes of participants.

Although officers can review an offender's location points for designated date and time periods, VeriTracks automatically distributes event notifications to designated recipients and engages an agency's event-escalation tree if one exists. Because it is an exception-based application, users can choose whether to receive event notifications for violations and non-compliant locations and movements. For example, if an offender is compliant for 24 hours, the supervising officer does

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not receive any notifications during that period. These capabilities are augmented by the ability to conduct basic predictive modeling, and the software can identify serial-offender anchor-point locations. However, it does not estimate the statistical significance of these predictions, nor does it predict behavioral trends, good candidates for community monitoring, or provide next-event forecasting (Reference [14]).

5.5 BI Analytics: Risk-based Dashboard Analytics Suite

BI's Analytics Suite provides analytical functionality in many of the categories of interest to this market survey. The company plans to develop capabilities in several of the other topical-areas in the future. The product permits both individual and groups of offenders to be tracked, and its ability to perform both geocoding and reverse geocoding tasks allows offender habits to be geo-contextualized on archived maps and imagery on which points-of-interest can be overlaid. Both aerial and street-level views are available, and metadata is provided using the software's "mouseover" functionality to support stop-analyses. Although entity-resolved client data points from different days can be visually distinguished, the product does not currently support the conduct of social network analysis or offender association monitoring, nor can it identify patterns of activity or provide heat maps. All of these features are planned for the future.

Arbitrarily and regularly shaped zones can be defined, and monitoring parameters customized to individual offenders. These zones can be applied to more than one client and zone templates can be created for certain classes of participants, although mobile restriction zones are not permitted. Officers can review tracking points relative to these parameters and approve acceptable behaviors, but events can be automatically configured as alerts and escalated when appropriate. Offender watch-lists must be created manually.

Automated crime scene analyses can be performed using the company's Crime Scene Correlation product, although the "mouseover" feature contained in the base product is not available in this instance. While an individual offender's habits in a single jurisdiction or the habits of all offenders being supervised by a particular PPO in that jurisdiction can be analyzed, an agent can also choose to correlate the locations of all of his/her offenders with crime data gathered across multiple jurisdictions within user-defined time and distance thresholds. Furthermore, possible travel routes after commission of a crime can be identified automatically. Although the location of serial-offender anchor-points can be computed and geographic profiling can be conducted, BI's product does not provide the ability to identify offender behavioral trends, predict good candidates for community monitoring or conduct next-event forecasting based on linked-crime-incident locations. All of these features are planned for future updates.

Several additional features of this product were identified that were not explicitly included in the published RFI. In particular, the Analytics Suite features a dashboard based on a proprietary algorithm that is driven by risk-based outcomes, which permits the highest-risk offenders to be easily identified and managed. Gauges are included to indicate risk by offender alert category (e.g., equipment, behavior, travel). That dashboard is integrated into the company's TotalAccess tool to provide alert management with single-sign on functionality (Reference [13]).

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5.6 GeoTime, Ver. 5.6

The current version of GeoTime offers the ability to track both individual and multiple offenders. It provides a suite of analysis tools that automatically identifies gaps and speed changes in offender movements, as well as proximity to areas-of-interest and repeat visits. Dedicated tools are included for finding meetings and locations visited by multiple targets, which can be easily configured by users. Its entity resolution capabilities facilitate identifying abnormal behavior and patterns of activity, allowing users to spot outliers that may require further attention. The number of clients that can be loaded for visualization and analysis is not limited provided sufficient computing system capacity is available, and data points can be dynamically differentiated by color, size, or shape. Users can group these points into various time intervals with a single mouse-click. These features would support use of the software for victim as well as offender monitoring, but it was not apparent that it has been used for that application.

Uncharted Software currently utilizes ESRI's ArcGIS services for geocoding. Many different mapping/display options are available including aerial views and Google StreetView. The product displays points-of-interest and provides associated metadata. It also generates color-ramps of areas based on the frequency of visits to embedded locations, and "provides both visual and automated tools for geographic profiling, including frequency analysis, pattern of life analysis, trip counts, outlier locations, (and) home base identification…." Tools are provided for conducting Social Network Analysis, including "links between targets, co-location link creation, and network graph visuals." The company noted that its product "is the only tool with a temporal view of link graph(s) showing relationships over time. Links between entities can include communications, financial transactions, meetings, (and) relationships."

GeoTime offers automated crime scene correlation, providing a single view into data from multiple sources. Data showing a target's location can be merged or split depending on the user's needs, and data can be aggregated, "… from different jurisdictions, … different devices or sources, as well as non-traditional sources such as case notes, ALPR[11], surveillance logs, witness statements, (and) social media." Users can specify distance and time thresholds, and switch between focusing on single or multiple targets with the click of a button. The connection to ArcGIS Online services from GeoTime Web provides an opportunity to investigate potential travel routes between any two locations on the map, including those available to suspects after commission of a crime as long as crime-occurrence information is available from other sources.

Although this software does not explicitly support the creation of curfews, its automated features for monitoring user-specified geographical areas can be used to establish arbitrarily shaped fixed zones, and for generating alerts when one or more offenders cross these boundaries. However, monitoring parameters cannot be customized to individual offenders nor can zone templates be created for separate classes of clients. Furthermore, mobile exclusion zones cannot be created.

The company did not explicitly indicate whether GeoTime provides basic predictive modeling capabilities, but its dynamic visualization modes for rapidly identifying and classifying target movements and behavioral patterns support the identification of behavioral trends. While the ability to forecast future behaviors by conducting historical pattern analysis might provide the

[11] Automatic License Plate Reader

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basis for predicting good candidates for community monitoring, there was no indication that the company has attempted to use this (or any other) approach to identifying such candidates or to estimating crime-repetition probabilities. No capabilities exist for conducting next-event forecast modeling or identifying the location of serial-offender anchor-points (Reference [18]).

5.7 EM Manager

Although 3M declined to provide specific information in response to the RFI (Reference [10]), the company's Web site offered some information on EM Manager's analytic capabilities (Reference [12]). This was supplemented by information presented for other purposes about the analytic features of the electronic monitoring systems used by the Oklahoma and Michigan Departments of Corrections (References [20] and [21]), which are based on various versions of 3M's product offerings. While these results might not represent the most current or the full set of this company's analytic capabilities, they provide the basis for further discussions with that company by any departments or agencies that are interested in that software.

The aforementioned sources of information indicate that 3M's electronic monitoring products provide entity-resolution and permit agencies to search for location points on all tracked offenders. Users can view one or multiple offenders on a single mapping screen. The products are Web-based and provide offender stop-analysis and drill-down options, as well as the ability to conduct association monitoring. At least one of the cited references indicated that users can view up to seven days of an offender's GPS points. Geocoding and reverse geocoding functionality exists, and offender habits can be geo-contextualized on maps and archived imagery. Points-of-interest can be overlaid, and both aerial and street views are available of scenes of interest, possibly relying on the use of linked third-party products.

The software does not provide social network analysis, and no information was available on whether the product(s) permit geographic profiling to be conducted. Once the bounding (i.e., time and distance threshold) parameters are entered, EM Manager provides a direct link to their automated crime scene correlation tool, which permits assessments to be made based on all of the offenders monitored by a given PPO over multiple jurisdictions when those data are available. Users can hover over points-of-interest to obtain more information, and possible travel routes can be identified following commission of a crime.

The product supports caseload management planning by PPOs, and the review and approval of acceptable behavior. Logged events can be automatically configured as alerts and event escalation procedures can be implemented as appropriate. Offender watch lists can also be generated, although not automatically. Curfews can be defined, and both standard and free-form zones can be established. Furthermore, PPO's can customize monitoring parameters to individual offenders. Examples provided included the ability to enter and modify enrollments, schedules, zones, profiles, and alerts. Established zones can be applied to more than one client, and zone templates to be created for various offender classes. Although no explicit information was available regarding whether victim monitoring is supported, mobile restriction zones can be defined.

None of the references indicated any capability to perform predictive modeling, determine offender behavioral trends or provide next-event forecasting. If agencies are interested in these

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types of analyses, they should contact 3M directly to determine whether those features are offered.

The product brochure for EM Manager summarizes the current system's capabilities by noting that "[u]tilizing clickable drop-down menus, offenders can be enrolled, zoned, scheduled, activated, mapped, tracked, and deactivated in minutes. Offender information can be entered, modified, or deleted in the Graphic User Interface and location information can be viewed as a sequence of points or 'played' like a video…. This software tool was specifically developed to track and monitor a large number of offenders and to be utilized around-the-clock for accessing and reviewing their tracking data" (Reference [12]). Although point assessments can be conducted, there was no indication of whether geospatial or social network analyses are under development or planned for the future.

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Table 5–1. Summary of Analytical and Supporting Capabilities

Topic (Response: Yes or No)	SAS Institute	FMS	Track Group	Satellite Tracking of People	BI	Uncharted Software	3M Electronic Monitoring
Geospatial analysis	NR*	NR	Yes	NR	NR	NR	No
Track individual offenders	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Track groups of offenders	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Offender stop-analysis/drill-down capabilities	Yes	Maybe/Yes	Yes	Yes	Yes/Mouse	Yes	Yes
Offender association monitoring	Yes	Yes	Yes	Yes	No (future)	Yes	Yes
Entity resolution	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Identify patterns of activity	Yes	Yes	Yes	Yes	No (future)	Yes	NR
Visually distinguish client data points by day	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Victim monitoring	Yes	Yes	Yes	Yes	Yes	Yes	NR
Geocontextualize habits on imagery	NR	NR	Yes	NR	NR	NR	Yes
Geocoding/reverse geocoding	Yes	No	Yes	Yes	Yes	Yes	Yes
Provide both aerial and street views	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Overlay points-of-interest on maps/imagery	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Conduct geographic profiling	Yes	No	Yes	No	Yes	Yes	NR
Heat maps	Yes	No	Yes	No	No (future)	Yes	NR
Social network analysis	Yes	Yes	No	Yes	No (future)	Yes	No
Automated crime-scene correlation	NR	No	Yes	Yes	Yes	NR	Yes
Requires separate analysis of each jurisdiction	No	No	No	No	No	No	No
Requires separate analysis of each offender	No	No	No	No	No	No	No
Evaluates multiple jurisdictions/offenders	Yes	Possibly	Yes	Yes	Yes	Yes	Yes
User-specified time/distance thresholds	Yes	Yes/No	Yes	Yes	Yes	Yes	Yes
Hover over points for more information	Yes	Yes	Yes	No	No	Yes	Yes
Identify possible travel routes after a crime	Yes	Possibly	Yes	No	Yes	Yes	Yes
Automatic creation of offender watch lists	Yes	No	Yes	No	No	No	No
Caseload management planning by a PPO	NR	No	Yes	Yes	NR	NR	Yes
Allows curfews to be defined	Yes	No	Yes	Yes	NR	No	Yes
Supports creation of global zones	Yes	No	Yes	Yes	Yes	No	Yes
Supports creation of free-form zones	Yes	No	Yes	Yes	Yes	Yes	Yes
Configure zones as regular/arbitrary polygons	Yes	No	Yes	Yes	Yes	Yes	Yes
Customize monitoring parameters to individuals	Yes	No	Yes	Yes	Yes	No	Yes
Apply established zones to multiple clients	Yes	No	Yes	Yes	Yes	Yes	Yes
Create zone templates for offender classes	Yes	No	Yes	Yes	Yes	No	Yes
Permits definition of mobile restriction zones	Yes	No	Yes	Yes	No	No	Yes
Allows warm zones to be set around hot zones	Yes	No	Yes	Yes	NR	No	NR
Review tracking points/approve behavior	Yes	No	Yes	Yes	Yes	Yes	Yes
Automated alerting/event escalation	Yes	No	Yes	Yes	Yes	Yes	Yes
Provides basic predictive modeling	NR	No	Yes	Yes	NR	NR	No
Prediction of offender behavioral trends	Yes	No	Yes	No	No (future)	Visualization	No
Prediction of community monitoring candidates	Yes	No	Yes	No	No (future)	Pattern Eval.	No
Provides next-event forecasting	Yes	No	Yes	No	No (future)	No	No
Computes statistical significance of predictions	Yes	No	Yes	No	No (future)	No	NR
Able to identify serial offender anchor points	Yes	No	Yes	Yes	Yes	No	NR
Additional capabilities not covered above	See text	NR	NR	No	See text	See text	See text
Dates of Information (2015)	9/25, 10/5	9/16, 9/17	10/6, 10/9	9/23, 9/24	10/2, 10/5	9/29, 10/1	9/29

* NR means “No Response”; Mouse means “mouseover.”

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6. DATA FORMATTING AND INFORMATION EXCHANGE

Information was requested in the FRN about the explicit methods used by companies to enter, access, and exchange data and analytics results. The establishment of protocols for exchanging information among agencies, between agencies and vendors, and from one vendor's system to another would greatly facilitate both the exploitation of analytics for correctional purposes and the ability of an agency to change among companies providing offender monitoring services. However, information exchange methods do not appear to have been standardized[12], and most of the respondents to the RFI did not explicitly address this topic. Some insight was gained regarding the approaches taken to these issues from the information provided in response to other topics included in this section of the RFI. These results are summarized at the end of this section in Table 6–1.

6.1 SAS Targeting Framework

SAS has not adopted specific data sharing protocols, but the product is compatible with standard Extensible Markup Language (XML). "SAS/ACCESS software delivers seamless, transparent read and write data that's stored on different platforms and in various formats. It supports sourcing data from the most popular platforms and formats on the market natively. Examples include Hadoop, open-source platforms, PCs (ASCII, .csv, .xml, .xls, .dbf, etc.), UNIX and mainframe system files as well." The number of data-streams that can be monitored are typically restricted only by hardware or network limitations. The company noted that some of their customers monitor millions of transactions that require sub-second actions.

The Targeting Framework software does not come with any databases, and the configurable interfaces for case management and analysis of offender behavior require underlying transactional databases for proper functioning. These Web applications can use PostgreSQL, Oracle, MS SQL Server, or DB2 for that purpose. SAS' product "provides visualization of customizable data sets, which can be saved, modified, or exported to common file formats," allowing for seamless integration with other tools. Users can easily and automatically import data from a wide variety of platforms, such as relational databases, data warehouse applications, distributed file systems, mainframe (non-relational) data sources, and PC Files (e.g., Microsoft Excel, Microsoft Access, and dBase). A graphical tool is provided to allow relevant data to be exported.

The statistical methods applied to the production of various types of analytic results were not specifically enumerated, but a partial list can be found on the company's Web site under SAS Advanced Analytics and Business Intelligence & Analytics[13]. SAS noted that it "… provides an

[12] After the RT&E Center's market survey research was completed, an "Offender Tracking Record Transfer Service Specification" report prepared by the Global Standards Council was published, which described the development of a Global Reference Architecture Service Specification Package (SSP) for standardizing the transfer of offender tracking records between systems. That SSP was based in part on Initial Information Exchange Package Documentation funded by NIJ. This new report can be accessed at http://www.it.ojp.gov/GIST/186/Offender-Tracking-Record-Transfer-Service-Specification--Version-1-0.

[13] See http://www.sas.com/en_us/software/business-intelligence.html.

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analytic platform that contains the richest set of analytic tools in the industry as well as … integration of 3rd Party and open source analytic products."

In its response regarding known issues related to easily integrating the product with existing criminal justice information systems, SAS noted that its solution is "data agnostic." It delivers "a robust data integration capability for data extraction, transformation and loading functions with virtually any data source." However, the company cautioned that data access and quality comprise significant risks to a data mining/analytic warehousing project, and that "[s]ignificant effort is required to understand the nuances of the source data." The company acknowledged that it has prior experience with similar criminal justice data, and this experience would be leveraged when customizing an offender-monitoring solution for correctional departments and agencies.

A wide variety of options are provided for displaying results or exporting data to other applications. The Output Delivery System (ODS) enables SAS procedures to generate output in several different output formats, and it controls the formatting of these products. "End users can query, report and navigate through warehouse data using an easy, point-and-click web interface …" and web browsers can "dynamically access SAS data marts for reporting, graphics and drill-down analysis."

When describing the company's approach to maintaining cyber security of the data and accompanying analyses, it noted, "SAS solutions are used extensively by highly secure agencies throughout the US government and can be configured to comply with necessary security requirements." The "SAS 9 Security Model is multi-tiered and includes integration with and exploitation of network, OS, DBMS and its own metadata level security environments. Overall user security (authentication and authorization) is managed through the central administrative interface - the SAS Management Console (and) [i]nformation being exchanged between SAS servers can be encrypted." Customers with greater needs for security can choose to encrypt all traffic; a variety of encryption algorithm alternatives are available.

With regard to reporting and the degree to which reports are customizable, SAS indicated that it provides "out-of-the-box predefined reports and dashboards for all types and levels of users" that rely on scored and ranked results. "Interactive, self-service reports are available in a secure manner to the appropriate personnel with the proper credentials… (and) interactive web interfaces help users easily review cases, status, results and management information, and identify trends and anomalies to glean new insights."

Patterns in the data, exceptions to "business" rules, and the overall accuracy, completeness and validity of the data can be monitored over time and displayed on dashboards to provide insights into overall trends in the data (Reference [16]).

6.2 Sentinel Visualizer, Ver. 7

The ODBC-compliant Microsoft SQL Server database used by (and supplied with) Sentinel Visualizer can hold millions of records, but link chart displays are limited to approximately 20,000 entities (depending upon the size of the monitor and the amount of random access

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memory and processing speed available)[14]. However, these data are not automatically entered into Sentinel Visualizer's database. Data formatted as text-delimited (i.e., csv), Microsoft Excel or Microsoft Access files must be acquired and aggregated using either the data-import tool or by manual entry. Separate datasets can be entered or imported into different databases if desired. All databases reside on the user's computing infrastructure or network, and as such the user is responsible for data security.

Although the analytical results produced by Sentinel Visualizer do not require post-processing, data can be exported to other applications for further analysis (e.g., as PDF, Microsoft Excel or XML files) as desired. No dashboards are provided with the standard system, and real-time analyses are not supported. Instead, the software produces entity and relationship reports. In responding to the request for information on known issues germane to integrating the product with existing criminal justice systems, the company indicated that its off-the-shelf pricing does not include an option for such integration. In normal operations, the user must import the data (e.g., using the product's data-import tool). However, Sentinel Visualizer can be customized (for an additional fee) to integrate with existing systems (Reference [17]).

6.3 INTELLITRACK, Ver. 1

The Track Group indicated that its product can concurrently monitor a "significant number" of data streams. Data can be imported as text files or through a Web service into a relational database based on Microsoft SQL Server, although several (unspecified) options are available. New tracking data and analysis results are continually added to that archive. SQL Lite is also required for internal process management.

Although this commercially available product provides a menu-driven set of analytical options, it is still being refined for corrections applications. The associated results do not require post-processing, but they can be exported to the Tableau application for further interpretation. The software produces output files in text-delimited (i.e., .csv) and Google Earth (i.e., .kml) formats. The company noted that a wide-variety of reports are available, many of which are customizable, but specific examples were not provided. Several unspecified methods are used to protect the confidentiality of personally identifiable information in accordance with customer requirements, and the company employs "the highest-level security protocols available" (Reference [15]).

6.4 VeriTracks, Ver. 11

VeriTracks can be accessed using any standard Web browser, and "[a]ll offender information (e.g., name, address, phone number(s), risk level, physical characteristics) and monitoring data (e.g., GPS location points, violations, zones, zone schedules) are securely stored within VeriTracks." No additional databases are required to access or perform work while using this product. After logging in, authorized users can view their entire caseload on a dashboard, which shows an offender's alert status, risk level, location status and equipment type. Customers "can select a client to view his/her violations and events. The events are listed in chronological order under the Events tab in the Enrollee tile. Authorized personnel can confirm events and add freeform notes … at any time. They can also view a GPS-related event on a map."

[14] FMS has displayed up to 60,000 entities during its internal testing.

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The approach adopted by STOP for transferring data to and from VeriTracks involves having its software engineering team work with the customer's IT group to develop secure APIs. All fields are mapped and thoroughly tested before launch. For example, such data could be downloaded from the agency's offender records system or uploaded into the agency's database. The preferred file format is discussed with the customer and agreed to during development of the APIs; any of the most commonly used data formats can be employed. STOP is not aware of any issues related to the ability of VeriTracks to integrate with other systems through those APIs.

The company indicated that "an unlimited number of data streams can run concurrently without impacting the functionality and speed of VeriTracks." All monitoring data are available as soon as they are received from BLUtag, including data related to the product's analytics functionality. Although post-processing is not required, data can be exported in customer-chosen formats. The most commonly requested file formats are Google Earth (.kml), text (.csv), Microsoft Excel (.xlsx), and .pdf. The underlying statistical approach used by the software to provide analytics results is proprietary.

STOP noted that it "takes a proactive approach to application and network security, upgrading security measures on a continuous basis…. (using) industry-leading technology and tools to provide the highest levels of security to protect monitoring data, prevent hacking into our monitoring system and implement fast fault recovery." Interested agencies should contact STOP for more details.

The VeriTracks reporting subsystem can be customized to support the customer's requirements. An "initial standard template of reports are delivered to setup a customer's database, but additional reports can be added that have been developed specifically for the Agency." Any of the standard reports that are not required by the agency can be removed from the template, and any aspect of the report format can be changed, including insertion of an Agency's logo and re-arranging data elements. "Due to the volume of data referenced by many of VeriTracks reports, our custom report writing group facilitates the process of customizing reports for customers. Customizing reports is a very straightforward process,... (that) can very easily be initiated" at the agency's request (Reference [14]).

6.5 BI Analytics: Risk-based Dashboard Analytics Suite

BI's Analytics Suite comprises a risk-based dashboard that is a Graphical User Interface (GUI) adjunctive to the TotalAccess caseload snapshot. The dashboard displays an "offender list, sorted by highest risk offender, (and provides) [g]auges that detail average risk scores by offender and respective alert category (behavior, equipment, and travel) based on current and historical views." The product also provides Alert Response Analyses, which include "(a) Client Analyses (Comparison Analysis, Summary Analysis, Detail Analysis), (b) Officer Analyses (Comparison Analysis, Summary Analysis, Detail Analysis), (and) (c) Agency Analyses (Overview Analysis)." Users can select analysis timeframes and adjust sorting options by three risk-based categories. The Alert Response Analyses can be customized to allow users to select timeframes and specific officers and clients.

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The number of data-streams that can be monitored is unlimited, and no additional databases are required. Acceptable data-input file formats include ASCII, .csv text, .shp, .dbf and .bmp. A proprietary algorithm is used to generate risk-based scores that identify the highest risk offenders in the case management tool, but the company did not explicitly list the analytics products that the software provides in real-time. Although not required, the option exists for users to export files to other applications for further analysis. In particular, users can export data to Google Earth or to Microsoft Excel (e.g., for extracting current/historical alert trend data). BI is unaware of any issues regarding integrating its product with existing criminal justice information systems.

BI's approach to maintaining cyber-security and protecting personally identifiable information is "based on NIST Special Publication 800-53 ('Security and Privacy Controls for Federal Information Systems and Organizations')," which can be found at http://dx.doi.org/10.6028/NIST.SP.800-53r4 (Reference [13]).

6.6 GeoTime, Ver. 5.6

GeoTime utilizes "geofencing and historical movement trails" to produce real-time analytical results, and "[m]eeting finder, proximity detector, active site finder, speed finder, gap finder, stationary finder (stop finder), (and) cluster finder" to produce historical analyses. No additional databases are required for exercising the product, and data can be input using any of several file formats (e.g., .xlsx, .csv, .kml, .jpg, .png, .xml and as shape files). There is no limit on the number of live XML streams that can be monitored in real-time, and the company does not know of any issues regarding integrating its product with existing criminal justice information systems.

Although not required, GeoTime provides an option for exporting data and reports for further analysis. Output file formats include Microsoft PowerPoint (.ppt), text (.csv), Google Earth (.kml), screen-shots (.jpg, .png), and animated playback of movement (.avi). An "integrated reporting system" is also provided, which "allows for the rapid creation and publishing of work products. Users can easily markup data and capture both static and animated images of the data. Publishing of reports is done via PowerPoint or as a video file," and both two- and three-dimensional views are provided for standard use. GeoTime relies on the protocols and procedures that exist at the user's site for data handling and protection, i.e., for maintaining cyber-security and protecting personally identifiable information (Reference [18]).

6.7 EM Manager

Given 3M's decision not to respond to the RFI, no description is provided for these aspects of EM Manager. The referenced product brochure indicates that users can search for GPS points for all of the offenders being tracked, and a few screen shots of the graphical user interface are shown. Agencies that desire to understand this software better should consult 3M Electronic Monitoring directly (References [10], [12]).

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Table 6–1. Data Formatting and Information Exchange Summary

Topic	SAS Institute	FMS	Track Group	Satellite Tracking of People	BI	Uncharted Software
Data entry/access method	NR	NR	NR	Development of secure APIs	NR	NR
Data sharing protocols	None adopted; integration into standard XML possible.	Export to .pdf, Excel, and .xml	Product specific. No restrictions.	Secure API interface to offender records system.	Yes	N/A
Acceptable data-input formats	Data can be sourced natively by common approaches (e.g., Hadoop, UNIX, open-source platforms, PCs, mainframes).	Text-delimted (i.e. .csv), Microsoft Excel or Access	Text files or from a web service	Any of the most commonly-used formats, which are agreed upon with agencies when developing APIs.	ASCII files, .csv text files, .shp, .dbf, .bmp, other	.xlsx, .xls, .csv, .kml, .shp, .jpg, .png, .xml
Number of data streams that can be monitored concurrently	Typically restricted by either hardware or network limitations.	The Microsoft SQL Server database can hold millions of records, but link chart displays are limited to about 20,000 entities.	Not directly specified. A "significant number" can be concurrently monitored.	An unlimited number of data streams can run concurrently without impacting the functionality and speed of VeriTracks.	Unlimited	GeoTime has no set limit to the number of live XML streams that can be monitored in real time.
Ability/need to create a new database that aggregates the acquired data	Data can be automatically imported from relational data bases; distributed file system; data warehouse applications; PCs, mainframe (non-relational) sources.	Users can create as many databases as desired, but the data-import tool must be used for aggregation.	NR	Users do not need to create any new databases to aggregate acquired data.	Option for export to MS Excel	No
Type and purpose of databases supplied with the product	The software itself does not come with any databases.	Microsoft SQL Server	Relational database. Data and results are continually added using MS SQL Server.	All offender information and monitoring data are securely stored within VeriTracks.	Users can export data to Excel to extract alert trend data for further analysis.	N/A
Additional databases that must be accessed to use the product	Underlying transactional databases; PostgreSQL, DB2, Oracle, MS SQL Server.	None	SQL Lite - for internal process management.	No additional databases are needed to access or perform work.	None	None
Known issues with integrating the product with criminal justice information systems	Data agnostic approach to data extraction, loading and transformation from most data sources. Data access and quality can be a risk to a data mining project.	Sentinel Visualizer does not integrate with “existing justice information systems", but it can be customized to do so for an additional fee.	Commercial challenges around contracting arrangements.	None, using secure APIs.	None	None
Analytic products provided in real-time or that require post-processing	NR	None	The menu-driven set of analytical options are still being refined for corrections applications.	All monitoring data is made available as soon as it is received. Post-processing is not required.	NR	NR
Date of Information (2015)	9/25, 10/5	9/16, 9/17	10/6, 10/9	9/23	10/2, 10/5	9/29, 10/1

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Table 6–1 (continued)

Topic	SAS Institute	FMS	Track Group	Satellite Tracking of People	BI	Uncharted Software
Underlying statistical approaches for producing analytic results	An initial list of the statistical approaches used can be found on the web (see the text).	NR	NR	The statistical approach used by VeriTracks is proprietary information and will not be released.	A proprietary algorithm generates a risk-based score that is used to identify the highest-risk offenders.	Real-Time: geofencing and historical movement trails. Historical: Meeting, cluster, speed, gap and stop finders, proximity detector.
Ability/need to export output files for further analysis	A graphical tool permits export of relevant data; integration with other applications can occur using Web Services, REST APIs, and file transfers.	As desired by the User. Since Sentinel Visualizer's database is ODBC-compliant, third-party products can be used to access the data.	Files can be exported to the Tableau application.	There is no need to export data to other applications for additional analysis.	The option exists but it is not a requirement.	GeoTime exports both data and reports for further analysis as required.
Output file formats produced by the analytic software	Outputs can be generated in several formats, including: .pdf, .rtf, .xml, .csv, and .html	.pdf, Excel, .xml	.csv and .kml	Agencies request the format; the most commonly-requested are .kml, .csv, .xlsx and .pdf.	.csv, .pdf, and Google Earth.	PowerPoint (.ppt), .csv, .kml, screenshots (.jpg, .png), animated playback of movement (.avi)
Method for maintaining cyber-security of the data and analysis products	SAS solutions are used extensively by highly-secure agencies throughout the US government and can be configured to comply with necessary security requirements.	Users are responsible for data security since all databases reside on their computers/networks.	Use of "the highest-level security protocols available".	Industry-leading technology is used to provide the highest levels of security to protect monitoring data, prevent hacking and to implement fast fault recovery.	Based on NIST Special Publication 800-53 ("Security and Privacy Controls for Federal Information Systems and Organizations".	GeoTime users employ the protocols and procedures that exist at their sites for data handling, security and publishing of analytical products.
Method for protecting confidentiality of personally-identifyable information	Encryption algorithms specified at installation time. Industry-standard encryption algorithms such as AES are available.	Database(s) reside on the user's computer/network. The user is responsible for data confidentiality and security.	Specific procedures were not identified. Several methods are used, which are driven by customer requirements.	The response provided was identical to that for maintaining cyber security.	Based on NIST Special Publication 800-53	GeoTime users employ the protocols and procedures that exist at their sites for working with personally-identifiable information.
Types of available reports and the extent to which they are customizable	Out-of-the-box predefined reports and dashboards are provided for all types and levels of users, which can be customized to fit user needs. Interactive reports and web-interfaces help users easily review cases, status, scored and ranked results and management information.	Entity and Relationship reports are included in the Sentinel Visualizer software.	Specific examples were not provided. A wide-variety of reports are available. Many are customizable.	A wide variety of customization options are available. A standard template of reports is delivered initially, but reports developed specifically by and for the agency can be added and those not needed can be removed.	(1) Risk-based dashboard; (2) Alert Response Analyses: (a) Client, (b) Officer, (c) Agency. These allow users to select analysis timeframes and adjust sorting options.	An integrated reporting system is provided, which permits work products to be rapidly created and published (in Power Point or as a video file). Users can easily markup data and capture both static and animated images of the data.
Standard dashboard configurations provided	Customizable business rules are provided for tracking patterns in data, looking for exceptions, and keeping track of the overall accuracy of the data. These can be monitored over time and displayed on dashboards.	No dashboards are included.	NR	An agent's entire caseload can be viewed on a Dashboard showing location and alert status, and risk level. A chronological view can be selected of a client's violations and events, and GPS events can be displayed on a map. Freeform notes can be added at any time.	(a) Display the offender list, sorted by highest risk offender; (b) Gauges detail average risk scores by offender and respective alert category based on current and historical views.	GeoTime employs both 2D and 3D views for standard viewing.
Date of Information (2015)	9/25, 10/5	9/16, 9/17	10/6, 10/9	9/23	10/2, 10/5	9/29, 10/1

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7. REQUIREMENTS FOR HOST-AGENCY COMPUTING SYSTEMS

The RFI solicited information in several categories related to host computing system requirements, such as operating systems capable of running the products, the recommended minimum amount of random access memory (RAM) and processor speed, and the hard disk storage needed. It also asked about graphics requirements and whether analytics products are vendor-agnostic, i.e., capable of being used with data provided by location-based surveillance technologies offered by other companies. The responses received are described briefly in this section, and summarized in Table 7–1.

7.1 Operating System Requirements

The analytics products described in this report run on a variety of different operating systems. For example, the SAS Targeting Framework is supported on different releases and distributions of Linux, Unix, WinC and Apple's zOS (Reference [16]). FMS' Sentinel Visualizer runs on Microsoft Windows 7 or later versions (Reference [17]), and Track Group's INTELLITRACK requires Windows XP or later versions and Microsoft Server 2008 and above (Reference [15]). The BI Risk-based Dashboard Analytics Suite runs on Windows 7 or higher and Internet Explorer 10 or better (Reference [13]). Uncharted Software's GeoTime software also operates with Windows 7 as well as with either the 32-bit or 64-bit versions of Windows 8/8.1 (Reference [18]). In contrast, STOP's VeriTracks product is a Web-based monitoring application that is accessible using standard Web browsers on any computer, smart phone or tablet with a high-speed Internet connection. Agencies do not need to download any software onto their IT network or individual computers (Reference [14]). No information was available for 3M's EM Manager.

7.2 RAM, Processor Speed and Hard-Disk Storage

The RAM, processor speed and storage requirements also vary among the respondents. Since each deployment is unique, SAS provides solution sizing for each customer. The minimum requirements are dependent upon several variables. To size those environments, the company "recommends utilization of the SAS Enterprise Excellence Center. The sizing will include all the hardware necessary to support the System. SAS will work with those correctional departments and agencies to correctly size the storage, including growth over time" (Reference [16]). The FMS system requires "4GB RAM, SSD hard drive, Intel chip, (and a) Windows operating system. While there are not any minimum speed requirements,… the more powerful the machine the better the software will operate" (Reference [17]).

Track Group's software is able to operate on an x86 processor running at 1.4 GHz or higher, or on an x64 running at 2.0 GHz. However, any modern processor should work (e.g., an Intel Core 2 Duo or Core i5/i7) but processor speeds of 2.0 GHz or faster are recommended. With regard to random access memory, 2 GB are needed when using an x86 CPU and 4 GB or more are recommended for x64 CPUs. The base installation utilizes ~500 MB of hard disk space for the desktop version. For the Web version, the cached XML Browser Application (XBAP) uses ~100-200 MB (Reference [15]).

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STOP "recommends the following specifications for the computer, smart phone or tablet used to access and login to VeriTracks: 4GB RAM, (no minimum hard disk space is required) and minimum processing speed of a Pentium chip" (Reference [14]). BI Analytics recommends 4 GB of RAM, 80 GB of hard disk space, and a 1.6 GHz Pentium 4 chip or better for implementing its Risk-based Dashboard Analytics Suite (Reference [13]). Uncharted Software's GeoTime product (Reference [18]) requires 2 GB of RAM, 1 GB of free hard disk space and a 1.6 GHz Intel Core i3 processor or equivalent (2 cores). Further discussion of GeoTime's requirements can be found at http://www.geotime.com/Support/System-Requirements.aspx. No information was available for 3M's EM Manager.

7.3 Graphics Board and Display Requirements

The information provided in this category by the six companies that responded to the RFI is useful but difficult to compare since they did not uniformly address the same aspects of these items. The SAS product requires a standard Windows operating system, client workstation and graphics card. The display should feature a 15-in monitor with a pixel resolution of 800 x 600 at four bits per pixel (bpp). FMS requires support for DirectX 9 graphics with 512 MB of graphics memory. BI Incorporated indicated that a VGA or better was necessary, with 1,024 x 768 pixels or better resolution. Uncharted Software replied that an integrated Intel HD or Iris 4000/5000 series chipset was necessary. For the STOP product, there are not any minimum requirements for the graphics board to access VeriTracks. Neither Track Group nor 3M provided a response in this category (References [13], [14], [16]–[18]).

7.4 Software Utilization Options

The analytic solutions offered by SAS, Track Group, BI, Uncharted Software and FMS are vendor agnostic, and can be used with any offender monitoring technology. However, the latter company's product, Sentinel Visualizer, is a desktop (client/server) software application into which data must be imported.

In contrast, STOP's VeriTracks must be used with BLUtag, the company's one-piece monitoring device. While STOP frequently creates secure APIs in order to download or upload data, VeriTracks can be used only with that company's GPS and RF monitoring equipment. No information was available about 3M's EM Manager (References [13]–[18]).

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Table 7–1. Requirements for Host-Agency Computing Systems

Topic	SAS Institute	FMS	Track Group	Satellite Tracking of People	BI	Uncharted Software
Computer operating systems capable of running the product.	SAS solutions are supported on different releases and distributions of Linux, Unix, WinX, Z0S.	Microsoft Windows 7 or later.	(a) MS Desktop Operating systems: Windows XP and above; (b) MS Server 2008 and above.	VeriTracks is a web-based monitoring application. Agencies do not need to download any software.	Microsoft Windows 7 or better. Internet Explorer 10 or better.	Microsoft Windows 7, or Windows 8/8.1 (32 or 64 bit).
Minimum amount of RAM, hard disk space and speed required to install and run the product on each type of acceptable operating system.	SAS provides solution sizing for each customer through its' Enterprise Excellence Center. The sizing process addresses all the hardware necessary to support the System as well as the required storage capacity, including anticipated growth over time.	4GB RAM, SSD hard drive, Intel chip, Windows operating system. While there are not any minimum speed requirements, the more powerful the machine the better the software will operate.	(a) Processor: x86 or x64 running at 1.4 GHz or higher. (Any modern processor should work, such as an Intel Core 2 Duo or Core i5/i7); (b) Memory: 2 GB for x86 CPU, 4 GB or more for x64; (c) Hard Drive: Base install is ~500 MB (desktop). Cached XBAP application is ~100-200 MB (web).	STOP recommends the following specifications for the computer, smart phone or tablet used to access and login to VeriTracks: 4GB RAM, (no minimum hard disk space is required) and minimum processing speed of a Pentium chip.	4 GB RAM, 80 GB HD, 1.6 GHz Pentium 4 or better.	(1) 2 GB of RAM; (2) 1 GB of free space; (3) 1.6 GHz Intel Core i3 processor or equivalent (2 cores).
Minimum graphics board and display requirements for each type of operating system.	Standard Windows OS and client workstation and graphics card. Display: 15in, 800x600, 4bpp.	Support for DirectX 9 graphics with 512 MB of graphics memory.	NR	There are no graphics board minimum requirements for computers/devices used to access VeriTracks.	VGA or better. 1024 x 768 pixels or better resolution.	Integrated Intel HD or Iris 4000/5000 series chipsets.
Approximate amount of time needed to provide the principal analysis products on computers configured to meet these minimum requirements	The SAS Solution is "operationalized" providing automated outputs based upon various detection scenarios defined by the department or agency.	It depends upon the amount of data, the processing speed of the computer, and the ability of the User to produce a link chart.	Less than two minutes in most cases. Timing varies with the duration of the underlying track data.	All monitoring data in VeriTracks is immediately available for analysis and investigation once received by the application.	Immediately, no delay.	N/A
Whether the product must be used with a particular vendor's offender monitoring technology, or is vendor-agnostic.	SAS solutions are vendor agnostic.	Three formats of data can be imported into Sentinel Visualizer: a text-delimited (e.g., CSV) file, an Excel spreadsheet, or a Microsoft Access database.	Vendor-agnostic.	VeriTracks must be used with STOP's GPS and/or RF monitorig equipment. APIs can be created to exchange data with offender records systems.	Vendor-agnostic.	Vendor agnostic.
Date of Information (2015)	9/25, 10/05	9/16, 9/17	10/6, 10/19	9/23	10/2, 10/5	9/29, 10/01

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8. OPERATOR/ANALYST EDUCATION AND TRAINING REQUIREMENTS

The final section of the RFI sought information about the minimum education and training levels that each company felt are necessary to set-up and operate its analysis software product, and to interpret the results. The nature and availability of documentation and training aids was also probed. These responses are described below, and summarized in Table 8–1.

8.1 Minimum Education and Training Requirements to Set-up/Operate the Product

SAS indicated that interacting with its portal technology "is as easy as using a web browser to browse the internet" and that application development "requires no knowledge of HTML or JAVA programming. It is entirely point-and-click" (Reference [16]). Wide varieties of user interfaces are provided to meet customers' varying needs and technical expertise levels for analytic model creation and report building. Members of the SAS team provide appropriate training, and additional classroom and Web-based instruction is also available to supplement those resources.

FMS observed that there are no minimum education and training requirements for operating its product, and both the Track Group and BI Analytics responded that only a basic knowledge of computers is needed to operate their applications. Uncharted Software agreed with the latter, saying that GeoTime requires only basic Windows skills to operate and no prior training is necessary.

STOP noted that since the education/experience level of its customers varies widely, the firm's "Training Department can customize our curriculum to meet the needs of the Agency, its infrastructure and its supervising officers…. (Nevertheless) it is ideal if authorized users have earned at least a high school diploma. But those without a high school diploma can use our GPS monitoring system after completing our initial training course" (Reference [14]).

8.2 Number of Training Hours Needed to Set-up/Operate the Product

Most of the vendors quantitatively identified the amount of training-time necessary to set-up their product, although SAS simply indicated that its consultants will provide the customer's staff "with hands-on experience and knowledge transfer during implementation to ensure an easy transition into operations." The company's response elaborated that the "SAS team will develop knowledge transfer plans, with content and schedules …. (and) we will train your IT and administrative/managerial staff to operate and support the SAS solution to ensure they understand all of the processes for operating it." As agency personnel become skilled and confident in operating/supporting the SAS system, the amount of technical assistance provided is reduced. "Formal review and turnover of processes, documentation, training materials, data bases, software, testing, operations, and production support will be provided." If additional training is desired, "SAS can provide formal training for an additional fee," which includes interactive training options that are separately focused on training-the-trainer, self-paced and live

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Web-based courses, on-site training, and public courses at any of the company's U.S. sites (Reference [16]).

As noted above, specific time periods were identified by several of the vendors. For example, BI replied that one-hour is sufficient, while Uncharted Software stated that users generally start with 2 hours of online training, followed by an additional hour at a later date. The Track Group said that three-to-four hours of end-user training is recommended, and a 1.5-day commitment is required by STOP for users to participate in its training course. The latter covers all aspects of STOP's offender tracking system and extensive hands-on use of their hardware and software. FMS indicated there are no minimum requirements.

8.3 Minimum Educational/Experience Requirements for Interpreting Results

SAS did not directly respond to this information-request category, noting instead that "both analysts and statisticians can build more models, faster with a powerful, easy-to-use GUI…. (that provides an) easy-to-interpret visual view of the data mining process. Advanced visualization tools enable a user to quickly and easily examine large amounts of data in multidimensional histograms and to graphically compare modeling results." FMS and Unchartered Software said there are no minimum requirements, and both the Track Group and BI indicated that the only requirements are a high-school education, basic knowledge of offender-monitoring systems, and an ability to interpret graphical output. STOP responded that after completing their initial training course, authorized users can interpret the analytics results provided by VeriTracks.

8.4 Required Familiarity with Supporting Software

No specific previous experience is required to utilize the SAS tool. Knowledge transfer and training are available to help users begin utilizing SAS solutions rapidly. To utilize the FMS product, users will need to know how to perform basic operations with Excel and Google Earth and Microsoft's Windows operating system. Knowledge of Microsoft SQL would also be needed if users want to perform queries (or) stored procedures … at the database level. In addition, they would have to know how to use Microsoft SQL Server Management Studio if they want to back-up and (if necessary) restore the database" (Reference [17]). No additional requirements were identified by Uncharted Software or the Track Group, although the latter noted that familiarity with Google Earth would be helpful.

STOP responded that an agency-authorized user "must be familiar with PDF, Microsoft Word and Excel and comma delimited software programs since these are the formats reports and analytic tools use to display query results. It may be helpful if users know how to use a screen capture application, but it is not necessary to use our system" (Reference [14]). BI reaffirmed that users of its analytics software must be familiar with TotalAccess, which is that vendor's case management product.

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8.5 Available Documentation and Training Aids

SAS provides "a wealth of authoritative, easy-to-read documentation," much of which is provided online at no additional charge at http://support.sas.com/documentation/onlinedoc. In addition, "the SAS Publications Division maintains a wide variety of paper-based and online materials that support our software users at every level and stage of experience." Customers can access SAS Communities on the Web at http://support.sas.com/rnd/intro.html, and the documentation used to support training is provided to users as part of the training class (Reference [16]).

FMS offers a User guide and several YouTube videos, and the Track Group's product comes with embedded Help files, a User Guide, and other training materials. Agency-authorized users at all of STOP's customer sites "have unlimited access to our Solutions Center, which provides technical support 24 hours a day, 365 days per year. They also have unlimited access to our secure online library that contains training guides, hints and tips cards and videos" (Reference [14]). BI offers an accessible Help Desk, User Manuals, screen-shots, sample data and training classes. Uncharted Software provides "online … live training, as well as access to various online learning materials" including: (a) a full software help system and documentation; (b) online Training Videos; (c) the official GeoTime YouTube Channel (more than 70 videos); (d) GeoTime's Online User Group, which has more than 100 Law Enforcement members; (e) and a full-time Support Team based in Toronto, Canada (Reference [18]). 3M's Web site/product brochure indicated that officer training materials are provided to its customers, but additional details should be sought directly from that company.

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Table 8–1. Operator/Analyst Education and Training Requirements

Topic	SAS Institute	FMS	Track Group	Satellite Tracking of People	BI	Uncharted Software
Minimum education level/experience needed to set-up and operate the software.	Using SAS portal technology is as easy as using a web browser, and application development for the portal is entirely point-and-click, requiring no knowledge of HTML or JAVA programming. Training is provided throughout the project and additional classroom and web-based training is also available.	No particular minimum requirements.	Basic computer knowledge is required.	STOP's Training Department can customize a curriculum to meet the needs of an Agency, but it is ideal if authorized users have earned at least a high school diploma. But those without a high school diploma can use the company's GPS monitoring system after completing an initial training course.	High-school level knowledge of computers. No input files are required.	GeoTime requires basic Windows computer skills to operate and requires no prior training.
Minimum education level/experience needed to interpret the results.	Not directly answered.	No particular minimum requirements.	High school education with a basic knowledge of Offender Monitoring Systems.	After completing an initial course, users can interpret the analytical results provided.	High-school knowledge & ability to read/interpret graphics, etc.	GeoTime reports and videos are accessible to anyone.
Number of training hours necessary to set-up/operate the product.	SAS develops a knowledge transfer plan, and provides hands-on training to ensure an easy transition into operations. As personnel become more skilled in operating the system, the amount of technical assistance is reduced. After final transfer of the system, supplemental training can be provided for a fee.	No particular minimum requirements.	Three to four hours of training is recommended for end-users.	Initial training requires a 1.5-day commitment. This course covers all aspects of our GPS monitoring system and includes extensive hands-on use of the hardware and software.	One hour.	Most GeoTime users start with 2 hours of online training, followed up with an additional hour of training at a later date.
Types of available documentation and training aids (e.g., help desk, user manuals, screen shots, training classes, sample data).	SAS has developed a wealth of authoritative, easy-to-read documentation, much of which is provided at no additional charge, to support users at every level and stage of experience. Users can explore SAS Communities on the Web. Documentation used to support training will be provided as part of the class.	User Guide (200+ pages) and YouTube videos.	Embedded Help files, User Guide, training materials.	Users have unlimited access to STOP's Solutions Center, which provides technical support 24 hours a day, 365 days per year. They also have unlimited access to our secure online library that contains training guides, hints and tips cards and videos.	(1) Accessible help desk; (2) User manuals; (3) Screen shots; (4) Sample data; (5) Training classes.	GeoTime comes with online live training, as well as access to various online learning materials including: Full software help system and documentation; Online Training Videos; Official GeoTime YouTube Channel; GeoTime Online User Group; Full Time Support Team based in Toronto.
Support programs the user must be familiar with to use the product.	No specific previous experience is required to utilize the tool. Training is available to help users begin utilizing SAS solutions rapidly.	Users must know how to perform basic operations with Excel, Google Earth and Microsoft's Windows operating system. Knowledge of Microsoft SQL is also needed if users want to perform queries at the database level. Knowledge of the use of Microsoft SQL Server Management Studio is necessary if users want to back-up or restore the database(s).	Familiarity with Google Earth would be helpful, but it is not required.	PDF, Microsoft Word and Excel, and comma-delimited software programs. It may also be helpful if users can use a screen capture application.	BI's case management product: TotalAccess.	None
Date of Information (2015)	9/25	9/16, 9/17	10/6, 10/9	9/23	10/2	9/29, 10/1

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9. SUMMARY, ISSUES, AND RECOMMENDATIONS

This report summarizes information gathered by the RT&E Center directly from the responses provided by six companies to the RFI issued by NIJ in the Federal Register regarding the analytics features of their commercially available offender-tracking systems/software. It also describes some of the capabilities of a seventh vendor's product, which were derived by synthesizing information from its Web site and insights provided by correctional departments that use that firm's services. These businesses include companies that currently provide integrated offender-monitoring services to correctional customers (BI, STOP, Track Group, 3M), an industry-leader in big-data predictive analytics (SAS), and vendors offering to adapt current (often stand-alone) products that have been successfully applied to criminal justice and other applications (FMS, Uncharted Software) to community corrections. As such, it comprises a near-term resource for correctional departments and agencies that may be considering establishing or upgrading an analytics capability in support of their location-based monitoring mission prior to making purchasing decisions. Nevertheless, products and their capabilities evolve over time, and this snapshot will progressively become out-of-date.

Whether or not this information has lasting value will be determined by the degree to which the listed systems cost-effectively meet an agency's mission-related needs, as well as on how rapidly the characteristics of these systems evolve and on the volume of business that is generated for the reporting companies. These factors suggest that it will be important to reassess periodically the principal mission-related analysis needs of community corrections agencies engaged in location-based monitoring, whether those needs are being met by their current systems, and the state of the analytics marketplace.

With the growing need for deriving actionable information from the burgeoning volume of offender tracking system data, it will be essential to leverage advanced analytics to enable PPOs to manage more effectively their caseloads in the future. An effective approach to leveraging evolving corporate capabilities in analytics would be to implement the descriptions of relevant systems and analysis engines in an easily accessible and searchable online database that is periodically updated. As this type of resource became more widely recognized and utilized, vendors would be motivated to keep the information current, and other companies that haven't listed their products would be more likely to participate.

9.1 Principal End-User Information Needs

An initial view of end-user needs was obtained during this study by developing a brief questionnaire that was offered to ten "state" (including the District of Columbia) and four county-level correctional departments/agencies that focused on the analytics currently used in support of location-based electronic-monitoring missions, by whom, and with what product(s)[15].

[15] A range of terminology is presently used when discussing the three principal phases of electronic supervision comprising pretrial, probation and parole, and reentry. Although electronic monitoring was traditionally associated with "curfew monitoring" by RF-based systems, it is also used today as a synonym for location-based tracking with GPS technology. Electronic supervision itself refers to a broader array of technologies that assist with supervising individuals, including those used for crime-scene correlation and to monitor alcohol use remotely (Reference [22]).

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The analytics-oriented results from that inquiry are summarized below, and are presented more completely in Reference [23]. Although the departments selected and the questions posed were not chosen to provide statistically meaningful results, the knowledge acquired helped guide interpretations of the vendor responses to the published RFI.

Six responses were received, five of which came from state-level organizations: (1) California Department of Corrections and Rehabilitation (CDCR); (2) Oklahoma Department of Corrections (ODOC); (3)Michigan Department of Corrections (MDOC); (4) Maryland Department of Public Safety and Correctional Services (DPSCS); (5) Colorado Department of Corrections (CDOC); and (6) Pretrial Services, City and County of Denver. The Massachusetts Department of Corrections also responded, noting that it does not currently have a GPS-based tracking program. However, several county-level programs exist in that state (Reference [24]), and the Massachusetts Probation Service has operated an electronic monitoring program for probationers and parolees since 2001. That program was expanded to include sex offenders in 2005. None of those offices replied.

The number of offenders subject to community supervision in these and two other states that have large programs are shown in Table 9–1, together with representative values for the sizes of their electronically monitored populations and the subset tracked by GPS technologies. The latter range from a few hundred to a few thousand clients annually. The electronic monitoring program run by CDCR is the largest in the nation as measured by the number of offenders monitored by a single law enforcement agency, with as many as 10,000 clients being monitored on a daily basis in 2011 (Reference [25]).

Table 9–1. Community Monitoring Populations for Selected Jurisdictions

		Monitored Population Totals			Geographic Size	Ref.
Jurisdiction	**Staffing Level**	**Community Supervised Total**	**EM Supervised Total**	**GPS Monitored Subtotal**		
Colorado	~100	12,300	1,869	NR	Entire state	26
Oklahoma	NR	26,882	863	755	Entire state	20
Maryland	~166	60,000	6,128	5,561	Entire state	27
Michigan	~58*	NR	5,706	2,235	Entire state	21
California	290	44,000	6,900	6,400	Entire state	25
Denver	20	2,626	1,000	NR	City, County, some State	28
Texas**	NR	NR	3,672	2,100	Entire state	29
Florida***	NR	139,883	4,223	4,223	Entire state	30

* Call Center employees that monitor offender alerts. In addition, there are an unspecified number of field agents in each county.

** On average

*** As of July 31, 2015

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All of the responding departments/agencies use commercially available electronic monitoring systems to supervise their community-released offenders, but analytics were generally not an important factor in the competitive bidding processes. Overall price and responsiveness to agency requirements were identified as the predominant selection factors. For example, Maryland's DPSCS noted that it "has been more focused on the value of electronic monitoring as a containment tool and hasn't really explored the analytics aspect to any great degree." Reliability, ease-of-installation of the tracking hardware, and ease-of-use of the monitoring software were among the primary factors considered (Reference [27]). Similarly, ODOC noted that in addition to cost, its principal evaluation criteria were the offender population to be monitored, the performance of equipment in rural areas, and program set-up and implementation issues. ODOC's current system is 15 years old, and at the time its vendor was selected, the primary objectives were to track location and receive violation alerts. The department elaborated that as "analysis technology progresses and becomes more user-friendly, that feature would become more of a consideration" in any replacement systems that are contemplated (Reference [20]).

Although market forces have provided agencies with many attractive and affordable technology options for offender tracking and analysis in the past, the development and performance of those systems were not guided by standards. This resulted in considerable end-user confusion about the capabilities of products that agencies sought to procure. To address this issue, NIJ has recently released a voluntary standard that defines the minimum requirements and appropriate testing methods for assessing the performance of offender tracking systems (Reference [31]). Earlier drafts of that document, which has been under development for several years, were reviewed during several public comment periods and by the Government Accountability Office (GAO), (Reference [32]). Adherence to this voluntary standard will enable equipment performance claims to be confirmed under realistic and controlled environments and ensure that devices are built robustly.

9.2 Role of Analytics in Corrections

Each of the responding departments/agencies indicated that their current systems provide easily understandable information that allows individuals to view all the content permitted by their roles, permissions, and information technology devices. The systems generally support the establishment and monitoring of curfews, and have good mapping and tracking capabilities. However, when the six departments and agencies that responded to the survey were asked whether the system capabilities that enable their missions depend on the type(s) of offender(s) being monitored, CDOC, ODOC, Maryland's DPSCS and the City/County of Denver said "yes," but MDOC and CDCR said "no." MDOC indicated that "[w]e look for the same features for our entire population" (Reference [21]). Although Maryland indicated that the required capabilities do depend on the type of offender, it noted the DPSCS currently enter(s) only two types of offenders (sexual offenders and violent offenders) into its electronic monitoring program, and that "… the analytical capabilities we would be interested in would be somewhat similar for these two groups" (Reference [27]).

CDCR was the only respondent that indicated analytics represented one of its bid discriminators. To be successful, bidders were required to develop a "Point Pattern Analysis" (PPA) feature to distinguish locations on maps visually where offenders spent designated periods of time. That

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department's Division of Adult Parole Operations (DAPO) is currently exploring other uses of analytical software in addition to PPA (Reference [25]). MDOC focused its analytics comments on crime-scene analysis, which is promoted by that department "as a tool that can help solve crime," although that feature was not a major factor in their vendor/product selection process (Reference [21]).

9.3 Potentially Enabling Analytics Capabilities

What are the most significant roles that analytics could play in enabling mission effectiveness? To gauge views on this topic, the questionnaire asked correctional organizations what they considered to be the most important analytical capabilities for facilitating their offender-tracking responsibilities. Not surprisingly, the responses varied according to the perceived missions of the various departments. For example, Maryland's DPSCS reiterated that "our concentration to date has been on efficiently operating an electronic tracking program that contributes to the effective containment of particular types of offenders. We have not yet turned our focus to the analytic capabilities of the system" (Reference [27]). Of those departments and agencies that have, CDOC framed its response in the context of using predictive analytics to model offender behavior in order to help decide whether early intervention is warranted to prevent the commission of a crime (Reference [26]).

That theme was echoed by Denver Pretrial Services, which emphasized the importance of "[b]ehavior prediction, specifically when a defendant is getting closer and closer to a restricted location (in order to alert the officer that the defendant is pushing boundaries)." The value of "automating crime scene correlation by gaining access to an appropriate database" was also identified (Reference [28]). MDOC agreed, noting that the use of crime scene correlation and pattern recognition can help to solve crimes. It elaborated that "[o]ur concern is primarily monitoring offender movement and ensuring compliance with curfew schedules. Michigan requires its GPS agents to review all maps for every offender to try to determine pattern behavior. Pattern deviance or unusual/unexplained behavior can be investigated to determine if the offender is … preparing to commit new crime" (Reference [21]).

Among the additional CDCR-identified analytical needs, three areas emerged as most important: offender association monitoring; the ability to identify which new data are the most important to map based on approved protocols and algorithms; and acquiring quick and easily interpretable reporting options that identify any new locations frequented by an offender. For example, an ability to identify the timeframe when offenders "associate" with other monitored offenders would be valuable, provided it allows agents to filter out "approved" locations and times where associations are permitted (such as at a parole office, treatment provider, or shelter). Such a feature "should identify locations where the offenders were present at the same time, as well as locations where the offenders were present, but at different times." More generally, quickly accessible reporting is needed that identifies new locations frequented by an offender, where labeling can be used to eliminate the need to dwell on locations known by PPOs to be acceptable (e.g., the offender's home), and the definition of what comprises a "new location" is configurable by the amount of time spent at those sites (Reference [25]).

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The RT&E Center recognizes that advances will continue to occur in the technological[16] and analytic capabilities of products focused on geospatially monitoring community-released offenders. At the same time, the number of people released from prisons and jails will continue to grow. A decade ago, Renzema and Mayo-Wilson (Reference [34]) concluded that while electronic monitoring of offenders had been in use for diverse purposes for more than two decades, "applications of EM as a tool for reducing crime are not supported by existing data." Whether location-based tracking can be effective in reducing crime and ensuring community safety is still unclear today. Fragmentation among agencies, legal processes and constraints, and local and state budgets will all contribute to shaping the future of this increasingly important and widely used tool.

[16] Information on the (then) current state of commercially available offender-tracking systems marketed for use by the criminal justice community was solicited by an earlier RFI released by NIJ in the January 26, 2015 issue of the Federal Register Notices (Vol. 80, No. 16, pp. 3989-3991). The data collected were used to support a separate market survey of location-based offender tracking technologies, which was published by the RT&E Center earlier this year (Reference [33]).

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APPENDIX A. PUBLISHED REQUEST FOR INFORMATION

The Request-for-Information on commercially offered analytics products for deriving actionable information from the data returned by geospatial technologies affixed to community-released offenders is shown below. It appeared as a Notice in the September 1, 2015 edition of the Federal Register as "Offender Monitoring Analytics Market Survey," Vol. 80, No. 169, pp. 52796-52798 (Reference 2), and can be viewed online at https://www.federalregister.gov/articles/2015/09/01/2015-21564/offender-monitoring-analytics-market-survey).

DEPARTMENT OF JUSTICE
Office of Justice Programs
[OJP (NIJ) Docket No. 1693]
Offender Monitoring Analytics Market Survey

AGENCY: National Institute of Justice

ACTION: Notice of Request for Information

SUMMARY: The National Institute of Justice (NIJ) is soliciting information in support of the upcoming National Criminal Justice Technology Research, Test, and Evaluation Center (NIJ RT&E Center) "Market Survey of Offender Monitoring Analytics (OMA) Technologies." This market survey, which will address offender monitoring in community settings, will be published by NIJ to assist agencies in their assessment of relevant information prior to making purchasing decisions on commercially available systems being marketed for use by criminal justice professionals. The NIJ RT&E Center also invites comments with regard to the market survey itself, including which categories of information are appropriate for comparison, as well as promotional material (e.g., slick sheets) and print-quality images in electronic format.

DATES: Responses to this request will be accepted through 11:59 p.m. Eastern Daylight Time on September 25, 2015.

ADDRESSES: Responses to this request may be submitted electronically in the body of or as an attachment to an email sent to administrator@nijrtecenter.org with the recommended subject line "OMA Federal Register Response." Questions and responses may also be sent by mail (please allow additional time for processing) to the following address: National Criminal Justice Technology Research, Test and Evaluation Center, ATTN: OMA Federal Register Response, Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Road, Mail Stop 17-N444, Laurel, MD 20723-6099.

FOR FURTHER INFORMATION: For more information on this request, please contact Hal Heaton (NIJ RT&E Center) by telephone at 443-778-5025 or administrator@nijrtecenter.org. For more information on the NIJ RT&E Center, visit http://nij.gov/funding/awards/Pages/award-detail.aspx?award=2013-MU-CX-K111 and view the description or contact Jack Harne (NIJ) by telephone at 202-616-2911 or at Jack.Harne@usdoj.gov. Please note that these are not toll-free telephone numbers.

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SUPPLEMENTARY INFORMATION: *Information Sought:* The NIJ RT&E Center seeks input to its upcoming "Market Survey of Offender Monitoring Analytics (OMA) Technologies," which seeks to identify commercially available products being marketed to the offender monitoring community to facilitate the discovery and communication of meaningful patterns in diverse data that address their strategic and tactical information needs. OMA products may (but are not necessarily restricted to) use various combinations of statistical analysis procedures, data and text mining, and predictive modeling to proactively analyze information on community-released offenders to discover hidden relationships and patterns in their behaviors and to predict future outcomes. They may feature dashboards (i.e., user-interfaces) that provide easily understandable information in either real-time or off-line to a wide variety of professionals, which are customizable to permit command staff, Probation and Parole Officers (PPOs), crime analysts, and officers on the street to view all content permitted by their roles, permissions and information technology devices.

Usage: This market survey will be published by NIJ to assist agencies in their assessment of relevant information prior to making purchasing decisions. Whether an agency faces a mandate to monitor the habits of offenders released into the community, institute proactive policing by performing crime-scene correlation, or to more effectively allocate resources based on real-time planning, OMA technologies can provide cost-effective tools for quickly extracting actionable knowledge from the plethora of available data.

Information Categories: The NIJ RT&E Center invites comments with regard to the market survey, including which categories of information are appropriate for comparison, as well as promotional material and print-quality images (e.g., of analytical graphics and associated dashboards) in electronic format. At a minimum, the Center intends to include the following categories of information for *each* OMA model, service, or product:

1. Vendor Information:
    a. Name
    b. Address of corporate office
    c. Years your company has been in the OMA business
2. Product Information:
    a. Product name and version number
    b. Purpose of the OMA product
    c. Intended market (e.g., community corrections, crime-scene correlation)
    d. Method for accessing product (e.g., purchase, lease, vendor-hosted)
    e. Installation options (e.g., stand-alone package or networkable)
    f. Time required to install the software on compatible computers
    g. Supporting (i.e., tethered) software packages required to implement/use the OMA product (including their version numbers)
    h. Licenses required to use the product and/or tethered software
    i. Manufacturer Suggested Retail Price for the base product, including licenses

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j. Cost of any tethered software, including licenses
k. Terms and cost of any standard and extended warranties offered
l. Software version-upgrade approach (e.g., expected release frequency, cost)
m. Approach and cost to customers for post-procurement technical assistance

3. Performance Characteristics and Validation:
   a. Criminal justice (or other) requirements the product was developed to address
   b. How the tool adds value to and differs from other commercial products
   c. Whether the product offers configurable levels of Administrative Privileges
   d. Approach for evaluating whether the product meets user needs (e.g., repeat customers, interviews, satisfaction surveys)
   e. Whether and how product performance has been verified and validated
   f. Examples of the OMA product's impact on users

4. Analyses Performed by the Product (minimum Y/N; additional detail welcomed):
   a. Geospatial analysis of offender habits;
      » Track individual offenders
      » Track groups of offenders
      » Offender stop-analysis and drill-down capabilities
      » Offender association monitoring/congregation analyses
      » Entity-resolution
      » Identify patterns of activity
      » Visually differentiate client data points obtained on different days
      » Victim monitoring
   b. Geo-contextualization of offender habits on commercially available maps and/or archived imagery (Identify compatible mapping and imagery products);
      » Perform geocoding and reverse geocoding
      » Provide both aerial and street views of local and regional scenes
      » Overlay points-of-interest on maps/imagery (e.g., offender residences, public transportation types/routes, schools, parks and other landmarks)
      » Conduct geographic profiling
      » Heat maps
   c. Social Network Analysis
   d. Automated crime-scene correlation with offender space-time habits;
      » Requires separate analysis of the data acquired from each jurisdiction
      » Requires separate analysis of the habits of each offender
      » Encompasses multiple jurisdictions over defined space-time windows and all offenders monitored by a PPO
      » User specification of time and distance thresholds for analyzing events

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- » Ability to hover over map points-of-interest to obtain more information
- » Identification of possible travel routes following commission of a crime
- » Automatic creation (and updating) of offender watch lists

e. Case-load management planning by PPOs;

- » Definition of curfews (i.e., confinement and restriction zones)
  - ➢ Creation of global zones
  - ➢ Creation of free-form zones
  - ➢ Configuration of zones as circles, rectangles or arbitrary polygons
  - ➢ Customization of monitoring parameters to individual offenders
  - ➢ Application of established zones to more than one client
  - ➢ Creation of zone templates for certain classes of participants
  - ➢ Implementation of mobile restriction zones
  - ➢ Setting of warm zones around hot zones
- » Review of tracking points and approval of acceptable behavior
- » Automated configuration of logged events as alerts when appropriate, and implementation of event escalation procedures

f. Basic predictive modeling (e.g., spatial regression analysis);

- » Prediction of offender behavioral trends
- » Prediction of good candidates for community monitoring
- » Next-event forecasting based on linked crime-incident locations
- » Computation of statistical significance of spatial-temporal crime repetition probabilities (e.g., using Monte Carlo simulation techniques)
- » The location of a serial offender anchor point(s)

g. Additional capabilities not covered above (please list)

5. Data Formatting and Information Exchange:

a. Method for entering/accessing/exchanging data (e.g., manual, created using other applications (list them), Web Services, other);

- » Data sharing protocols adopted (e.g., NIEM)
- » Acceptable data-input file formats (e.g., ASCII files, .csv text files, .shp, .dbf, .bmp, other)
- » Number of data-streams that can be concurrently monitored
- » Ability/need to create a new database that aggregates the acquired data, and if so, the data-basing approach (e.g., relational, semantic)

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b. Type and purpose of any databases supplied with the analytics software
c. Additional databases that must be accessed to operate the software
d. Known issues germane to easily integrating the software with existing criminal justice information systems and technology
e. Analytic products provided by the OMA software in real-time, as well as those that require post-processing;
    » Underlying statistical approach used to produce product (e.g., cluster analysis, autocorrelation analysis, others)
f. Ability/need to export output files to other applications for further analyses
g. Output file formats produced by the analytics software (e.g., .kml, .shp, .csv)
h. Method for maintaining cyber-security of the data and analysis products
i. Method for protecting confidentiality of personally identifiable information
j. Types of available reports and the extent to which they are customizable
k. Standard dashboard configurations provided by the product

6. Requirements for Host Agency Computing Systems:
    a. Computer operating systems capable of running the product
    b. Minimum amount of RAM (GB), hard disk space (GB), and speed (MHz) required to install and run the OMA product on each type of operating system
    c. Minimum graphics board (e.g., must support OpenGL 1.0) and display (e.g., size, resolution, color levels) requirements for each type of operating system
    d. Approximate amount of time taken to provide the principal analysis products on computers configured to meet these minimum requirements
    e. Whether the product must be used with a particular vendor's offender monitoring technology or is vendor-agnostic

7. Operator/Analyst Training Requirements:
    a. Minimum education level/experience needed to set-up and operate the software (e.g., high-school level knowledge of computers; college-level statistics to create required input files and select appropriate options)
    b. Minimum education/experience needed to interpret the output results
    c. Number of training hours necessary to set-up/operate the product
    d. Types of available documentation and training aids (e.g., embedded help files, accessible help desk, user manuals, on-line instruction videos, screen shots; sample data; training classes)
    e. Support programs the user must be familiar with to use the tool.

Dated: August 21, 2015.
Nancy Rodriguez,
Director, National Institute of Justice.
Billing Code: 4410-18-P

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APPENDIX B. ABBREVIATIONS AND ACRONYMS

3G	Third Generation
ACM	Adaptive Case Management
AES	Advanced Encryption Standard
ALPR	Automatic License Plate Reader
API	Application Programming Interface
APPA	American Probation and Parole Association
ASCII	American Standard Code for Information Interchange
AT&T	American Telephone and Telegraph
AVI	Audio Video Interleave (multi-media file format)
BMP	Bitmap (file format)
Bpp	Bits per Pixel
CDCR	California Department of Corrections and Rehabilitation
CDMA	Code Division Multiple Access
CDOC	Colorado Department of Corrections
COTS	Commercial-off-the-Shelf
CPU	Central Processing Unit
CSV	Comma Separated Variable (text file format)
DAPO	Division of Adult Parole Operations
DBF	Database File (format)
DBMS	DataBase Management System
DPSCS	Department of Public Safety and Correctional Services
EM	Electronic Monitoring
eOMIS	Electronic Offender Management Information System
FBI	Federal Bureau of Investigation
FRN	Federal Register Notice
FTP	File Transfer Protocol
GB	Giga Byte
GIS	Geographic Information System
GPS	Global Positioning System
GSM	Global System for Mobile (communications)
GUI	Graphical User Interface
HTML	HyperText Markup Language
IACA	International Association of Crime Analysts
iOS	iPhone Operating System (Apple)
IT	Information Technology
JPG	Joint Photographic Group (image file format)
KML	Keyhole Markup Language (Google Earth file format)
LE	Law Enforcement
LLC	Limited Liability Company
MB	Mega Byte
MDOC	Michigan Department of Corrections
MS	Microsoft

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MSRP	Manufacturer's Suggested Retail Price
N/A	Not Applicable
NASPO	National Association of State Procurement Officials
NIEM	National Information Exchange Model
NIJ	National Institute of Justice
NIST	National Institute of Standards and Technology
NLECTC	National Law Enforcement and Corrections Technology Center
NR	No Response
ODBC	Open Database Connectivity
ODOC	Oklahoma Department of Corrections
ODS	Output Delivery System
OMA	Offender Monitoring Analytics
OS	Operating System
OTS	Offender Tracking System
PC	Personal Computer
PDF	Portable Document Format (file format)
PNG	Portable Network Graphics (image file format)
PO	Probation or Parole Officer
POC	Point-of-Contact
PPA	Point Position Analysis
PPO	Probation and Parole Officer
RAM	Random Access Memory
REST	Representational State Transfer
RF	Radio Frequency
RFI	Request for Information
RT&E	Research, Test and Evaluation
RTF	Rich Text Format (Microsoft file format)
SHP	Shapefile (geospatial vector data file format)
SNA	Social Network Analysis
SQL	Structured Query Language
SSD	Solid State Drive
SSP	Service Specification Package
STOP	Satellite Tracking of People
USD	United States Dollars
VGA	Video Graphics Array
WAP	Wireless Application Protocol
XAML	Extensible Application Markup Language
XBAP	XAML Browser Application
XLSX	Microsoft Excel (spreadsheet file format)
XML	Extensible Markup Language
ZOS	Z Operating System (z/OS is a 64-bit OS for IBM mainframes)

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