USING GEOGRAPHIC INFORMATION SYSTEMS IN LAW ENFORCEMENT BY THE YEAR 2002

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This Command College Independent Study Project is a FUTURES study of a particular emerging issue in law enforcement. Its purpose is NOT to predict the future, but rather to project a number of possible scenarios for strategic planning consideration.

Defining the future differs from analyzing the past because the future has not yet happened. In this project, useful alternatives have been formulated systematically so that the planner can respond to a range of possible future environments.

Managing the future means influencing the future--creating it, constraining it, adapting to it. A futures study points the way.

The views and conclusions expressed in the Command College project are those of the author and are not necessarily those of the Commission on Peace Officer Standards and Training (POST).

In the Fall of 1993, a large brush fire erupts in a densely populated hillside area in southern California. Valuable watershed, homes and wildlife are being destroyed by the fires along with utility poles and other equipment. Power is out, telephone service is interrupted and countless natural gas leaks exist from destroyed homes. Santa Ana winds drive the flames and create new fires. Arsonists add to the chaos by lighting additional fires throughout the wind-whipped coastal and foothill areas until numerous fires are burning out of control at one time. The resulting firestorm creates havoc in a number of communities simultaneously, stretching personnel and equipment resources to the limit. Entire neighborhoods cease to exist and thousands of people are homeless. While fire officials deal with massive fire control problems with the advancing flames, law enforcement is faced with the developing problems of traffic control, evacuation, emergency shelters and looter control in a number of areas in addition to handling the other essential day-to-day law enforcement functions. Given the location of the fire, where are the best places for evacuation centers, traffic control positions and looter patrols? How do the police, fire and other governmental agencies establish a system which handles the dynamic, massive coordination required among multiple agencies to respond to this disaster effectively? How does an Incident Commander make the best use of resources in the least amount of time? Geographic information systems provide the answer for police, fire and other municipal entities to provide timely, effective and cost-efficient response to this emergency.

Data You Can See

The Clinton administration and many of the communications giants have been heralding the coming of "information superhighways" which will improve and speed up the ability of government, business, schools and individuals to access and utilize the thousands of existing information databases available today. This vision of the future also creates a major difficulty for its users. How does anyone integrate all of this data into a meaningful medium so that it can be understood? The answer is in geographic information systems or GIS. According to the

President of Ultimap Corporation, Bob Bro, "there are tax assessment systems and there are parks and recreation systems, and there are all kinds of accounting systems and police systems that have all kinds of attribute data from all over the United States. The real benefit of GIS will be the integration of all of the attribute data with the geographics."[1] GIS provides the opportunity to present virtually all data in a very visual manner. If the laborious, one dimensional pin maps used by law enforcement in past years were valuable to plot crimes, imagine the ability to create this map in minutes (or seconds) with multi-dimensional information including type of crime, MO, type of location, owner/resident information, time, day, date, history, street lighting and proximity to known suspects. Imagine the ability to perform this task in real time. GIS provides the opportunity to make full use of the technology and data of the "information age" by presenting it in an easy to understand visual medium - a map.

What is GIS?

Geographic (or Geobase) Information System (GIS) is an overall term encompassing the entire field of computerized mapping as used today. GIS is like 5, 10 or 20 transparent maps representing different features of the same plot of land, overlaid on one another to represent the totality of that area. The user, however, is able to peel away a layer or layers to view the maps of interest and combine this with database information - all in a highly visual format. The geographic information systems of today, however, are rooted in 18th century developments in cartography when the first accurate base maps were developed.[2] To some, GIS may seem like a new concept but, more than two centuries ago, George Washington's cartographers used map overlays in plotting his strategy for the battle of Yorktown in the Revolutionary War.[3] Various refinements in mapping and printing technologies, plus improvements in statistical techniques and mathematics improved the field of cartography over the next 200 years but the development of computers in the mid-twentieth century marked the beginning of a revolution in mapping.

The advent of computers allowed for the creation of a true GIS and, while it

is not a requirement that GIS be computer-based, the reality is that in today's fast moving world, all useful GIS systems are computer-driven. Computers have allowed the GIS field to expand as it has enabled valuable linkages with other disciplines including computer-aided drafting, remote sensing, photogrametry, spatial analysis tools and a variety of databases. Software design has enabled GIS to be used on ever smaller computer platforms including PC's. It is also increasingly evident that the constant and rapid changes in computer hardware, such as increased speed, decreased size and reduced price, are bringing smaller companies and organizations to see the value of GIS.

In the 1950's, thematic maps, those maps created to display a given theme such as land use or zoning, were first automated by researchers in a number of countries including the United States. During this time botanists, meteorologists, geophysicists and geologists began including computer-generated maps for a variety of purposes.[4] The evolution of GIS applications moved from limited meteorology, military, energy and transportation issues in the 1950's to almost every discipline in the late 1980's. Throughout this time, however, the primary customers of GIS firms were military and federal or state governmental entities. This pattern of usage had also influenced the design and marketing of products by GIS vendors.

GIS Today

The most critical issue in law enforcement today concerns the dramatic decrease in revenues in all areas of government which has severely affected safety services in California for the first time in recent memory. The deep, lingering recession and our huge national debt has caused the federal government to reduce aid to states and local communities. California has seen military bases close, aerospace jobs disappear, earthquakes, floods and riots contribute to its economic problems while Southern California has suffered the brunt of these calamities. As local financial resources have decreased, the expectations of the police by the citizens have not. In a labor intensive operation such as a police department, the timely and most effective assignment/allocation of personnel resources in service

delivery is of critical importance and it is in this area that geographic (or geobased) information systems (GIS) become invaluable.

The political and economic realities of the 1990's in the United States, however, are creating fundamental changes in GIS applications as the military (and, to some degree, its budget) continue to shrink and our economy struggles to regain its momentum. According to John Antenucci, President of PlanGraphics Inc., state and local governments are experimenting with smaller, more focused GIS applications. "Focusing on a particular application is a whole lot more sensible than just surrounding yourself with technology and then looking for something to do with it."[5] GIS firms are placing an increasing emphasis on local government uses while looking for new markets and applications for their products. This "second wave" or revolution of GIS in government has caused the political entities and vendors to develop and build integrated GIS using improved technology, better organizational skills and new standards.[6]

So what is GIS today? According to Understanding GIS (Environmental Systems Research Institute (ESRI), Redlands, Calif.) there are 5 generic questions that a sophisticated GIS can answer.

1. *What is at...?* GIS can answer what exists at a specific location. For example, a location can be described using place name, ZIP code, latitude and longitude or many other type of location system.
2. *Where is it?* Find locations satisfying specified conditions. For example, an investigator may have some information from an anonymous party on a criminal suspect who is living in a small apartment building adjacent to some railroad tracks in a commercial area of a large city. GIS would be able to narrow the search to speed the elimination process. The more information, the narrower the search becomes.
3. *What has changed since...?* GIS can spot changes in an area over a certain period of time. For example, changes in the crime rate of a neighborhood since the creation and installation of a street lighting

district.

4. *What spatial patterns exist?* GIS can find patterns. For example, GIS could develop a pattern analysis of burglaries in a given reporting district or beat in a few minutes to assist investigators.
5. *What if...?* GIS is extremely effective in modeling various scenarios. For example; or, what impact would the creation of a new police patrol system have on crime in a specific area?[7]

GIS can handle graphic data, but also has the ability to store nongraphic data and geographically referenced data and to link this information with the digital points on a map so that the users can perform any number of correlations, print the data, print a map or combine the features of both. The prime thrust of this technology is to provide geographic analysis and not just a display. In providing a variety of spatial analyses it can create any number of overlays for one project so that a researcher can "peel away" the demographic profile, the land use, the street lighting, the school districts or any number of other features.

Today, GIS is employed by government and business to conduct land-use studies, provide environmental assessments, evaluate and develop natural resources, determine the best place for residential or commercial developments, and to manage the infrastructure (roads, sewer, water, etc.) by both private industry and government. It is used to create highly accurate digitized mapping, to find the most efficient routes for school buses, analyze disease patterns and to define election districts. It is used in private industry to develop demographic and spatial analysis to develop markets and assist in locating retail or commercial facilities. Federal Express and other private parcel delivery services use the technology to manage the collection and delivery of packages. Its uses are virtually unlimited.

In law enforcement, GIS is used in hundreds of locations to enhance 911 services. This is one of the major growth areas expected for GIS in public safety in the future. "In the next 10 years, we can expect 911 emergency services to change drastically as competition increases in the industry, and large multi-

location systems begin to provide increased levels of technical sophistication in the processing of emergency calls."[8] In Beaverton, Oregon, Des Moines, Iowa, Bradenton, Florida and numerous other locations, GIS is being used to improve emergency service deliveries. In cities like Jersey City, New Jersey GIS is being combined with CAD and call prioritization to improve response times and reduce errors. Recent software by Strategic Mapping and other vendors uses global positioning system (GPS) technology for vehicle tracking, displaying the vehicle's location directly to a base map and/or monitor.[9]

GIS is being used in crime analysis in Seattle and Tacoma, Washington, Minneapolis, Minnesota and San Bernardino County, California. Police officials have learned that graphically selecting, displaying and analyzing criminal activity allows officers to "see" crime via GIS and enables them to anticipate criminal activity, develop probable cause and focus scarce resources. The closer that this analysis approaches real-time, the more effective the analysis becomes.[10] In a related area, Melbourne, Australia is involved in a crime trend analysis study. The aim of this study is to use GIS to see whether resulting crime analysis reveals trends that could be used to improve police effectiveness and public safety.[11]

Products such as Find 911 (GTE) have been combined with StatusMap (ESRI/GTE) enabling linkage of nongraphic information to geographic locations. StatusMap type programs are designed to be fast, flexible display interfaces to enable not only the traditional tabular data (phone number, name, etc.) to be displayed, but would combine this with a map on the 911 display. Future enhancements will include last known vehicle location and routing information at this time.[12]

GIS is being used in disaster planning in Texas for flooding (Corpus Christi), earthquake response in California and hurricane response in Florida. In the aftermath of Hurricane Andrew, "GIS was used to locate the best sites for kitchens, tent cities, disaster application centers, hazard mitigation locations and other types of location-dependent facilities".[13] In the relief efforts, GIS created 30 different types of maps each day for the multitude of involved agencies. One of

the most important uses of GIS in the wake of Hurricane Andrew was in the removal and dumping of the hugh amounts of debris. Clark County Nevada is engaged in an emergency management GIS project involving over a dozen agencies. This system is designed to assist in rapidly defining danger zones, critical facilities, shelters, power outages, hazardous material locations and spills, fires, road closures and other specified critical areas. They have conducted two successful simulations of the program at this writing.[14]

One of the most visible GIS stories in California law enforcement is SINS, which is shorthand for Statewide Integrated Narcotics System. SINS has been developed under the direction of the Western States Information Network (WSIN) and is a bureau of the California Attorney General's Department of Justice. This system operates two "war rooms" (Sacramento and Los Angeles) that will handle daily operations, provide real-time access to narcotics case information and coordinate investigations to avoid the potentially tragic situations where one agency's undercover officer is working a "suspect" who is actually an officer with another department working their case. SINS will eventually link numerous law enforcement databases to enhance safety, improve investigative quality and increase apprehensions.[15]

In Spain, the Guardia Civil instituted a full GIS to deal with all aspects of national security with inaugural use for the 1992 Olympic Games in Barcelona. This GIS provided national and local authorities with a real-time global view of multiple, evolving situations. This GIS included special event security and routing, vehicle control, real-time patrol allocation, digital terrain modeling, thematic cartography and report generation, monitoring itineraries and routes of VIP's, and location/attribute queries.[16]

Other current uses for GIS in law enforcement have been the creation of mutual aid response areas, beat and reporting district structures, patrol routes and rudimentary flex beats (beats that change depending on need).

GIS technology is being pushed by several trends that will cause it to have an even greater role in local governmental decision-making, operations and

reporting. First, governments have a better understanding and working knowledge of GIS and, because of this, are organizing their information and structuring their operations more effectively. Second, technology continues to rapidly expand providing GIS users greater variety and choice in both hardware and software plus rapidly decreasing cost. Third, a stronger pursuit of standards for GIS and data-sharing is making it easier for different entities to share systems and data. Last, GIS software is becoming more user friendly as vendors create improved, menu driven graphical interfaces to allow people without extensive backgrounds in computers to use their systems. All of these trends have combined with external issues (i.e. military cutbacks) to re-focus the GIS market on local government applications. The changes in market direction are already evident as one market research firm has concluded that over 37% of today's $2 billion GIS market is attributable to state and local government.[17] In fact, the Executive Vice President of Intergraph Corporation's Mapping Services Division believes that , "State and local government are probably the best customers for GIS technology. They have a mission that won't go away, and they have some of the most complicated problems that cut across jurisdictional, physical and political boundaries".[18]

Definition of Related Knowledge Areas

A number of improvements in related fields have also advanced the cause of GIS during the past 30 years. The following definitions are important to the discussion of GIS.

Cartography

The technology of mapping or charting features of the Earth's topography. An important area of cartography is "thematic mapping", mapping a particular subject (such as burglaries in a given area) to present a visual representation of the subject.

Remote Sensing

Remote sensing, the recording of imagery or data from a distance (such as

satellite infrared photography), can be coupled with aerial photography through the technology of photogrammetry to create accurate maps that can be incorporated into a GIS.

Photogrammetry

The technology of preparing maps from aerial photographs.

Computer-Aided Design and Drafting

Computer-aided design and drafting (CADD) is an automated drawing method that displays information spatially and which allows for the rapid development through GIS of various maps and fast, accurate printing thereof.

Global Positioning Devices

In addition, global positioning devices (GPS) can be linked with GIS to provide immediate locations of mobile units or to determine the geographic location of a particular place or area and image processing can be employed to insert digitized graphic information (such as photographs) into the GIS in reference to a particular location or purpose.

Computer Aided Dispatch (CAD)

Computerized assistance for dispatch that takes many forms including call prioritization, automated location information and available units. When used with emergency vehicles, CAD can be very sophisticated. On-line maps of a city can display emergency vehicles as moving dots on a map with their status (awaiting call, enroute, completed, etc.) displayed in color.

Artificial Intelligence

The part of computer science which studies how to use computers to simulate human mental processes.

Expert Systems

Computer programs that simulate the way experts solve problems and which improve performance in all areas.

Forecasting the Future of GIS in Law Enforcement

The examination the potential of geographic information systems in the

next decade requires a structured approach to the forecasting process. Literature scans, interviews with professionals in the GIS field and other techniques assisted in focusing the study. Utilizing an small group of experts from the GIS, law enforcement and data processing fields enabled the author to examine the primary issue and identify significant sub-issues as follows:

What will be the use of geographic information systems (GIS) by law enforcement by the year 2002?

- What will be the effect of advanced geographic information systems (GIS) on law enforcement resource allocation by 2002?
- What will be the effect of advanced geographic information systems (GIS) on law enforcement service delivery by 2002?
- What will be the effect of advanced geographic information systems (GIS) on law enforcement planning by 2002?

The nominal group technique (NGT) was then employed using a panel of 12 professionals from the GIS, law enforcement and data processing fields who developed ten events and ten trends that would have a significant effect on the issue. Thirty-three events were identified but the NGT identified the following ten events as most important to the issue in this order:

1. Expert systems are developed that link geographic information systems (GIS) with computer-aided dispatch (CAD) and crime analysis.
2. State mandates all crime reporting in geographic information format.
3. Developments in geographic information systems create the capability for real-time, flex-beats for law enforcement.
4. 1995 FBI crime statistics indicate an 80% increase in Part I crimes since 1992.
5. Geographic information systems are used for the first time in real-time response to a 7.8 earthquake.

6. Federal government mandates all levels of government to build geographic information databases as part of a national system.
7. Federal government makes military and intelligence satellite data available to local government.
8. All California law enforcement is regionalized by the year 2000.
9. All major items of property are capable of being tracked by electronic tracking devices.
10. Police departments mandate basic computer skills for all entry level employees.

The NGT also identified trends that would be important to monitor to affect the issue. The NGT generated thirty-three trends and the top ten trends were selected and prioritized by the panel in rank order beginning with that trend which the group felt was most important. The final list of ten trends in order of ranking were:

1. Level of data and technology sharing between the government and the private sector.
2. Changes in crime trends.
3. Availability of computer databases to local government.
4. Level of funding for law enforcement computer systems.
5. Level of law enforcement staffing.
6. Number of new state and federally mandated law enforcement programs.
7. Level of urban forecasting utilizing geobase (geographic) information systems.
8. Level of understanding of needs between the law enforcement and geobase (geographic) information fields.
9. Level of compatibility of computer systems.
10. Level of funding of law enforcement.

A computerized cross-impact analysis (XIMPACT ver. 1.X, Wayne Boucher) process was employed which identified data for 100 possible futures based upon the generated trends and events. From these various iterations, scenarios were developed to examine the affect of the occurrence of various events and changes in the direction or intensity of various trends. Three scenarios were developed of which one ("most likely") was driven by the trends, events and analysis from the NGT. The other two scenarios were driven by data derived from the XIMPACT iterations which, in turn, were based upon the original 10 trends and events. A scenario was selected from those developed and the policy implications of that scenario were evaluated to assist in bringing the scenario to reality.

The next part of developing the issue involved the creation of a strategic plan. This process of strategic planning also involved the examination of the stakeholders and their assumptions about the issue so that a strategy can be developed and selected to provide the best opportunity for success. In this process, a situational analysis was completed examining the social, technical, environmental, economic and political issues as well as the strengths, weaknesses, threats and opportunities in relation to the organization and the selected scenario. Strategies were developed to implement the selected scenario and a single strategy was selected. An implementation plan was developed to provide guidance in implementing GIS according to the selected scenario and strategy.

Strategy #3: ***Purchase a "Turn-Key" Geographic Information System With A Combination Of General Fund And Asset Seizure Funds***

The Orangedale Police Department should purchase a "turn-key" geographic information system with a combination of General Fund monies (initial down payment) and asset seizure funds (yearly payments) amortized over five years. This type of system is approximately five times more expensive than the "take out" system and more than twice as expensive than the "tech transfer" systems. The "turn key" system would be built, designed and installed for the Orangedale Police Department with all of the time consuming needs assessing, table building,

trouble-shooting and software rewriting performed by the vendor. This system would be operational quickly but complete installation could take as long as 10 years as refinements and additions are made to the system into the next century.

Pros

- *A totally customized system for the Orangedale Police Department.*
- *System is totally supported by software vendor.*
- *System is in full operation in a very short time showing benefits almost immediately.*
- *In-house personnel are trained on the job over an extended period (one to four years) by vendor supplied experts.*
- *Very small expenditure of personnel resources to bring system on line.*
- *Purchase price is shared between General Fund and asset seizure monies.*
- *System is constantly revised and improved over an extended period (up to two years).*

Cons

- *Expensive, even over five years. Part of purchase funds still rely on General Fund monies.*

The final step in this process involved the creation of a transition management plan. The most important individuals or groups ("critical mass") relative to the issue, chosen scenario and strategy were identified and analyzed as to their current positions relative to the implementation of GIS. Important to this step was determining the desired positions of the critical mass and developing a plan to move the groups/individuals in the desired direction. Equally important was creating a management structure to insure that the plans were properly implemented.

In this process, the issues were carefully identified, alternative futures analyzed and structure for implementation and transition provided. The process

provided a method for examining the issue and sub-issues with clarity in the context of the future.

Visualizing a Better Future

The future for GIS is unlimited. Today, people are looking at GIS technology to address any number of societal issues and one of the major areas of concern is crime with its related problems. For law enforcement personnel to realize the potential of GIS they must begin to accept and learn the technology now. According to marketing research in 1992, state and local government GIS use will grow annually by 27% for the next five years. Public safety related GIS spending, however, will grow at a 34% annual rate during this same period of time.[19]

One of the most significant potential areas for growth in GIS is multimedia. In fact, "multimedia organizes data types such as maps, video animation, graphics and audio in a nonlinear format - akin to the way the human mind works. When linked to a GIS, multimedia becomes a toolbox from which the user can access various models for exploring "what if?" situations."[20] It dramatically expands our ability to "see" data and, therefore, to put it to better use.

Database access is improving daily as more off-the-shelf type data bases (such as TIGER, DIME, Census, and USES) become more readily available and affordable. More government databases, including some former military and intelligence types, are becoming available although the costs vary as the different governmental entities attempt to establish a consistent pricing philosophy. In many cases, the government has made its files available at no cost to other governmental entities and for specific private endeavors. Additionally, more sources are emerging for remote sensing databases including governments from all over the western world plus the emerging former East Bloc nations. Data conversion techniques are improving as well as the ability of systems to update themselves across the board as new data is entered and spread across the GIS system.

Hardware comparability will continue to improve as hardware costs decline. In fact, Jack Dangermond, founder of Environmental Systems Research Institute (ESRI) discussed the significance of plummeting hardware prices when he stated, "...the capital costs [of GIS implementation] are dropping and software prices are dropping with it". This change will have a significant effect as GIS becomes more affordable to local government even in the face of severe economic difficulties.

Another related technological change that will significantly affect GIS are efforts by vendors and governments to create standards in databases, GIS structure and database conversion. If more systems will accept more data from other systems efficiently it creates a better opportunity for the creation of state and national GIS systems.

What will be the effect of advanced GIS on law enforcement resource allocation by 2002? The data indicates that GIS will assist in tracking resources, eliminating duplication and preventing waste. Disaster response will be directed on a real-time basis including prioritization, evacuation, shelter set-up, hospital and other essential service identification. Additionally, GIS can help responders determine the serviceability of critical facilities and graphically display the information to prevent duplication of effort as well as to direct personnel, refugees and injured to these facilities. In the wake of Hurricane Andrew, the State of Florida is beginning the creation of a state-wide GIS to prepare the structure to permit such a response. The City of Oakland is using GIS as part of its disaster response to assist not only in rebuilding the city but also to assist in addressing other disasters or significant events of the future. Already, plans are being developed for highly accurate, real-time tracking of "plume dispersion" in hazardous material situations in Clark County, Nevada.[21] GIS 's ability to generate real-time maps for different subjects (thematic overlays) will provide opportunities to track resources in a wide number of areas.

Searches for lost children or elderly walkaways, graffiti abatement and investigative tracking are all areas that can be improved through the utilization of GIS. Imagine a search for a missing child where the GIS system zooms into the

neighborhood, identifies the location potential child molesters or sexual registrants in the area and then provides you with a corresponding aerial map that enables the incident commander to actually "see" the neighborhood - including backyards, bodies of water and other potential hazardous areas. The entire process is expedited and improved through the use of GIS. The ability to plot the residences of local parolees, probationers, registrants, taggers and gang members will allow police agencies to make event-to-suspect correlations in seconds for any number of crimes or issues. Community-based policing efforts will be enhanced as problem areas can be more readily identified and visually displayed. Neighborhood problems, blighted areas, high crime locations - all are easily tracked with GIS. GIS will also provide law enforcement the ability to locate and track resources whether they are "in house" or available from outside vendors and whether it is in day-to-day activities or large incidents.

What will be the effect of advanced GIS on law enforcement service delivery by 2002? Data indicates that real-time GIS will provide the opportunity for a true flex-beat system - beats determined by the criminal activity of the week, day or shift. It will enable departments to make seasonal changes to beats and patrol configurations in order to deliver the right personnel at the right time to a given problem. GIS will be able to identify high activity locations, provide contact relationships between criminals and known associates, track incidence of graffiti vandalism and provide crime trend analysis. Searches will be made easier through access to GIS and the links to actual aerial maps of a specific area. Responding officers will have knowledge available regarding parolees, gang members or taggers living in proximity to or frequenting the location of a given crime. GIS will prioritize and direct the police to calls in the future as global positioning satellites in geosynchronous orbits talk to a database that identifies blocked or closed streets, tracks police units on patrol, tracks property with GPS locating devices and, perhaps, tracks probationers or parolees released on electronic "leashes". GIS will provide via mobile data terminal, full data on a 911 response address including owner/resident information, criminal histories,

weapons violations and even floorplans. Eventually, GIS will enable the police officer of the future to anticipate criminal activity through sophisticated GIS-based crime analysis linked to expert systems and artificial intelligence.

What will be the effect of advanced GIS on law enforcement planning by 2002? GIS crime analysis systems will be linked with neural networks to look for crime trends and enable police officers to anticipate criminal activity in specific areas. One of the strongest current uses for GIS is in the area of modeling or asking "what if..." questions. Law enforcement has not made significant use of this ability to this date. Through modeling, potential patrol areas or beats can be examined for effectiveness and impact and potential housing tracts can be modeled for their impact on police services, potential patrol route problems and proximity to other hazards. Models will test scenarios for critical incidents that can assist police agencies in identifying hazards, evaluating critical facilities, acquiring resources and determining response levels. GIS has incredible potential in assisting with a number of areas of disaster preparedness. GIS can be used in modeling scenarios to assist government in mitigating disaster hazards so that previously unseen problems can be addressed prior to a crisis. Hazardous material spills at known locations can be modelled to determineAnother potential use for GIS is in traffic accident analysis where terrain modeling can be combined with mapping capabilities and other databases to examine potentially dangerous locations, visibility issues and cause.

What will be the use of geographic information systems (GIS) by law enforcement by the year 2002? Law enforcement organizations are already organized in a geographical framework with street addresses, streets, reporting districts, beats, areas and divisions. What GIS does is digitize this information to establish the exact spatial relationship of data, locations and occurrences within an area, city, county or other geographic entity. The result is that digital map overlays representing different themes can be instantly created and, if necessary, printed to provide specific, visual information in a real-time mode. Additionally, the ability of GIS to overlay various thematic maps creates the ability to easily

examine possible correlations between seemingly unrelated data such as a correlation between the establishment of a new recreation program and crime in a neighborhood. With all of the technological and software improvements combined with the increased future investment in GIS by public safety agencies, what opportunities does this create for law enforcement in the future? GIS provides the opportunity to effectively allocate resources, engage in strategic planning and dramatically change our method of service delivery. With the continuing decrease in government revenues and, in many areas, the increased interest in regionalized service, another vital area for GIS will be regional planning. In New Mexico, regional government councils are realizing that GIS can be a valuable tool for providing human resource service, including law enforcement, to areas.[22] The geographical organizing of data will create better informed personnel which, in turn, will result in better decision making, improved resource allocation and superior service delivery. The uses of GIS by law enforcement by 2002 are only limited by law enforcement's imagination and willingness to learn and employ the technology.

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