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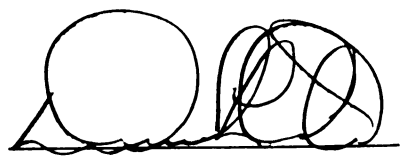

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GEOGRAPHIC INFORMATION SYSTEMS: AN EFFECTIVE TECHNOLOGICAL INTERVENTION FOR PROACTIVE POLICING

By

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ABSTRACT

GEOGRAPHIC INFORMATION SYSTEMS: AN EFFECTIVE TECHNOLOGICAL INTERVENTION FOR PROACTIVE POLICING

By

Tae-Jin Chung

Geographic Information Systems (GIS) use technology to predict areas of high crime. GIS has been shown to reduce crime in large cities, but at a substantial cost. Demographic factors such as, employment rate, population density, educational level, and community involvement influence GIS[1] effectiveness. Since so many factors influence GIs, it is necessary to have guidelines to determine whether measures other than GIS might be more cost effective.

GIS are effective when law enforcement agencies have exhausted traditional crime fighting methods and are seeking innovative solutions to proactively reduce crime. One way GIS allows law enforcement agencies to more effectively use existing resources is by pinpointing statistically high crime areas, thus creating more time for improving community service. Overall, GIS will result in a lower crime rate, while developing a stronger community relationship with local law enforcement. GIS is an effective crime prevention method that eventually must be implemented in cities worldwide.

DECICATION

To my family, especially my parents, whose loving support and encouragement are the sole reason this work was completed. Without Grand mother's endless love (Veronica Kim), I could not achieve my academic goals. Grand mother (Teresa Kim), Aunt (Agnes Chung), are perpetually in my thoughts and prayers.

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I am also deeply grateful to Susan Trowjanowiz, whose organization, guidance, and dedication for my academic life at Michigan State University. Hazel Harden, she always provided me with the most valuable information of the school.

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LIST OF ABBREVIATIONS

GIS.....Geographic Information Systems

Chapter 1

INTRODUCTION

Geographic Information Systems (GIS) is a computerized mapping system, which allows police departments to identify criminal hot spots in their jurisdiction occur. Based on collected data, police departments can deploy more officers to these hot spots while still providing other services to the community. GIS has been used by law enforcement agencies for more than 10 years. However, many other police departments have not implemented GIS to date. There are several possible barriers encountered when implementing GIS, some of which are substantial cost, training.

Currently, GIS is becoming important within the law enforcement agency. GIS allows law enforcement agencies to analyze and correlate data sources to make detailed crime incidents and relate factors within a community or other geographic area. As technology advances, criminals are getting smarter and crimes are getting more complicate. Some criminals use more sophisticated technology than the police do. In order to maintain public safety in the 21st century, the information age, police should be equipped with high technology such as GIS. GIS is an important technology that police departments should implement to provide a higher quality of service to their clients, the community.

Statement of the Problem

GIS has been identified as a very useful system in many different areas such as military, forestry and other sciences. However, there has been no systematic data existed to prove the effectiveness of using GIS in Policing (Lavign, 1999). Moreover, it is not widely employed by police departments and the national crime rate has been dropping continuously. Thus, it is difficult to prove the effectiveness of GIS in the law enforcement agency. Generally, it may be assumed that advanced technology provides some advantages when utilized with the older methods of gathering information. However, science always requires sufficient evidence to prove any claims of fact. Although overall society has been changed tremendously as a result of technology, police departments are still far behind when it comes to such technology.

The author will test whether the use of GIS for targeting crime hot spots relates to the total number of arrests. Particularly, the author will test to determine whether a police department that utilizes GIS has attributed to increase arrest rate. The author also will test whether the use of GIS for targeting crime hotspots has attributed to the increase in the total number of reported index crimes. If GIS is found to be effective in reducing crime and increasing community relationships, it should be implemented by more police departments in the U.S. and worldwide.

The Purpose of Study

The purpose of this study is to determine the relationship between the use of GIS for targeting crime hot spots and the total number of arrests in order to help police department assure that GIS is a very useful method for proactive policing. This will be achieved by examining the Uniform Crime Report (UCR) data from Michigan State Police. Specially, the author will look at the UCR arrest data and index crime data from 1991 to 1997 in Lansing, Michigan and the State of Michigan. It is believed that this data will show whether GIS has an influence on the arrest rate and index crime rate or not. The main focus of this research is to explain the effectiveness of using the GIS technology in policing. To provide the better service to community, police should be equipped with the best technology in order to their job effectively and efficiently. Both crime data and current academic literature will be presented to show if GIS effectively works in community policing. The research hypotheses will be tested, and policy implication will be made for using GIS in law enforcement agencies.

Limitation of the Study

This study contains arrest data and index crime data obtained from Michigan State Police and literature information collected from many different academic resources. However, these data and literatures are relatively few to support author's hypotheses in terms of generalization. There are many limitations to be involved with this study. These limitations are including:

1. No current crime data locally available (only up to 1997).
2. No systematic data available for the use of GIS in policing.
3. Lack of research regarding the use of GIS in policing.
4. No other countries use GIS for policing other than the United States of America.

In addition, contemporary administrative and technical concerns were identified by current available literature. Analysis and evaluation of academic journal articles focused on factors related to GIS. This study was concerned only with these issues in the United States. Therefore, it is very difficult to apply this research result to other countries.

Hypothesis

1. H0: There is no significant relationship between the use of GIS for targeting crime hot spots and the total number of arrests in Lansing.
2. H1: There is a significant relationship between the use of GIS for targeting crime hot spots and the total number of arrests in Lansing.

1. H0: There is no significant relationship between the use of GIS for targeting crime hot spots and the total number of reported index crimes in Lansing.
2. H1: There is a significant relationship between the use of GIS for targeting crime hot spots and the total number of reported index crimes in Lansing.

Chapter 2

REVIEW OF LITERATURE

Today, GIS is becoming more popular among law enforcement agencies. This comes at a time when the cost for computer hardware and software is declining, the technological efficiency continues to improve, access to digital calls for service and incident data within police departments is increasing. Therefore, many criminal justice researchers are currently focusing GIS on more than ever. Although there are not many articles regarding GIS, the few that exist illustrate some very good example of GIS usage. Before examining the current literature on Geographic Information Systems, the author will discuss some of the findings from studies of other policing approaches. These approaches have been used and are also considered effective policing interventions.

Police Technologies

American police departments largely converted from foot to automobile patrol between the 1930s and the present. Then they have patrol cars in conjunction with telephones and two-way radios. The telephone made it possible for the ordinary citizen to summon the police, and the combination of two-way radios and patrol cars allowed the police to respond quickly (Gay, 1977). Later, many police technologies have developed to Computer Aided Dispatch, Mobile Data Terminals, and Automatic Vehicle Location have become commonplace in many of the larger field agencies (Sparrow, 1991). However, these technologies

are not considered as 'proactive policing' methods (Hart, 1990). These systems are not used entirely to prevent crime before it happens. The new terminology of "technological proactive policing" emphasizes the use of technology, such as, GIS to gather and monitor information on criminal activities. GIS is not only targeted to prevent crimes, but also to increase community relationships with local law enforcement agencies. Technological proactive policing is based on community policing (Chung, 1998). As Sparrow (1991) reported, "Community policing seeks to revitalize that partnership for two major reasons: First, to produce a cooperative process of identifying police priorities and Second, to provide a more effective methods of achieving those jointly nominated goals" (p.26).

History of GIS

GIS has been around in manual form for a long time. For example, the French cartographer Louis Alexandre Berthier drew up a map of the 1781 Battle of Yorktown in the American Revolution which contained hinged overlays showing troop movements (Star & Estes, 1990). Such manual geographic information systems were useful in their day, but the people who used them had to contend with a number of problems. There were no standardized scales and the information was not always up-to-date (Rogers & Craig, 1996).

Graphical crime pattern analysis in the form of pin maps has been used in police departments for many years. Typically, an analyst puts a pin representing a crime on a map to note how crimes cluster around other crimes, the land use characteristics of the location, and so on. The mechanical task of plotting the

crimes was independent of any other data management or analytic task and must be kept up to date to be used. As the characteristics of the crime or the location multiply, or as the crimes proliferate, the density and complexity of the map can become unmanageable. Severely limited choices have to be made about which dimensions of data to display with different pins, or the data have to be culled frequently. However, culling undated or indistinguishable pins can be a burdensome task. The analyst must either remember other characteristics of crimes or search manually through a separate file to tie locations to crimes. Under these conditions, the maps frequently fall into disuse (Maltz, 1991).

Before the day of computer, the map was the spatial database. In order to produce new information from maps, humans had to read and study them with a great deal of effort. There are also limitation of memory. However, GIS can hold as much data as the computer hardware will allow. GIS can combine, add, subtract, multiply and divide data, and perform many other such operations. With GIS, users can answer extremely complex question (Parker, 1988). Initially, computerized mapping started in the military, but now police are using it to map crime. The system combines geographic information with crime statistics (Pilant, 1997). Recently, GIS combines its technology with the Global Positioning Systems.

GIS in Law Enforcement Agencies

In 1996, the United States, had about 20.000(18769 in 1996) police, special police, sheriff departments (BIJ, 1998). Among those departments, less than 5% of the departments used GIS to its full potential (see Appendix A).

Because there was a lack of knowledge and personnel that can operate the system effectively (Lavign, 1999). However, GIS interest among law enforcement agency executives and planners appears to be growing (Mamalian & Lavigne, 1999). Today computer technology has expanded so quickly that the market for computers has brought the price down substantially making GIS less expensive to acquire for law enforcement agencies. The cost of the system can also be distributed among all agencies using the GIS such as police, fire, emergency medical service, and public transportation. All of these departments utilize a common street file and possibly a Parcel file. This assists in sharing the cost of developing the base map and the cost of purchasing a computer server that will house the data (Rogers & Craig, 1996). Efficiency deals with the cost of what police do in relation to what they achieve. The question is not what the police accomplish but whether the cost of what they do is minimized. Efficiency and effectiveness represent the cost and benefits of police activity (Bayley, 1994).

In general, when the crime rate increases, police departments seek to increase their number of human resources allocated to a given problem. To show that GIS is more effective than just hiring more officers, it needs to show the cost of hiring more officers is more expensive than implementing GIS. In addition, GIS is not used only by patrol units, but also crime investigation which traditionally has involved hundreds of man-hours gathering and evaluating information (Pilant, 1993).

Benefits of Using GIS

In comparison to using a wall map, GIS affords police officers the ability to ask more focused questions about crimes on their specific beats (Witkin, 1997). Thus patrol officers know where they have to go and how to spend their time more effectively fighting crimes in their area. It also helps to identify emerging crime problems (hot spots) sooner by downloading crime data more often, by simplifying the mapping software so more employees can utilize it, by creating visual maps of crime data instead of utilizing computer print outs. It also allows researchers better prediction capabilities to foresee future crime patterns (Block & Green, 1997). Serious crime in New York City dropped 27% between 1993 and 1995, while a 2 % drop was recorded nationwide over the same period after using GIS. It indicated that GIS might significantly reduce crime.

GIS allows citizens in the community to participate in the prevention of crime in their own neighborhoods. Both police and community members are aware of where the problems are; this increases the police/community partnership in reducing crime (Radelat & Carter, 1994). It also increases safety and decreases victimization in neighborhoods by monitoring ongoing problems such as a hot drug areas, abandoned buildings, liquor store, prostitution etc (Block & Green, 1994). The maps were very useful as a method of transmitting complicated information to community organizations. For the community groups, they are not only a graphic way of communicating, but they were also a more powerful tool because the maps made community residents' concerns tangible and concrete to the police and are a professional and polished means of

transmitting their concerns. Thus, it is believed that GIS is one of the most powerful tools available to connect police and community.

Barriers of Implementing GIS

Many articles published on GIS indicate that economic issues are the main factors when deciding to implement GIS (Rogers & Craig, 1996). There are also other barriers such as cultural and political considerations. Some police cultures are resistant to the idea of technology being used in their work. Because of this resistance and a general lack of knowledge in technical matters, they prefer to be dependent more on personal experience than relying on statistically based information (Block & Green, 1994). In order to change the perception that GIS is difficult to operate, software training can be provided to show how large quantities of police information can be displayed visually on a map. In addition, we can demonstrate how simple it is to see where crime hot spots are located.

For political reasons many politicians do not want police to become more technologically advanced fearing that the police will have too much power. Showing the effectiveness of reducing the crime rate by new systems as well as using the police department's human resources can eliminate political barriers more effectively. In addition, other organizations and departments can share GIS. For example, mapping hydrants, underground hazards and emergency facilities would facilitate faster reaction in times of disaster (Binkley, 1991). This would go a long way towards making GIS a more public system and not

exclusively in the domain of the police alone. It will eventually become a true public-share system.

Crime and Place

Researchers and practitioners in Criminal Justice recently began to shift their focus from people to places (Taylor, 1997). They realized that the specific place where offenses occur is more important than the people who committed the offenses are (Weisburd, 1997). It is more difficult to predict human behavior than place where crime will occur in the future. Not every crime, but most crimes occur in some specific locations. For example, domestic violence occurs mostly at the same place as long as offender and victim are living together (Sherman, 1992). Burglary occurs in the same place if there is a source of vulnerability. The same house is to be reburglarized after the initial burglary (Polvi et al., 1991).

Some crimes are most likely to occur at the same place (hot spot) such as assault, drug and car-theft, etc. Those crimes are linked together with certain environmental conditions. For example, assaults that occur near nightclubs or bars, car-theft at unlighted parking lots, and drug dealing takes place at demolished buildings or place without management. However, some kind of general street crimes, such as robbery, where neither victim nor offender is fixed in place, makes this relationship weaker (Eck & Wartell, 1998). It is more difficult to predict crimes that do not link with certain environmental conditions. However, some fixed location crimes have been improved by the place-based intervention (Taylor, 1997). In addition, the place-centered view has also lead to police success and shows potential for other areas of criminal justice practice, such as

parole and probation (Taylor, 1997). Shifting from an offender-based to a place-based criminological theory or more accurately, developing the place-based theory as a complement to the individual focus requires thinking in new ways (Weiburd, 1997). The new concept needs to be supported by the new crime control and prevention methods such as GIS. The use of GIS in proactive policing will result in reducing crime rate and increasing the better community relationship. The fundamental concept of place-based theory and the use of GIS in policing are based on the philosophy of community policing.

Hot Spot

Hot spot is a location of extremely high crime. The term is borrowed from geology. A hot spot may be a single address, a cluster of addresses close to one another, a segment of street block, an entire streetblock or two, or an intersection (Taylor, 1997). According to Sherman (1995), many service calls are from a relatively small number of addresses. The hot spot concept has been moved from the calls for service to the location of drug market, uncivil or disorderly behaviors such as prostitution (Maltz et al., 1991).

The underlying mix of person-based and place-based factors may contribute to victimization: state dependence and risk heterogeneity. High victimization risk may be dependent on the state the person is in at the time of victimization. For example, if a burglary victim has had his or her front door jimmied, he or she is more susceptible to another burglary until the lock is repaired; that is called state dependence. By contrast, some people are more

likely to be victimized because of their habits, routines, or occupations; this is called risk heterogeneity (Lauritsen & Quinet, 1995).

Sometimes, police officers would find that residents' concerns centered on site that were neither crime based nor 911 call based hot spots (Maltz et al., 1991). Therefore, it is important to understand how activities in, attitudes toward, and crime in the hot spot itself are shaped by the surrounding context (Rosenbaum & Lavrakas, 1995).

Chapter 3

METHODOLOGY

Data Collection

The purpose of this research is to show the effectiveness of using GIS for targeting crime hot spots. Currently, there are not many police departments using GIS. The author will try to prove the effectiveness of using GIS in policing by comparing the total number of arrests before and after. The author believes that GIS has influence on the total number of arrests and the total number of reported index crimes in Lansing.

The author will begin this study by collecting arrest records from Lansing police department. The author began to collect the data from the spring of 1998 to spring of 1999. The data contains all arrest record from 1991 to 1998. The author will record the number of arrest, types and numbers of change. This data will enable the author to test the hypothesis. This data will be used to analyze the relationship between the use of GIS for targeting crime hot spots and the total number of arrests in Lansing.

For the second hypothesis, the author will use information obtained from the Michigan State Police. The data was collected during the spring of 1999. The data is compiled from all of Michigan (see Appendix B), and create the UCR for the State of Michigan.

The goal of this research is to determine how police departments use GIS effectively in terms of arrest rate. GIS technology is relatively new and

rare in policing; there is not much research on the topic. Generalization of other findings has yet to be established, so explanatory research is still needed in this area. Previous research has reported that GIS is an effective method in policing. However, there is no data that indicates the actual outcome with the number.

The author believes that GIS dedicates itself to reduce the crime rates, but it is very difficult to prove the fact while overall national crime rate has been dropping. This study will be limited by the use of arrest records and the total number of reported index crimes from Lansing and Michigan State Police, however, these sources seem to provide the most accurate and complete information for the author's research proposal.

Information Sources

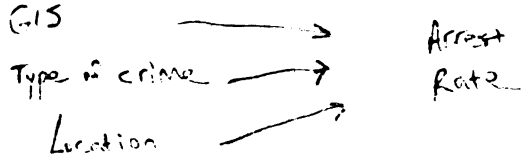
An analysis was conducted on the data maintained by Lansing and Michigan State Police department. The primary reason that the data collect from Lansing and Michigan is not only convenience of collecting data but also qualification of source of this research. There are not many police departments that use GIS for their policing nationally. Lansing police department began to use GIS since 1997 (see Appendix C). It seems that it has been very effective in their jurisdiction. Lansing police department has 254 full time police officers, and their jurisdiction covers the area that has a population of total 127,321. Lansing State Journal (February, 1999) reported that the crime rate has decreased significantly from July 1998 to December

1998, murders decreased by 33.3 percent, burglaries by 28.5 percent, larcenies by 12.5 percent and auto thefts by 10.4 percent. Lansing Mayor, Hollister, attributed the decrease in the reported crime statistics to an aggressive community policing strategy. According to Lansing police Lt. Ray Hall, " a close community and an increase in technology both played major roles in improving the department".

The second reason to use the data from Michigan State Police is to compare the effectiveness of using GIS for targeting crime hot spots in Lansing in the larger context. The total number of UCR reporting agencies in Michigan is 603 (Michigan Uniform Crime Report, 1996). This data also consists of total number of arrests and total number of reported index crimes. By examining this data the author hope to identify the pattern of crime rate and arrest rate in Michigan from 1991 to 1998.

Reliability and Validity

The reliability of this research is determined by the measurement technique that the author will apply in this particular research. In other words, measurement reliability is roughly the same as measurement consistency or stability (Babbie & Maxfield, 1998). The author believes that there is reliability in this research since the author collected and used secondary data from the local and state agencies. The state government has compiled the data, so it could be more reliable than any other data.


GIS
Type of crime
Location
Arrest
Rate

The validity of this research is determined by the operational definition that reflects the concept under consideration (Babbie & Maxfield, 1998). In this research, the author measure the effectiveness of using GIS for targeting crime hot spots with arrest; crime rate in Lansing. The author believes that it has a validity of research since arrest and crime rate has been considered as indicators of crime activity. The arrest and crime rates reflect the concept of author's conceptual and operational definitions in the research. Generally, criminal justice agencies collect data for their own use, not for the use of researchers. So it is difficult to adapt agency records for specific research purposes. However, this thesis research shows that concepts are identical to measure the actual measures maintained by criminal justice agencies.

Data Analysis

To analyze this data, the author will use a T test for statistical significance to determine a relationship between my independent and dependent variables. Author's variables (GIS, Type of Crime, Location) are nominal and (Arrest rate) is the ratio descriptions of traits (Lurigio et al., 1997). The T test is used for determining levels of significance for those types of variables. The independent-samples t test is used when two unrelated samples from normal distribution, or the sample size, must be large enough to compensate for non-normality (Norusis, 1997). This will tell author whether any average difference between the after and before intervention value (Norusis, 1997).

In order for the first hypothesis to be supported, collected data analysis would provide a relationship that is statistically significant between the use of GIS for targeting crime hotspots and the total number of arrests. Statistical significance would indicate that observed frequencies of these factors are not occurring by chance. In other words, GIS intervention will be more likely to increase arrest rates.

For second hypothesis to be supported, the author would expect a statistically significant relationship between the use of GIS for targeting crime hot spots and the total number of reported index crimes. If these relationships are statistically significant, GIS will be related to an increase in total number of arrests and total number of reported index crimes in a manner that is not through chance or by coincidence. It is believed that this result will indicate that GIS does work for arrest and crime rates. If the hypothesis is supported, the author expects his results to be similar to the expectations made by other findings

Chapter 4

FINDINGS

Hypothesis 1

The independent sample t-test is used to examine the relation between the use of GIS for targeting crime hot spots and total number of arrests in Lansing. The test result indicates that there is no significant relationship between those variables. In the table 1, consider the column labeled Equal variances assumed. The observed difference of 400 arrests, the statistics is .648 (To calculate the t statistics, divide the observed difference of 400 by 617 the standard error of the difference estimate when the two population variances are assumed to be equal). The degrees of freedom for the t statistics are 6.

The observed two-tailed significance level is 0.541. This indicates that only 54% of the time would author expect to see a sample difference of 54 arrests or larger, when two population means are equal. Since 54% is greater than 5%, author fail to reject the null hypothesis that there is no relation between the use of GIS for targeting crime hot spots and total number of arrests in Lansing.

The 95% confidence interval for the true difference is from –1,111 arrestees to 1,911 arrests. This tells author it's likely that the true mean difference is anywhere from –1,000 from +2,000 arrests. Since author's observed significance level for the test that the two population's means are equal was greater than 5%, the 95% confidence interval will contain the value of 0.

Table 1.

Independent sample t test of total number of arrests in Lansing from 1991-1998

	t-test of Equality of Means						
						95%confidence interval	
	t	df	Sig.	MD	S.E.	Lower	Upper
Equal variance assumed	.648	6	.541	400.16	617.79	-1111	1911

Table 2. contains the descriptive statistics for the two groups. Before using GIS and after using GIS for targeting crime hot spots. The difference is 400 persons arrested. The average arrests from 1991 to 1996 are 7,868. The average arrests from 1997 to 1998 are 7,468. This difference indicates that there is no statistical change of arrests after using GIS for targeting crime hot spots in Lansing.

Table 2.

Variable coding and preliminary descriptive statistics for total number of arrests in Lansing from 1991-1998

Variable	Coding	Value	N	Mean	S.D.
GIS	Yes	2	2	7468.5000	195.8686
	No	1	6	7868.667	824.2239

Note. GIS= Geographic Information Systems

Table3.

Independent sample t test of total number of arrests in Lansing from 1991-1998

	Levene's Test for Equality of Variances	
	F	Sig.
Equal variances assumed	1.620	.250

Based on the Levene test in Table3, there is no reason to doubt that the population variances are equal, so you can use the t value in the row labeled Equal to test the null hypothesis that in the population. There is no relation between the use of GIS for targeting crime hot spots and total number of arrests in Lansing. The two-tailed significance level is 0.541(see Table 1), so don't reject the null hypothesis. As expected, the 95% confidence interval for the mean difference includes the value of 0.

Hypothesis 2

The independent sample t-test is used to examine the relation between the use of GIS for targeting crime hot spots and total number of reported index crimes in Lansing. The test result indicates that there is no significant relationship between those variables. In the table 4, consider the column label Equal variances assumed. The observed difference of 251 crime offenses, the statistics is .583 (To calculate the t statistics, divide the observed difference of 251 by 430, the standard error of the difference estimate when the two population variances are assumed to be equal). The degrees of freedom for the t statistics are 6.

The observed two-tailed significance level is 0.581. This indicates that only 58% of the time would author expect to see a sample difference of 58 crime offenses or larger, when two population means are equal. Since 84% is greater than 5%, the author fails to reject the null hypothesis that there is no relation between the use of GIS for targeting crime hot spots and total number of reported index crimes in Lansing.

The 95% confidence interval for the true difference is from –802 crime offenses to 1,304 crime offenses. This indicates that the true mean difference is anywhere from –802 from +1,304 crime offenses. Since the observed significance level for the test that the two population's means are equal was greater than 5%, the 95% confidence interval will contain the value of 0.

Table 4.

Independent sample t test of total number of reported index crimes in Lansing from 1991-1998

	t-test of Equality of Means						
						95%confidence interval	
	t	df	Sig.	MD	S.E.	Lower	Upper
Equal variance assumed	.583	6	.581	251.00	430.39	-802	1304

Table 5. contains the descriptive statistics for the two groups. Before using GIS and after using GIS for targeting crime hot spots. The difference is 251 crime offenses. The average arrests from 1991 to 1996 are 9650 offenses. The

average arrests from 1997 to 1998 are 9399 offenses. This difference indicates that there is no statistical change of arrests after using GIS for targeting crime hot spots in Lansing.

Table 5.

Variable coding and preliminary descriptive statistics for total number of reported index crimes from 1991-1998

Variable	Coding	Value	N	Mean	S.D
GIS	Yes	2	2	9399.000	197.9899
	No	1	6	9650.000	570.6014

Note. GIS= Geographic Information Systems

Based on the Levene test in Table6, there is no reason to doubt that the population variances are equal, so you can use the t value in the row labeled Equal to test the null hypothesis that in the population. There is no relation between the use of GIS for targeting crime hot spots and total number of arrests in Lansing. The two-tailed significance level is 0.581(see Table 4), so don't reject the null hypothesis. As expected, the 95% confidence interval for the mean difference includes the value of 0.

Table6.

Independent sample t test of total number of reported index crimes in Lansing from 1991-1998

	Levene's Test for Equality of Variances	
	F	Sig.
Equal variances assumed	3.213	.123

Chapter 5

DISCUSSION AND CONCLUSION

This chapter is divided into three sections. It begins with a discussion of the study results and how these findings may relate to the contemporary policing. Limitations of the study are discussed in the second section. The third and final section addresses the direction of future research.

Section A– GIS in Proactive Policing

In this study, the use of GIS for targeting crime hot spots, and arrest rate and crime rate, resulted in that there is no relationship between these variables. Initially, it was expected that the use of GIS for targeting crime hot spots significantly affect both the arrest and crime rates in Lansing. However, statistical results for this thesis research indicate that there is no relationship between independent and dependent variables. The research results are also different from those expectations from other literatures. In spite of these statistical results, it is believed that some relationships exist between the use of GIS for targeting crime hot spots, and arrest and crime rate. Because the total number of arrests and total number of reported index crimes in Lansing have not been changed significantly before and after using GIS. Although the national crime rate has been dropped continuously, the crime rate and arrest rate in Lansing do not appear to have been influenced by the national trend.

Section B- Limitations of Findings

The major limitation in interpreting the above information concerns generalizability. It is highly likely that the findings are not generalizable to all times and places. The primary reason for this concern steams from the use of GIS in Lansing is not representative of any other cities or countries. Since there is less than 5% of police departments use that GIS for policing, Lansing police do not represent the overall law enforcement agencies. The author also found that there are many factors to influence arrest and crime rate other than GIS. These factors are not considered when the author began to investigate the relationship between GIS, and arrest and crime rate in Lansing.

First, demographic factors such as employment, age, and education level of residents are not considered in this research. Without understanding this information, it is not useful to test the relationship between the use of GIS for targeting crime hot spots, and arrest and crime rate. Since GIS is not the only factor to reduce the crime rate, the effectiveness of using GIS can not be explained by itself alone. For example, low employment rate of residents is an important factor to accelerate the criminal activity in their area. Insufficient economic resources of human society create the competition for survivals often expressed by criminal activities. The average age of residents is also an important factor to influence the crime rate. Younger generation in the population is more likely to cause the crime activity than older generation. The education level of residents is also an important factor to influence the crime rate. Since lower educational background people more likely to involve the criminal activity

than higher educational background people. Therefore, it is difficult to establish the effectiveness of using GIS in policing with the only arrest or crime offense data. Depending on the demographic factors, crime rate could be affected significantly. In order to establish the effectiveness of using GIS in policing, demographic factors must be studied in advance.

Second, legal aspects are not considered in this research. For example, it depends on percentage of prosecution and sentencing guideline in the jurisdiction, both arrest and crime rate will be different. The higher level of prosecution sends the more people to the court. Conservative sentence guidelines cause more people to receive guilty decisions. However, there is some intervention influence on the research such as plea-bargaining, fine and other alternatives.

Third, types of crimes for GIS are not considered in this research, because GIS works for certain crimes much better than others do. For example, car theft, burglary and domestic violence are more likely to be influenced by GIS. However, murder, assault, and kidnap are not likely to be influenced since those crimes are not place-based crimes. Therefore, this thesis research has a limitation to prove the effectiveness of using GIS without considering these kinds of problems. The author used the total number of arrests; total number of reported index crimes in Lansing.

Fourth, operational level of GIS by police officers is also not considered in this thesis research. If there is no trained officers for GIS, it could be a useless machine. Depending on operator's capability of using GIS, the outcome will be

varied. In order to get the full performance of using GIS in policing, there should be adequately trained officers who could utilize its full function. Thus, GIS should not be considered as the only factor that influences arrest and crime rate.

Section C- Implications

The findings presented in this research have implications to the over all crime control and prevention strategies developed by components of law enforcement agencies. First, GIS technology should be implemented by police departments in the United States and worldwide. As technology advances, crimes are getting more complicate and criminals are getting smarter than ever. To protect and serve for the community, police departments need to be equipped with the higher technology that satisfy the safety of community.

These findings show that there are no relationship between the use of GIS for targeting crime hot spots, and total number of arrests and total number of reported index crimes in Lansing. The null hypothesis was accepted since the significance level was more than 0.05. Therefore, the effectiveness of using GIS in proactive policing statistically could not be established. However, these findings are not conclusive since there is little, if any, data and research available to support these statistical results.

Second, GIS should be given more research attention. Researchers have found that there are few data available for GIS regarding policing. Criminal justice researchers have not studied GIS compare to other topics. However, GIS technology is no longer considered as a new technology. Recently, GIS is getting more attentions by many police departments. In order to promote the use of GIS

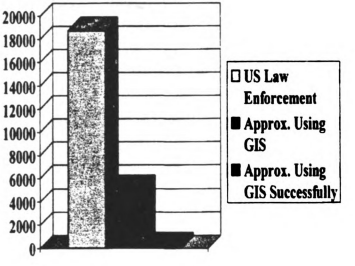
to police departments, there should be more studies mandated. Without academic support, police may experience difficulty in implementing GIS in their departments. Not only for police departments but also for researchers and practitioners in criminal justice field, GIS should be studied more, and without delaying. Time and criminals are not waiting for police departments' technological evolution.

APPENDICES

APPENDIX A

TOTAL NUMBER OF GIS IN POLICE DEPARTMENTS

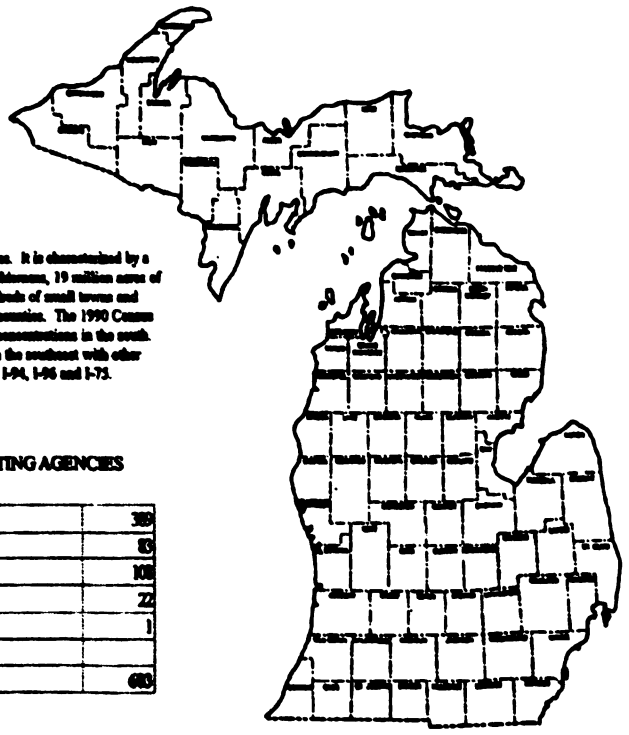
Percentage of Law Enforcement Using GIS



APPENDIX B

1996 UCR REPORTING AGENCIES IN MICHIGAN

MICHIGAN



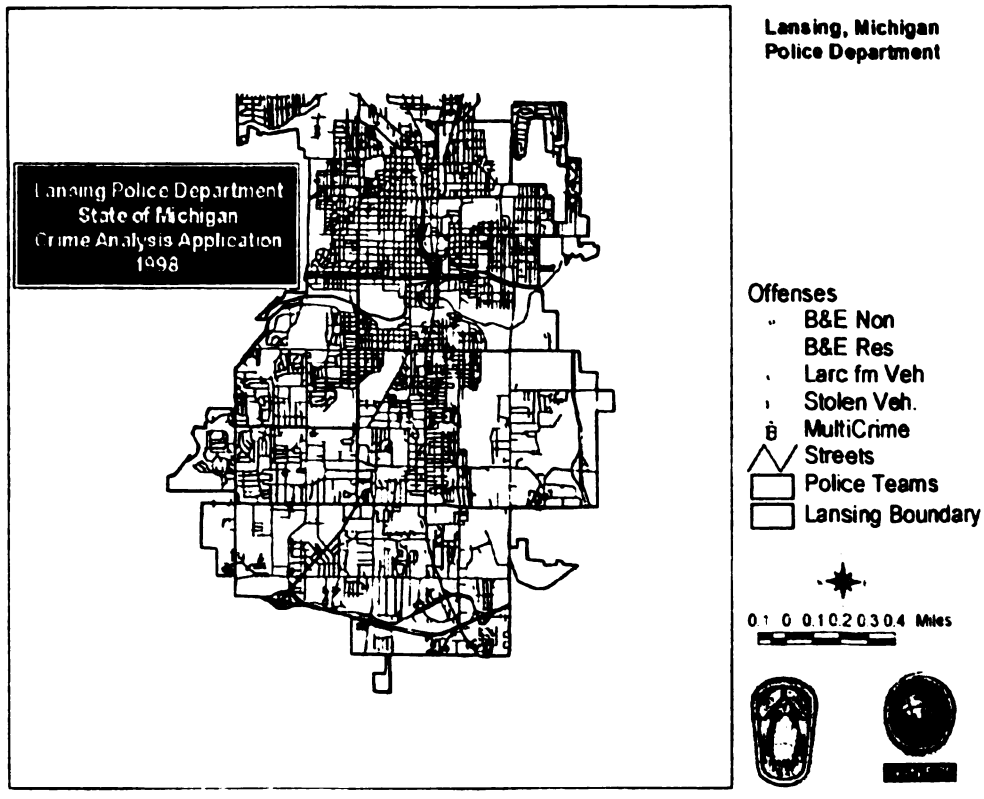
Michigan ranks 22nd in size among the fifty states. It is characterized by a patchwork of industrial cities, vast stretches of wilderness, 19 million acres of forest, acre upon acre of fruit orchards, and hundreds of small towns and villages. Its two peninsulas are divided into 83 counties. The 1990 Census indicated a population of 9,295,297 with dense concentrations in the south. Nearly half of the total population is clustered in the southeast with other metropolitan areas located along major highways I-94, I-96 and I-75.

1996 UNIFORM CRIME REPORTING AGENCIES

Cities and Villages	389
Sheriffs	83
Townships	108
Special (Airports, Universities, etc.)	22
State Police	1
TOTAL	603

APPENDIX C

GIS IN LANSING POLICE DEPARTMENT



BIBLIOGRAPHY

Bibliography

Bayley, D.H. (1994). Police for the future. New York: Oxford University Press.

Binkley, L.L. (1991, April). Futuristic system helps Long Beach corner career criminals. Police Chief, 142-145.

Block, C.R., & Green, L.A. (1994). The Geoarchive handbook: A guide for developing a geographic database as an information foundation for community policing. Illinois Criminal Justice Information Authority.

Chung, T.J. (1998). Technological proactive policing. The 12th International Congress on Criminology. Seoul, Korea : The Korean Institute of Criminology.

Duyn, V. (1991). Automated crime information systems. Philadelphia: TAB Professional and Reference books.

Eck, J.E., & Spelman, W. (1987, January). Problem-oriented policing in Newport News. Research in Brief. Washington, D.C: National Institute of Justice.

Eck, J.E., and Weisburd, D. (1998). Improving the management of rental properties with drug problems: A randomized experiment. In civil remedies, ed.L. Mazerolle and J. Roehl. Monsey, New York: Criminal Justice Press.

Gay, W. (1977). Improving patrol productivity, Volume I, Routine patrol. Washington, D.C: Government Printing Office.

Lauritsen, J.L., and Quinet, K.F.D. (1995). Repeat victimization among adolescents and young adults. Journal of Quantitative Criminology, 11, 143-166.

Lurigio, A.J., Dantzker, M.L., Seng, M.J., Sinacore, J.M. (1997). Criminal justice statistics: A practical approach. Boston: Butterworth-Heinemann.

Main, D. (1999, January 15). Crime drops, patrols increase. The State News, pp.9.

Maltz, M., Gordon, A.C., and Friedman, W. (1991). Mapping crime in its community setting. New York, New York: Springer-Verlag.

Norusis, Marija, J. (1997). SPSS 7.5 : Guide to data analysis. Simon & Schuster Company.

Parker, H.D. (1988). The unique qualities of a Geographic Information System: A commentary. Photogrammetric Engineering and Remote Sensing, 54, 1547-1549.

Pilant, L.(1993, January). Computerizing criminal investigation. Police Chief, 29-41.

Polvi, N., Looman, T., Humphries, C., and Pease, K. (1991). The time-course of repeat burglary victimization. British Journal of Criminology, 31, 411-414.

Pilant, L. (1997, December). Computerized crime mapping. Police Chief, 60-69.

Radelet, L. A. & Cater, D.L. (1994). The police and the community. New York: Macmillian College Publishing Company.

Rogers, R., & Craig, D.E. (1996). Geographic Information Systems: Computers in law enforcement. Journal of Crime and Justice, 16. 61-73.

Rosenbaum, D.P., and Lavrakas, P.J. (1995). Self-reports about place: The application of survey and Interview methods to the study of small areas. J.E. Eck and D. Weiburd (Eds.), In crime and place (pp.285-314). Monsey, New York: Criminal Justice Press.

Sherman, L.W. (1992). Policing domestic violence. New York, New York: Free Press.

Spparow, M.K. (1991, April). Information systems: A help or hindrance in the evolution of policing? Police Chief, 26-29.

Taylor, R.B. (1997). Social order and disorder of streetblocks and neighborhoods: Ecology, microecology and the systemic model of social disorganization. Journal of Research in Crime and Delinquency, 33, 113-155.

Weisburd, D. (1997). Reorienting crime prevention research and policy: From the causes of criminality to the context of crime, Research Report. Washington, D.C.: U.S. Department of Justice, National Institute of Justice, NCJ 165041

Witkin, G. (1996, December). Making means streets nice. Computer maps that take the 'random' out of violence. U.S. News & World Report, 63.