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L. Douglas Wilder School of Government and Public Affairs  
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This is to certify that the dissertation prepared by Ulvi Kun entitled  
THE USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) BY LAW ENFORCEMENT  
AGENCIES AND ITS IMPACT ON POLICE PERFORMANCE IN THE US  
has been approved by his committee as satisfactory completion of the dissertation requirement  
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THE USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) BY LAW ENFORCEMENT  
AGENCIES AND ITS IMPACT ON POLICE PERFORMANCE IN THE US

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of  
Philosophy at Virginia Commonwealth University.

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## Acknowledgements

Throughout the journey of completing my doctorate degree at VCU, there were numerous contributors who provided valuable guidance and advice to my study and dissertation research. Although I am not able to list and thank all of them, I wanted to express my sincere gratitude to the Turkish Government and the Turkish National Police at the outset for their support that has made this journey possible.

The idea of the study was approved and primarily led by Dr. Suen who has become a sincere friend and the chair of the dissertation committee. Dr. Gordon placed the study context into a more reasonable and feasible direction. Dr. Accordino and Dr. Wikstrom have always been attentive and supportive whenever needed. Dr. Weistroffer ensured the study to stay within the correct course within IT understanding and offered suggestions that were crucial to the study.

I consider myself lucky to have the chance of completing my Ph.D at VCU that prepared me with the essential coursework, student services and support. In addition, I am grateful to my chiefs, colleagues from USA, Erzurum and Ankara who have supported me with time, resource and other available means.

Nevertheless, my beloved wife Sıdıka was an unflagging supporter for the all family members and became both a nice mum and a dad-substitute. Already, I am in my daughter's (Nida) and son's (Yusuf) debt too. My mum, Mebrure and dad, Mehmet, became forever moral, physical and faithful auspices of the journey.

In sum, God granted the love and all of the instruments throughout the journey, therefore, the study was successfully concluded and lessons became available for all.

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## ABSTRACT

### THE USE OF GEOGRAPHIC INFORMATION SYSTEMS (GIS) BY LAW ENFORCEMENT AGENCIES AND ITS IMPACT ON POLICE PERFORMANCE IN THE US

By Ulvi Kun

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy at Virginia Commonwealth University.

Virginia Commonwealth University, 2014

Major Director: I-Shian Suen, Ph.D  
Associate Professor and Chair, Urban and Regional Studies

Do we know whether the use of geographic information systems (GIS) in law enforcement agencies increases police performance? This study examines the impact of GIS use to police performance outcomes in cities and counties of the U.S. between 2000 and 2007. Current research uses computerized mapping conceptualization to operationalize its measurement. Second, the police performance methodological context is used to measure the organizational impact of GIS. Finally, a new theoretical framework, information technology capacity that combines organizational, environmental and managerial factors to explain IT applications, is used to encompass most relevant dimensions of the subject matter.

Findings indicate that the use of GIS in police agencies increased sharply between 2003 and 2007. Additionally, the contribution of GIS use on police performance was found to be statistically significant, but in the opposite direction. Overall, results of the present study indicate significant links between crime rate (DV) and independent variables (IV) in law enforcement agencies. IVs are having a professional form of government and full time specialized crime analysis personnel, police strength, the use of GIS, population, being located in the Northeast and West regions, poverty, having encouraged SARA type projects and a community policing unit.

# CHAPTER 1

## Introduction

Crime is considered one of the major forces shaping society and individuals at the cost of substantial public and private resources (Miller, Schreck & Tewksbury, 2008). For the purpose of this study, crime is defined as forms of conduct which society prohibits for maintaining the order (Albanese, 2005). The study of crime and the attempt to identify its meaning have been the focus of several scholars (Sutherland, 1940; Tappan, 1947; Schwendinger & Schwendinger, 1970; Rock 1973; Sellin, 1938). Researchers have also studied variety of crime distribution (Eck & Weisburd, 1995) by place (Sherman, Gartin & Buerger, 1989; Weisburd and Green, 1995) and by type (Sherman et al., 1989; McLaughlin, Johnson & Bowers, Birks, 2004).

Although several causes of crime have been addressed to explore crime incidence in the studies of criminology, two distinctive tracks are indicated as mainstream focuses (Nagin & Paternoster, 1994; Pratt, 2001, Miller et al, 2008). One of these tracks is recognized as the micro level theory, which focuses on individuals and small groups to explain criminal decisions and behaviors relying on internal reasons (Pratt, 2001). The other track, known as the macro level theory, focuses on the role of society and structural characters to explain crime by relying on external reasons (Miller et al., 2008). These two tracks are complementary, not competitors (Eck & Weisburd, 1995). Specifically, micro level studies examine why certain types of people commit crimes while macro level studies examine why some urban locations experience higher or lower crime than other places (Eck & Weisburd, 1995). The current study stays within the macro level theoretical framework because it explores the distribution and variety of crime in cities and counties of the U.S. to understand the impact of Geographic Information Systems



(GIS) use to enhancement of police performance. Specifically, the purpose of the current study is to measure contribution of GIS use within the context of police performance, which is measured by crime rate.

The study of crime is considered an interdisciplinary area (Wilson & Herrnstein, 1998; Henry & Lanier, 1998; Coleman & Norris, 2000) with sociology, psychology, law, anthropology, history, geography, economics and political science indicated as some of its disciplines (as cited in Coleman & Norris, 2000). In general, crime theories have explained internal (e.g biological and psychological) and external (e.g societal) factors, as well as the effects of the formal (law and law enforcement actions) and informal (collective efficacy and peer effects) control mechanisms in different types of crime (Miller et al., 2008). Specifically, four approaches have achieved prominence in the literature on crime: classical, positivistic, ethical and structural views (Albanese, 2005). Specifically, the classical school, the positivist school and the Chicago school are regarded within the scope of the current study. Reviewing these schools and their prominent macro level theories (deterrence, social disorganization and collective efficacy) can provide a clear view to better understand the crime phenomenon.

The classical school relies on the free will of people who are supposed to make rational choices to pursue their maximized interests while minimizing punishments or costs (Bentham, 1789; Beccaria, 1819; Gartner, Thornton & Matsueda, 1986; Coleman & Norris, 2000; Miller et al., 2008). This idea considers that all people are equal and innocent in their conduct unless the law is violated and guilt is proven (Albanese, 2005; Miller et al., 2008). In this framework governmental institutions, specifically the criminal justice system, are expected to deter crime in society; otherwise, anarchy will stifle the legal authority and reign over individuals and groups.

Briefly, the deterrence perspective is considered one of the prominent examples of the classical school, providing theoretical ground to the current criminal justice process. Increasing crime rates can be attributed to ineffective deterrence. In fact, several scholars examine the deterrence effect (Feldman & Weisfeld, 1973; Sherman, 1980; Sherman & Berk, 1984; Sampson & Cohen, 1988; Sherman & Weisburd, 1995; Levitt, 2002, 2004) and a large body of study on deterrence continues to evolve (Miller et al., 2008) with some criticisms (Levitt, 2002; Pratt & Cullen, 2005).

The positivist view relies on scientific objectivity that identifies patterns of crime based on observable facts (Miller et al., 2008). The crime variety is attributed to external and internal influences in the positivist view, contrary to the classical view that relies on the free will of individuals. Specifically, scholars have studied individuals and families and their life courses from childhood to adulthood in order to understand and identify effects of biological and psychological factors of crime (Lombroso, 1876; Thrasher, 1949; Wolfgang, 1961; Feldman, 1977; Moffitt, 1993; Coleman & Norris, 2000; Miller et al., 2008). Nevertheless, it is not easy to scientifically validate some positivist theories (Miller et al., 2008).

The Chicago school attributes crime to societal and environmental influences, which is another positivist perspective (Quetelet, 1831; Guerry, 1833; Beirne, 1987). In this view, ecological and social variations are addressed as explanatory of crime, with ecology referring to examination of the relationship between the environment and an organism (Thabit, 2006). Several scholars are recognized as members of the Chicago School, such as Burgess (1925) Trasher (1927) and McKay (1929; 1942). Specifically, social disorganization theory represents

the mainstream of the Chicago school within context of urban development (Chainey & Ratcliffe, 2005; Pratt & Cullen, 2005; Miller et al., 2008).

As a macro level understanding, the social disorganization theory considers the community as a natural laboratory where large social institutions such as schools, businesses, churches, police forces, informal networks and the government fail consistently maintain the order (Shaw & MacKay, 1942). Social disorganization leaves the community, institutions and individuals vulnerable to a high crime rate. Within the social disorganization theory, three variables were found to be influential on crime: poverty, residential mobility and ethnic heterogeneity (Shaw & MacKay, 1942). In particular, the social disorganization theory does not indicate a permanent correlation among ethnicity, race and delinquency rates; rather, social and economic characteristics are indicated as influential factors on crime. Specifically, high delinquency rates point out some of the urban areas where ineffective or broken institutional bounds exist in society. Conversely, low crime rate areas point out the existence of lively institutional structures.

In the last decades, several scholars have addressed the resurgence of the social ecology approach in explaining crime (Bursik 1988; Flowers, 1989; Eck and Weisburd, 1995; Braga, 2001, Pratt, 2001, Pratt & Cullen, 2005). Particularly, the relation between place and crime (Cohen & Felson, 1979; Brantingham, 1975; 1995; Eck & Weisburd, 1995; Rossmo, 1995), built environment and crime (Jacobs 1961; Newman, 1972; Wilson & Kelling, 1982; Jeffery, 1999; Crowe, 2000; Casteel, Peek-asa, 2000, Gulak, 2004; Gulak, Kun, Koday, Koday, 2007), land use and city spending on education and crime (Savolainen, 2000; Feiock, 2004; Stucky, 2005) have been emphasized. Other theories are also indicated as explanatory to the relationship between

place and crime (Eck & Weisburd, 1995). These are rational choice (Clark & Felson, 1993), routine activity theory (Cohen & Felson, 1979; Hirschi & Gottfredson, 1993; Sherman and Weisburd, 1995; Chainey and Ratcliffe, 2005) and crime pattern (Eck & Weisburd, 1995; Brantingham & Brantingham, 2003; Chainey & Ratcliffe, 2005; Miller et al., 2008). In summary, internal community dynamics became the focus of earlier disorganization research and the need for examination of formal controls was underlined (Stucky, 2005). Recent disorganization research focuses on external community dynamics and local political systems. This line of research explores formal organizations and their ability to organize communities against crime (Kubrin & Weitzer, 2003). For example, neighborhood structure, social control and crime relations are examined in this respect. Finally, the collective efficacy understanding is considered the extension of social disorganization theory (Thabit, 2006). This is a complementary view because some scholars identify the role of collective efficacy as the “reverse of disorganization” or the “opposite of social disorganization” theory (Chainey & Ratcliffe, 2005).

In the collective efficacy view, the willingness of community members is combined to intervene for the common good (Sampson & Raudenbush, 1997). This understanding focuses on informal mechanisms instead of formal and external actions in fighting crime in neighborhood level studies. Several researchers have focused on the role of collective efficacy to explore disorder and crime variation in urban neighborhoods (Sampson & Raudenbush, 2001; Morenoff, Sampson & Raudenbush, 2001; Duncan, Okut, Strycker & Small, 2003; Browning, 2002). In general, it has been found that the collective efficacy concept is effective on crime because it mediates individuals, families and neighborhood demographics.

There are also a few studies that primarily evaluate the crime rates in U.S. cities in the 1990s (Blumstein & Wallman, 2000; Wintemute, 2000; Spelman, 2000; Grogger, 2000; Fox, 2000, Levitt, 2004; Zimring, 2007). To consider the correlates of crime, findings of these studies can facilitate the selection of appropriate major factors explanatory of crime.

In summary, racial heterogeneity (Shaw & MacKay, 1942; Miethe, Hughes, McDowall., 1991; Liska & Chamlin 1984; Pratt & Cullen, 2005), poverty (Flango & Sherbenou, 1976; Hsieh & Pugh, 1993; Pratt & Cullen, 2005), family disruption (Sampson, 1987; Sampson & Groves, 1989; Miethe, et al., 1991; Pratt & Cullen, 2005), incarceration (Levitt, 1996; Spelman, 2000; Qusey, 2000), urban size (Flango & Sherbenou, 1976; Fox, 2000; Nolan, 2004; Stucky, 2005, Zimring, 2007), and policing tactics (Ehrlich, 1973; Sampson & Cohen, 1988; Sherman & Weisburd, 1995; Levitt, 2004; Zimring, 2007) are identified as prominent variables of crime based on theoretical approaches and prior studies in the literature. Specifically, concentrated disadvantage variables are considered the strongest stable predictors of crime as macro characteristics (Pratt & Cullen, 2005). These variables involve racial heterogeneity, poverty and family disruption. Additionally, using essential demographic variables to avoid error is crucial (Fox, 2000) and requires including “age, sex, race or ethnicity” variables for national, state and local level studies (p.289).

In addition to the above, several studies examine the role of police in the community and their effect on crime. Policing is defined as a dynamic service delivery to enforce the law and keep the order in an area via law enforcement agencies (Skogan & Frydl, 2004). The role of policing in society is considered to fall within the deterrence understanding and there is ongoing research examining the relation between policing and crime levels (Ehrlich, 1973; Wilson &

Boland, 1977; Marvell & Moody, 1996; Vollaard, 2005). Notably, some scholars questioned the efficacy of policing on crime reduction for a period of time (Klockars, 1980; Hirschi & Gottfredson, 1993; Moran, 1995; Bayley, 1996) and most of these studies were found to be biased as a result of specification problems and the effect of the police was substantial (Marvell & Moody, 1996). In fact, recent researches have shown more clear evidence of the efficacy of policing in reducing crime (Gallo, 1998; Eck and Maguire, 2000; Levitt, 2004; Weisburd & Eck, 2004; Braga & Weisburd, 2006).

In particular, findings regarding the inefficiencies and overestimations in traditional policing strategies (Eck & Spelman, 1987; Hirschi & Gottfredson, 1993; Greenwood & Petersilia, 1975; Greenwood, Petersilia & Chaiken, 1976; Eck, 1983; Skogan & Antunes, 1979; Loftin & McDowall, 1982) might have prompted the claim of incompetence of policing in reducing crime at that time. Lately, scholars have focused on exploring emerging police innovations (Skolnick & Bayley 1988; Sherman 1993; Weisburd & Eck 2004; Braga & Weisburd, 2006; Skogan & Frydl, 2004; Bayley, 2008; Braga & Weisburd, 2006; Bayley, 2008; Mazeika, 2008) and examining their effectiveness as explanation for the crime decrease in the 1990s (Bratton 1999; Blumstein & Wallman 2000; Eck & Maguire 2000; Kelling & Sousa 2001; Goldstein, 2002; Skogan & Frydl, 2004; Bayley, 2008; Braga & Weisburd, 2006).

Specifically, the last three decades are recognized as the most innovative period in the U.S. (Weisburd & Uchida 1993; Moore, Sparrow, and Spelman, 1997; Blumstein & Wallman 2000, Eck & Maguire, 2000; Skogan & Frydl, 2004; Teichman, 2005; Braga & Weisburd, 2006). Police innovations have contrasted the standard model of policing (Eck & Maguire, 2000; Braga & Weisburd, 2006), defined and categorized in various forms by many scholars (Eck & Maguire,

2000; Weisburd & Eck, 2004; Moore, Sparrow & Spelman, 1997; King, 2000; Bayley, 2008; Braga & Weisburd, 2006). In the current study, the Standard (Traditional) Model of Policing, Community Oriented Policing, Problem Oriented Policing, Broken Windows Policing, CompStat and Hot Spot Policing have been considered major and well-known police innovations.

The literature review discussing innovative policing studies suggests community-oriented policing is a prevalent major policing innovation (Maguire et al., 1997; Skogan, 2006), and has become effective in reducing the fear of crime (McDonald, 2005; Skogan & Frydl, 2004, 46) and some crime rates (Connell, Miggans & McGloin, 2008). Similarly, problem-oriented policing shows evidence of reducing crime (Read & Tilley, 2000; Weisburd & Eck, 2004; Skogan & Frydl, 2004).

However, research on efficacy of broken windows policing indicates mixed findings in reducing crime rates (Greene, 1999; Bowling 1999; Eck & Maguire, 2000; Sousa & Kelling, 2006; Katz, et al, 2001; Sauso & Kelling, 2001; Taylor, 2001, 2002; Worrall, 2002; Corman & Mocan, 2005; Harcourt & Ludwig, 2006; Rosenbaum, 2007). Similarly, the effect of CompStat policing on reducing crime has not been determined with certainty (Eck & Maguire; 2000; Skogan & Frydl, 2004) for various reasons (Weisburd et al., 2006; Ratcliffe, 2004; Dabney, 2009).

The hot spot policing strategy was found to be effective in reducing crime (Sherman, Gartin & Buerger, 1989; Sherman & Weisburd, 1995; Weisburd & Green, 1995; Braga, 2001; Weisburd & Eck, 2004; Skogan & Frydl; 2004; Weisburd & Lum, 2005). Nonetheless, hot spot policing can be considered as a GIS based policing application (Weisburd & Green, 1995; Radcliffe & Mccullagh, 1998; Weisburd & Lum, 2005; Skogan & Frydl, 2004). In particular, there are major overlaps that can cause measurement losses if hot spot policing is controlled as a

separate policing strategy (Weisburd & Eck, 2004; Skogan & Frydl, 2004) while measuring the impact of GIS. Use of the GIS concept is supposed to comprise most of the hot spot policing effect; therefore, the effect of hot spot policing is not controlled in the current study.

All reviewed literature above indicates crime is a complex phenomenon emerging from a combination of several interrelated factors. These factors may provide independent or interactive explanations for crime phenomena. In fact, neither element can be entirely excluded from others in the analysis of crime, which shows there is no single explanation for crime. This necessitates taking into account major schools of thoughts and other evidence to stay away from the pitfalls of the study of crime. Nonetheless, using one or a few primary theoretical grounds can facilitate communication and control the variables in crime research. Considering social disorganization and collective efficacy variables, the current study uses concentrated disadvantaged, socioeconomic and demographic variables to study crime. In addition, the effects of policing on crime are controlled by using innovative strategies, proven effective in reducing the crime rate.

Specifically, the current study uses two sets of factors based on the reviewed theories and previous studies. The first set involves demographical and societal variables: age, sex, urban size, regions, family disruption, ethnic heterogeneity and poverty. In this structure, community policing and problem-oriented policing strategies are also controlled. The second set includes information technology capacity theory based variables (Kim & Bretschneider, 2004): form of government, police strength, crime analysis and education. At this phase, reviewing research on geographic information systems and information technology capacity theory can narrow the focus of the study.



GIS is defined as “a computer system for capturing, managing, integrating, manipulating, analyzing and displaying data which is spatially referenced to the earth” (McDonalds & Kemp, 1995, p.42). The emergence of GIS as a new tool has promised several benefits in advancing produced services (Budic, 1994; Campbell, & Masser, 1995; Mamalian & LaVigne, 1999; Greene, 2000; Gillespie, 2000; Tennant, 2001; O’Looney, 2003; Gilfoyle & Thorpe, 2004; Demirci & Suen, 2006; Smith, 2007; Ashby & Irving & Longley, 2007) depending on the stage in which organizations happen to be (Sieber, 2000; O’Looney, 2003; McDonalds, 2005).

The adoption and use of GIS increased considerably in local governments after the 1990s as the result of decreasing computerization, software and maintenance costs. This proliferation has also been strengthened as the result of increasing quality and quantity of data (Block, 1998), allowing better manipulation and analysis technique capabilities for enhanced decision-making. In fact, GIS applications depend on several resources (Mazeika, 2008), such as essential computer hardware and software, GIS personnel and relevant integrated technology depending on the budget. This stems from the complex and multidimensional nature of GIS adoption (King, 2000).

Although available evidence has mostly highlighted the promise of GIS, there are also costly and disheartening failures in GIS adoption and use because simple acquisition of GIS does not assure successful use (Budic & Godschalk, 1994). At the earlier phase, GIS research has focused mainly on examination of case studies to explore how GIS is adopted and used in organizations. Specifically, several studies have evaluated variables effecting successful GIS adoption and use (Pinto & Onsrud, 1993; Budic, 1994; Campbell, 1994; Anderson, 1996; Ratcliffe, 1998; Roodzand, 2000; Eric and Toorn, 2002; Gilfoyle & Thorpe, 2004; Chamard,

2004; Skogan & Hartnett, 2005; Demir, 2009), while others have explored barriers and obstacles causing failures in GIS adoption and use (Croswell, 1989; Ratcliffe, 1998; Ramasubramanian, 1999; Mazerolle, Belluci, Gajewski, 1997; Weisburd & McEwen, 1997; Kerski, 2003; Cope, 2004; Gilfoyle & Thorpe, 2004; Chamard, 2006). Respectively, other scholars address major challenges in GIS implementation, such as costs, funds and organizational constraints. These scholars seek to understand why more agencies have not started to adopt and use GIS (Manning, 1992; Brown, 1996; Mazerolle, et al, 1997; Harries, 1999; Police Foundation, 2000; Brown, 2001; Wartell & McEwen, 2001; Leipnik & Albert, 2003; Travis & Hughes, 2002; O’Looney, 2003; Gilfoyle and Thorpe, 2004; Thorpe, 2004; Ratchliffe, 2004; Pattavina, 2005).

Currently, GIS suggests a variety of functions and earlier GIS applications were centered on the use of an automated mapping process (Groff & La Vigne, 2002; LaVigne & Groff, 2001). Specifically, GIS was identified by Everett Rogers as an innovation and its evolution addressed at the early phase of the S curve (Masser & Onsrud, 1993). Since then, the use of GIS in local governments has often been examined (Harries & Elmes, 1993; Budic, 1994; Campbell, 1994; Nedovic – Budic, 1998; Queralt & Witte, 1998; West, 2003; Johansson, Graunland and Trnka, 2007).

Diffusion and use of GIS garnered much attention in policing when Compstat was successfully used for fighting crime in the 1990s. In brief, “computer statistics (CompStat) is a GIS-focused approach to managing a law enforcement organization and relies heavily on effective crime and investigative analysis” (ESRI, 2009). It was first applied in 1994 by the New York Police Department and in 1996 awarded an “Innovations in Government Award” by

Harvard University. Although CompStat has been identified differently in various resources, technology, specifically a GIS application (computerized mapping) was the central impetus of the integrated system. Since then, the use of CompStat-type GIS technology became more widespread among the other law enforcement agencies in the U.S. (Eck & Maguire, 2000; McEwen, 2002; Skogan, 2003; Police Foundation, 2004; Eterno and Silverman, 2006; Braga & Weisburd, 2006c; Weisburd, Matrofski, Willis & Greenspan, 2001; Mazerolle, Rombouts, & McBroom, 2007; Unter, 2007; Dabney, 2009).

Use of GIS in U.S. police organizations has been on a fast rise since the mid-1990s. According to Roth and Ryan (2000), use of GIS as a problem-solving tactic has increased from 39% to 74% between 1995 and 1998 in large, funded police agencies while use of GIS in non funded police organizations increased from 34% to 61% at the same time (205). In fact, 42% of fund beneficiaries reported that use of GIS was started and expanded via COPS MORE funds (Roth & Ryan, 2000). Increasing funds to support police expenditures might be one of the causes of increased GIS use. Other explanations are available to explain the shift in use of GIS in policing. Due to the fact that GIS is identified as a multidimensional innovative information (King, 2000) tool that has a positive effect on both internal and external means of the police, one logical explanation can be to expect an increase in overall police performance of service delivery. O’Looney (2003) claims, “a GIS can play a major role in integrating information from a variety of databases to identify problem areas” (12). In other words, organizational use of GIS may improve the analytical capability of the police agency by supporting managerial and operational decision making activities (Budic, 1994; Campbell, & Masser, 1995; Crossland, Wynne & Perkins, 1995; Block, 1998; Mamalian & LaVigne, 1999; Silverman & O’Connell, 1999; Hirschfield, 2001; Bowers & Hirschfield, 2001; Jankowski & Timothy, 2001; LaVigne &

Groff, 2001; Chainey, 2001; Greenwald, 2000; Leipnik & Albert, 2003; Gilfoyle & Thorpe, 2004; Smith, 2007; Pain, MacFarlane, Turner, Gill, 2006; La Vigne, Elderbroom, Brazzell, 2008; Demir, 2009; Gul, 2009) that may have a significant positive impact on policing outcomes, such as crime rates.

In particular, several studies have examined how police use GIS (Crossland, et al., 1995; Harries, 1999; Silverman & O'Connell, 1999; Lodha, 1999; Mamelian & LaVigne, 1999; Ghose, 2003; Pinto & Budic, 2000; Jankowski & Timothy, 2001; Craglia, Haining, & Wiles, 2000; Murray, McGuffog, Western, Mullins, 2001; Hirschfield, 2001; LaVigne & Groff, 2001; Chainey, 2001; Leipnik & Albert, 2003; O'Looney, 2003; Leipnik et al., 2003; Ratcliffe, 2004; Weisburd & Lum, 2005; Comfort & Kapucu, 2006; Curtin, McCall, Qiu 2007; Ratcliffe & Guidetti, 2008), and several others examined police input and output measures to understand how it helps the police in fighting crime (Rich, 1995; Weisburd & McEwen, 1997; Block, 1998; Radcliffe & McCullagh, 1998; LaVigne, 1998; Canter, 2000; Greenwald, 2000; Manning, 2001; Markovic, 2002; Leipnik & Albert, 2003; Gonzales et al., 2005; Ratcliffe, 2004; Paulsen, 2004; Chen et al., 2005; Levine, 2006; Smith, 2007; Li et al, 2008; LaVigne et al., 2008). However, there has been little exam of police outcomes with the aim of understanding the organizational impact of GIS in fighting crime.

Specifically, there is a recent line of research on this focus that has examined the contribution of GIS use on different police performance outcomes: fear of crime (Pain et al., 2006), crime rate (Garicano & Heaton, 2006), clearance rate (Hekim, 2009; Demir, 2009), crime rates (Gul, 2009), and clearance and crime rates (Garicano & Heaton, 2010; Garicano, 2010). However, findings of these studies have presented mixed results compared to theoretical benefits

of GIS use. This may indicate the existence of conceptual, methodological and theoretical problems in these examinations.

The current study extends this line of research by examining the impact of GIS use to police performance outcomes in cities and counties of the U.S. between 2000 and 2007. Different than the former studies, current research uses computerized mapping conceptualization (McEwen & Taxman, 1995) to operationalize its measurement. Second, the police performance methodological context (Roberts, 2006) is used to measure the organizational impact of GIS. Finally, a new theoretical framework, information technology capacity that combines organizational, environmental and managerial factors to explain IT applications (Kim & Bretschneider, 2004) is used to encompass most relevant dimensions of the subject matter. Additionally, the longitudinal nature of the current study is expected to provide discernable results when effects of crime and policing variables are controlled by major factors.

There were several obstacles facing GIS research in police departments in the 1990s. One of these, the adoption of GIS was viewed as a costly organizational decision to enhance public interest (Brown, 1996; Harries, 1999), and diffusion of GIS was very slow in local police departments until the Violent Crime Control and Law Enforcement Act was signed in 1994 (Rogers, 1993). There were other specification and measurement obstacles to be considered since adaptation of the technology was very new (Rogers, 1993). Considering the limitations and classical logic of the existing measures, the “need for a more sophisticated treatment” and search for new criteria to measure the value of GIS adoption were suggested by Masser and Onsrud (1993, p.4). Specifically, national longitudinal studies are suggested to examine the impact of

GIS adoption and non-adoption in organizations, institutions and society by use of new criteria geared to push away the barriers of current research (p.7).

In fact, nationwide systematic data collection for use of GIS did not take place until 1997. Since the mid-1990s, advancement in data collection and theoretical explanations has started to take place. The “Use of Computerized Crime mapping by Law Enforcement in the United States, 1997-1998” survey was implemented by the Inter-University Consortium for Political and Social Research (ICPSR) to collect data; however, its collected dataset was insufficient due to huge amounts of missing values. Systematic data collection of police departments in terms of use of GIS started in 1997 by Law Enforcement and Management Statistics (LEMAS). To date, LEMAS collected data periodically for 1997, 1999, 2000 and 2003, enabling the comparison of adopter and non-adopter police departments. Data collection of the LEMAS survey for 2007 has also been funded and its findings publicized recently.

In addition to the available data on GIS use, a new theory to measure the efficacy of local government organizations in terms of information technology capacity (ITC) (Kim & Bretschneider, 2004) has emerged. ITC theory aims to measure the "the ability of the local government to effectively apply IT to achieve desired ends." Although most available GIS research is divided as to GIS adoption and use (Skogan & Hartnett, 2005), ITC theory combines both adoption and use of GIS into one concept by knitting together organizational, environmental and managerial factors. These factors are identified as administrative authority, managerial capability of IT manager and financial support. A consideration of education is also suggested as a control variable to measure.

Although some studies conceptualized some functions of GIS as crime mapping (Burgess, 1925; Shaw & McKay, 1942; Block & Dabdoub, 1995; Weisburd & McEwen, 1997; Bowers & Hirschfield, 2001; Groff & LaVigne, 2002; Boba, 2005; Gilfoyle & Thorpe, 2004; McDonald, 2005; Chamard, 2006), crime analysis (Emig & Heck & Kravitz; 1980; Eck, 1987; Gottlieb, Arenbberg & Singh, 1994; O’Shea & Nicholls, 2003; Foster, 2004; Boba 2005; McDonald, 2005; Mazerolle, et al., 2007; Santos, 2012) and hot spot policing strategy (Weisburd & Eck 2004; Skogan & Frydl, 2004; Kappeler & Miller, 2006; Weisburd & Braga, 2006; White, 2007); use of GIS provides more analytical capability than these three separate functions to police agencies. To have a comprehensive concept, this study operationalizes the use of GIS by focusing on its computerized mapping function in police agencies (McEwen & Taxman, 1995; Rich, 1995; Harries, 1999; Chamard, 2004). This is due to the fact that computerized mapping comprises the mapping functions of crime mapping, crime analysis and GIS use. In fact, GIS use has the capacity to produce three major computerized mapping types that are descriptive, analytical and interactive (Taxman & McEwen, 1995).

The main assumption of the proposal is that use of GIS (computerized mapping) in police agencies increases police performance due to its wide practical scope in police agencies. For example, crime mapping and hotspot analysis are some of the frequent uses of GIS by police. These uses are presented in detail in the U.S and geographic information systems chapters. Specifically, the more the use of GIS occurs in a police agency, the larger the information technology capacity that the organization is supposed to have. Therefore, having a large information technology capacity is expected to increase police performance that is measured by crime rates—that is, an outcome measure (Roger, 2006).

In this respect, the study examines the research question: Does use of GIS (computerized mapping) contribute to police performance? Specifically, the focus of the study is not how the use of GIS contributes to police performance; rather, it aims to explore what the use of GIS does to police performance.

To measure the use of GIS by police can contribute to both practice and research in several ways. Do we know whether the use of GIS in law enforcement agencies increases police performance? Or whether this contribution has an effect on the crime reduction efforts of the police? Exploring these points may provide a meaningful answer to inform a decision about whether to continue investing in this popularized technology at police agencies or not, one of the major expectations of the research. Discerning more contributory variables in the use of GIS success in police organizations is another expected contribution. Exploring the net contribution of GIS use in police performance is the other contributive point. Capturing more specific knowledge on whether the use of GIS has a meaningful effect in reducing the crime efforts of the police is the other expectation. Finally, exploring the contribution of GIS use to policing is very important for the Turkish National Police because diffusion of GIS adoption into a police organization is a very new phenomenon in Turkey. Currently, only a few large police organizations have adopted computerized mapping in major Turkish cities and diffusion of mapping is in its early phases. Although Turkey offers a very wide potential scope and geographical area for GIS use, policy makers have not yet provided nationwide regulation or guidance for the adoption and use of GIS in the Turkish National Police. The potential findings of the current study can provide a clear picture of GIS use to help authorities make better decisions in the area of policing. Investments in computerized mapping technology can be better guided if research findings can shed enough light on the existing experiences in the U.S. police



agencies. If the general assumption that the use of GIS contributes to police performance and to a decrease in crime is confirmed, this can encourage more police organizations to also implement GIS. This finding can also expand the research area in GIS use in police agencies different types of GIS applications exist that may be currently measured in regard to use. In summary, the research objectives of the current study are to explore GIS use in local police departments in the U.S. between 2000 and 2007 and to examine the impact of GIS use toward the enhancement of police performance, thus reducing crime.

The measuring effect of the GIS in enhancing the overall capacity of police can provide several contributions in the practical sense. One clear contribution of findings might be about facilitation of budgetary costs, because adoption of GIS is a costly organizational decision to enhance public interest (Brown, 1996; Harries, 1999). Therefore, to explore its successful implementation and full utilization is critical (Masser & Onsrud, 1993; Goodman, 1992). In particular, findings of the study may facilitate decision making in increasing, decreasing, stopping or continuing budgetary support for GIS. Secondly, fund-based contributions are available only for large police agencies and populated areas (COPS, 2009). Small police organizations and low populated areas are excluded from this funding; whereas, the contribution of GIS may be needed more in a wider area where population and police organization may be lacking. Additionally, small organizations and low populated large areas may not be able to support the adoption of GIS by themselves; therefore, funding would be essential for them. Finally, the findings of the study may increase awareness as to the importance of GIS use in police agencies since bureaucratic organizations learn incrementally.

The literature review of the current study is composed of three chapters to provide an adequate research base for studying the interdisciplinary area in question. These three sections discuss the following: (1) crime (2) policing in the U.S. and (3) geographic information systems. The purpose of these three literature review chapters is to introduce GIS as a new policing innovation and to measure its contribution on police performance, measured by crime rate. This explanation is supported by the use of information technology capacity theory (Kim & Bretschneider, 2004).

Considering crime rate as an organizational performance measure, the first chapter presents the literature on the general causes of crime, the major theories of crime, major factors affecting crime and crime measurement. The crime measurement section describes national crime measures: The Uniform Crime Report (UCR) and National Incident-Based Reporting System (NIBRS), National Crime Victimization Survey (NCVS) and self-report surveys.

The second chapter mainly provides literature on the characteristics of U.S. policing. In particular, this chapter involves the evolution of policing, the effect of policing in reducing crime, the recent innovative policing strategies and their contribution in changing crime rates. Respectively, sections about the performance measurement in public service delivery and performance measures in the police are presented.

In general, the third chapter aims to show the general context of geographic information systems (GIS). Specifically, some of the major questions in GIS research are answered. These questions are: What is GIS? Is GIS an innovation? What are the benefits of GIS use? How is GIS adopted in organizations? What are the challenges in GIS use? How do police agencies use GIS? What are the differences among GIS, crime mapping and crime analysis? How does GIS

contribute to local governments? Respectively, a new line of research examining the contribution of GIS use to policing outcomes is underlined. Finally, the conceptualization of GIS and its operationalization as computer mapping are presented. In other words, the computer mapping represents the use of GIS as the focused explanatory IV in the current study.

In this framework, three chapters explain mainly two sets of factors to examine the impact of GIS use to police performance. To quantify the success of police performance, the crime rate of a police department is used as an outcome proxy, as the dependent variable for the current study (Swindell & Kelly, 2000; Moore and Baraga, 2003; Roberts, 2006). In this respect, the first set of factors is gathered in the light of the information technology capacity (ITC) theory which is defined as "the ability of the local government to effectively apply IT to achieve desired ends" (Kim; Bretschneider, 2004). Specifically, ITC knits together organizational, environmental and managerial factors affecting the level of IT capacity in local governments. This requires the consideration of three main factors, namely: (1) administrative authority, (2) the managerial capability of the IT manager and (3) financial support to examine an IT application. Education (4) is also used to control variety of GIS use.

The second set of factors involves correlates of crime to control their effects on crime rates. Specifically, age, (5) sex, (6) urban size (7) and regions (8) are considered as demographic variables. In light of social disorganization and collective efficacy theories, family disruption (9) ethnic heterogeneity (10) and poverty (11) are used as the social and economic control variables of crime. Considering the effect of the police in reducing crime rates, community policing (12) and problem oriented policing strategies (13) are used as control variables in order to discern impact of GIS use on police performance.

## CHAPTER 2

### Literature Review

#### 2.1. Introduction

Reviewing causes of crime can facilitate understanding of the root causes of illegal actions and the variety of crimes in different geographic areas. This understanding is also supposed to simplify the study of the impact of geographic information systems (GIS) to policing. The reason is because this study mainly assumes that using GIS can increase analytic capability of police agencies (Budic, 1994; McEwen & Taxman, 1995; La Vigne, 1999; Harries, 1999; Sieber, 2000; Leipnik et al, 2003; Boba, 2005) and this can increase police performance. Increased performance refers to information technology capacity (ITC) of a police agency which is theorized by Kim and Bretschneider (2004). This IT capacity is expected to be successful if organizational, environmental and managerial factors are adequately considered while using GIS (Kim & Bretschneider, 2004). Consequently, this increased information technology capacity of a police organization can contribute to outcomes of the police organizations. This study considers crime rate as the outcome measure of police performance (Swindell & Kelly, 2000; Moore and Baraga, 2003; Roberts, 2006). In other words, the crime rate is used as the dependent variable of the current study. In this context, this chapter explores crime, and provides general theoretical and empirical grounds for the explanation of crime. Thereafter, appropriate explanatory variables of crime are selected for the current study and they are explained in detail.

Crime is seen one of the major forces shaping individuals and societies at the cost of significant private and public resources (Miller, Schreck & Tewksbury, 2008). Arguments focusing on the understanding of crime are various (Sutherland, 1940; Tappan, 1947; Schwendinger & Schwendinger, 1970; Rock 1973; Sellin, 1938) and it can be practical to

consider the basic and common definition of crime at the outset. Michael and Adler (1933) provide a simple and less ambiguous definition of crime as “behavior which is prohibited by the criminal code.”

Discussing different arguments about the definition of crime can extend comprehension of its meaning. For example, some argue that there are ignored classes in crime definitions such as white collar persons (Sutherland, 1940), while others argue a more legalistic position that any person should not be regarded criminal unless there is a conviction because of a violation of the criminal law (Tappan, 1947). Yet others argue with apolitical views that crime occurs when the human rights of an individual or groups are violated (Schwendinger & Schwendinger, 1970); and other scholars (Rock, 1973) argue that crime is a socially constructed phenomenon and criminalization is a result of the social process. It is also noteworthy to mention the warning of Sellin (1938) which has been widely restated in different forms in relation to crime definition (Coleman & Norris, 2000). According to sociologist Sellin (1938), the criminal law frequently reflects the values of the strong interest groups of a society in addition to general moral standards. Besides, criminal behaviors also can vary between societies and change over time within the same society. Overall, Sellin (1938) suggests that researchers should define crime freely with their own terms to reflect the nature of the subject matter. In the current study, crime is defined basically, as “forms of conduct that society prohibits (by the criminal code) in order to maintain” order (Albanese, 2005, p. 11).

Several causes of crime are enlightened within the abundant theoretical ground of criminology. Scholars indicate two distinctive tracks of criminology to focus on (Nagin & Paternoster, 1994; Pratt, 2001, Miller et al, 2008). One of these is the micro level theory which

focuses on explanations of individuals or small group activities to search for internal reasons having effect on criminal decisions or behaviors. The second perspective is the macro level theory, so called environment theory, which focuses on explaining the society and its structural characteristics where social explanations look generally for external causes to crime. In general, this includes “social inequalities, culture, and demographic characteristics of population such as age, gender, race, educational attainment, and citizenship” (Miller et al, 2008, p.10). According to Pratt (2001), micro level studies explain why individuals break the law while macro level studies focus on characteristics of delimited geographic areas, such as neighborhoods, cities, counties states or nations, as the causes of crime. In other words, macro level approaches aim to explain why some characteristics of areas provide reasons for crime distribution.

Some scholars evaluate alternative theories, macro studies, and social disorganization to understand their utility in explanations of crime (Miethe, Hughes and McDowall, 1991; Rose and Clear, 1998). Considering traditional theories of criminality, such as anomie, differential association, conflict and social bonding, alternative opportunity based theories, such as routine activity and rational choice are reviewed so as to better explain social and crime rate changes (Miethe, et al., 1991). In particular, the empirical adequacy of criminal opportunity and social disorganization theories were evaluated in 584 U.S cities for the years 1960, 1970, and 1980 with the use of time series and cross sectional analyses. The social disorganization perspective has been found more supportive than criminal opportunity theories. Specifically, ethnic heterogeneity, household size and rate of crowding in households are found to be stronger predictors in explaining the official rates of homicide, robbery and burglary. Specifically, homicide and assault are indicated as crimes more associated with poverty or income inequality. Furthermore, Rose and Clear (1998) examine implications of the social disorganization theory of

incarceration and social capital. Considered as a formal control, overreliance on incarceration is suggested as a potential hindrance to the informal control ability of the community because incarceration may weaken the bonds of family and other community structures with the incapacitated offenders. This formal control can exacerbate the problems and communities may experience more disorganization.

It is essential to recognize that the distribution of crime events does not occur uniformly (Eck and Weisburd, 1995). Numerous studies can be presented in this frame. As cited in their studies, for example, repeat events at the same places have been explored for Boston by Pierce et al. (1986) and for Minneapolis by Sherman et al. (1989) and Weisburd et al., (1992). Distribution of crime can also be examined based on specific crimes. For example, hotspots of predatory crimes were examined by Sherman and colleagues (1989) and burglaries were examined by McLaughlin and colleagues (2004). As to Braga (2001), “three complementary perspectives on crime theoretically support these observations on the uneven distribution of deviance: rational choice, routine activity, and environmental criminology” (Cornish & Clarke, 1987; Cohen & Felson, 1979; Brantingham, 1981). According to Eck and Weisburd (1995), most research has focused on an individual level view of crime and its prevention by analyzing why certain types of people commit crimes and what can be done about this. However, they (1995) think that the offender (individual level) and event (societal level) examinations are complementary studies, not competitors. Researchers on crime recognize that certain contexts of an area and ecology may have an unusual level of crime rate. In particular, macro level studies of crime mainly question why some urban places experience higher or lower crime than other places. The current study is founded on this school of thought as a macro level study.

Macro level analysis of crime provides several predictors of crime based on diverse theories. Pratt and Cullen (2005) examined more than 200 empirical studies to understand ecological correlates of crime by means of the meta-analysis technique. In this study, social disorganization, resource and economic deprivation theories are addressed as strong empirical support receiver theories. Anomie, strain, social support and, social altruism theories are presented as moderate support receivers. Finally, deterrence, rational choice and sub cultural theories are shown as having the weakest support. Specifically, the findings indicate that ‘concentrated disadvantaged’ variables are the strongest stable predictors of crime. These variables may be better recognized within the context of social disorganization theory as racial heterogeneity (the percent of non-whites and the percent of black), poverty and family disruption. These findings do not imply that other variables are insignificant; instead, they emphasize the importance of these macro characteristics.

Crime theories help us to explain why crime occurs. Several theories attempt to explain the crime phenomenon from diverse views because the study of crime is seen as an interdisciplinary area (Wilson & Herrnstein, 1998; Henry & Lanier, 1998; Coleman & Norris, 2000). Specifically, sociology, psychology, law, anthropology, history, geography, economics, and political science are mentioned as some of the related disciplines by Garland (as cited in Coleman & Norris, 2000, p.15). In fact, criminological theories explain mainly the role of internal (e.g., biological and psychological), external (e.g., societal) factors; the effects of formal (law and law enforcement actions) and informal (collective efficacy and peer effects) social control mechanisms in different types of crime (Miller et al, 2008). Albanese (2005) states four general approaches as being more contributive in explaining crime. These are known as classical school, positivistic, ethical and structural views. In this chapter, the classical school (Coleman & Norris, 2000; Miller et al,



2008; Bentham,1789; Beccaria, 1819; Piliavin, Gartner, Thornton & Matsueda, 1986; Albanese, 2005), positivist school (Miller et al, 2008;Norris, 2000; Wolfgang, 1961 Coleman & Norris, 2000; Thrasher, 1949; Feldman, 1977; Albanese, 2005), and Chicago school (Quetlet,1831; Guerry,1833; Beirne, 1987; Burgess, 1925; Shaw & MacKay, 1942; Eck & Weisburd, 1995; Coleman & Norris, 2000; Chainey & Ratcliffe, 2005; Pratt & Cullen, 2005; Thabit, 2006; Miller et al, 2008) are reviewed to provide the fundamental research ground. Complementarily, relevant theories and research on deterrence, routine activity, social disorganization and collective efficacy are presented in detail below. Respectively, mostly used correlates of crimes are provided to explain the crime drop in New York City and other U.S. cities in the 1990s. Finally, some of the selected major variables in crime explanation based on previous studies are presented to control their effects on crime in the current study.

It is important to highlight that the focus of the study is to measure the impact of the GIS used in police performance. In particular, the crime rate is used as a tool (an outcome measure) to understand the effect of the GIS used in the context of police performance.

## **2.2 Classical School**

The classical school of criminology mainly relies on the assumptions of enlightenment philosophers on human nature (Coleman & Norris, 2000; Miller et al, 2008), and the free will of individuals that considers the dignity of human beings and the role of government for punishment to protect the order (Bentham,1789; Beccaria, 1819). Enlightenment philosophers searched for reasons in the understating of human problems rather than relying on tradition, superstition and religion. In the classical school approach, individuals are assumed to make rational choices based on their free will to pursue their maximized self (hedonist) interests while

minimizing their costs or punishment (Gartner, Thornton & Matsueda, 1986). In this frame, all people are considered equal in their capacity while conducting actions toward their aims. When the law is violated, crime occurs, and punishment takes place based on the offense not the person (Albanese, 2005).

In this context, all people are considered innocent until they are proven guilty (Miller et al., 2008) and punishment is expected to be fair, written and mainly to ensure the order and public safety (Beccaria, 1819). Specifically, any action of individuals would be valued based on the moral and immoral effects on the community's happiness (Bentham, 1789). Otherwise, anarchy could replace the legal authority and would allow individual or group excessiveness, as well as rampant injustice, unless this kind of ruling (deterrence) was in effect in a society (Albanese, 2005). Reviewing the deterrence perspective as one of the examples of the classical school can enlighten the role of the current criminal justice process to some degree.

### **2.2.1. Deterrence**

According to Beccaria, the deterrence of crime is the central purpose of the criminal justice system (Miller et al, 2008; p.15). In deterrence thinking, the basic aspects of human nature, such as having self-interest, being rational creatures, pursuing pleasure and avoiding pain, are accepted. There must be causes of crime in this understanding (Coleman & Norris, 2000). In fact, supportive evidence favoring the deterrence effect has been presented in the National Academy Science Panel in 1978 (Blumstein, Cohen & Nagin, 1978). Cook (1980) also confirms this and the further effectiveness of the deterrence understanding. Several other studies are referenced below to discuss and better understand deterrence. Cook (1980) states, "there are two main issues to be considered in a complete theory of criminal deterrence: first, the influence of

the threat of criminal sanctions on the choices made by individuals regarding their participation in criminal activity; and second, the effectiveness of various criminal justice system activities in producing threats” (216). The current study focuses on Cook’s second consideration which emphasizes the effectiveness of criminal justice system activities.

While criminology seeks mainly to discover the nature, the various causes and the variety of crimes in a systematic manner, the criminal justice system addresses crime with its institutions: the court, the police and the prisons (Miller et al., 2008). It is very important to understand the criminological motivations behind crime, therefore; appropriate policies can be adapted via criminal justice institutions. For example, the police can enhance its policies and tailor new strategies against crime by examining the nature and underlying causes of crime. In this study, the performance of police agencies is targeted by measuring the impact of GIS use to policing outcome.

Use of GIS in a police agency is assumed to increase analytical capability of the police agency (Budic, 1994; McEwen & Taxman, 1995; La Vigne, 1999; Harries, 1999; Leipnik et al., 2003; Boba, 2005; Sieber, 2000); therefore, it is supposed to have an effect toward increasing performance of the police organization to deter crime in a police district. In fact, this study does not aim to explain the ‘how’ question which attempts to prove the causality of how GIS can have an effect on police agencies. Rather, this study attempts to explore ‘what’ has happened in police agencies as an outcome (represented by the crime rate) if they utilize GIS or not. This is because there are a large number of police agencies which either do not use GIS (as operationalized crime mapping and hotspot identification) or utilize one or two of these conceptualized features of GIS. Causality may not be measured with the current available data and more resources, time, and

support are needed to set up an experiment to test its causality. To clarify contribution of GIS use in police agencies in terms of organizational outcome can provide several contributions to research and practice. In police practice, findings can show a positive direction toward adopting GIS within other large and small agencies. Current and prospective GIS adoptions may be adequately funded by the local, state and federal organizations. Contributor factors to GIS use can be better understood. This study also extends a recent line of research (Smith, Graettinger, Keith, Hudnall, Parrish, 2005; Mazerolle et al., 2007; Li, Mo & Zhou, 2008; LeBeau, 2001; Gul, 2009; Hekim, 2009; Demir, 2009) that examines the effects of the use of GIS, crime mapping and crime analysis in the police.

In sum, associations and correlations of police agencies which adopt and do not adopt the GIS are examined to understand its overall effect on police performance in this study. Use of GIS in police agencies is considered contributive to police performance which can be measured in terms of overall crime rate as an outcome measure.

Deterrence through the threat of apprehension and punishment is supposed to be a remedy to maintain order in an area. Reviewing prior studies and evidence on the efficacy of the deterrence perspective can facilitate understanding of its role and impact in the criminal justice system. Some studies exploring deterrence research are those by Cook (1980), Gartner et al., (1986), Paternoster, (1989), Levitt (2002), and Miller et al., (2008). According to Cook (1980), deterrence research aims to understand the “relationship between the crime rate and the threat of punishment generated by the criminal justice system” (212). Paternoster (1989) presents three propositions within the deterrence theory as inverse relations: certainty, severity and celerity of punishment, and crime. Levitt (2002) reviews the effect of deterrence on crime. Accordingly,

deterrence is not limited within the criminal justice system, such as the police and prisons, and it can operate in several ways. For example, neighborhood watch groups, private security companies, and armed individuals can constitute the deterrence effect. In fact, deterrence research is distinguished in two parts as general and specific deterrence (Miller et al., 2008). In general deterrence, it is assumed that the overall deterrence effect will be perceived by the people whether they are punished or not. This psychological barrier is supposed to make people more thoughtful before participating in crime. Specific deterrence intends to study recidivism of the offenders who have been officially punished before. In summary, specific deterrence involves reducing recidivism, while general deterrence involves reducing general crime rates (Miller et al., 2008, p.23). Although deterrence mainly includes the effect of the courts, police and incarceration (Nagin & Paternoster, 1994), this study focuses on the efficacy of the police dimension.

The efficacy of the deterrence perspective has been questioned by several scholars (Feldman & Weisfeld, 1973; Sherman & Berk, 1984; Sampson & Cohen, 1988; Sherman, 1990; Sherman & Weisburd, 1995; Levitt, 1997, 2002). An interdisciplinary study of crime (Feldman & Weisfeld, 1973) examined illegal actions and the deterrence effect. Findings indicate that financial reward is a unifying motivation of some illegal actions. These actions are stated to range from burglary to organized crime in this research. The deterrence effect's existence as punishment is also indicated. Specifically, the deterrent effect is stated to be stronger if the offender has family responsibilities. Conversely, the deterrence effect will be weaker if the offender learns criminality in prison. Sherman and Berk (1984) researched the deterrence effect of arrest in domestic assault. In this study, three police responses were chosen by randomly selected suspects. Suggested preferences were arrest, advice and order to leave. Six months after

the application, the activities of these selected suspects were examined as recidivism. The arrest preference was found more effective in deterring selected suspects that was measured with frequency of the recidivism. Sampson and Cohen (1988) examined the deterrent effect of the police on crime. In this study, population size, poverty, region, racial composition, inequality, income and family disruption were used as variables. The authors found a direct inverse relationship between proactive policing deterrence and aggregate robbery rates. Likewise, Sherman (1990) examined the deterrence effect of police crackdowns in eighteen cases. Fifteen of these cases showed evidence for an initial deterrence effect while only two of them provided a long term deterrence effect. The initial deterrence effect comprises the decay of the effect after a short period of time even though police presence is continued. A residual effect was also reported for deterrence that continued for a while after the police crackdowns. Sherman and Weisburd (1995) studied the general deterrence effect of police patrols in crime hot spots. Whether the police presence causes any measurable effect in concentrated crime areas or not was the general question of the study. Crime reductions were found in experimented areas. Specifically, the observed disorder decreased considerably in hot spots. The study concluded that modest reductions were found in the case of patrol presence; however, more impressive results were found in reducing disorder within directed hot spots. Levitt (1997, 2002) also questioned and analyzed whether hiring more police has an effect on crime or not.

Three different approaches are used to test the effect of the police on crime. Findings indicate the existence of a large reducing impact of police on crime. General deterrence research utilizes 'crime rate' as one of the dependent variables when a spatial area is focused on. For example, Ehrlich (1973) examined the deterrence effect of collective law enforcement activity in index crimes. The study indicated the existence of the deterrence effect of law enforcement

activity on overall crimes. Besides, income inequality was found to be positively correlated with property crimes. The study findings also addressed the effectiveness of the law enforcement activity in reducing crime.

The National Criminal Justice Commission assessed criminal justice system practice in the U.S. by producing the report titled “The Real War on Crime” in the mid-1990s (Donziger, 1996). The initial idea of the project was to understand the real capacity of the criminal justice system’s deterrence effect on crime rates and violence. The primary conclusion of the Commission is that the “criminal justice system is in crisis . . . The prison population has tripled since 1980 and expenditures on law enforcement have quadrupled. We have built more prisons to lock up more people than almost every country in the world. We are the only country in the West to employ capital punishment and use the death penalty against teenagers. Yet, Americans in record numbers still report that they feel unsafe in their streets and in their homes” (1996, p.1). In addition to this, “academic research has shown little or no correlation between rates of crime and the number of people in prison. States with high rates of imprisonment may or may not have high rates of crime, while states with low rates of crime may or may not have high rates of imprisonment” (1996, p.42). Although these articulations may imply that crime rates may be higher in the U.S. than in other countries, the overall official crime records show that crime rates in the U.S. are not extraordinary, except those for murder (1996, p.10). In fact, there is a difference between public perception which is measured in the National Crime Victims Survey, NCVS, and the reality of crime which is measured by the Uniform Crime Reports, UCR, in the U.S. Although there is an extensive review section in the current study presenting measures of crime in the U.S., it is noteworthy that the UCR provides a very accurate measure in recording the homicide rates (Donziger, 1996, p.4).

There are also criticisms against deterrence research articulated by scholars (Levitt, 2002; Miller et al., 2008). Levitt (2002) indicates three main deficiencies in correctly testing the effect of deterrence on crime. First of all, deterrence is seen as an individual behavior, whereas, it is generally measured based on aggregate data. Secondly, the distinguishing direction of the causality and correlation is seen as arbitrary. Finally, deterrence and incapacitation are similar concepts and their measurement process may not be differentiated easily. Although the existence of the deterrence effect is indicated on crime rates by the use of more police, more prison, longer sentences and the increased precautions taken by victims, Levitt (2002) articulates that “deterrence alone, however, cannot adequately explain the differences across place and time in crime rates” (450). Although the effect of deterrence within the criminal justice system can be considered as the “quickest and most efficient way of government to influence criminal activity” (450), only less than 25 % of the crime variation is attributed to deterrence alone.

Miller et al. (2008) also criticize the deterrence theory. Since the deterrence concept is a psychologically based construct, “deterrence theory is not directly observable” (Miller et al, 2008; p.23). This is because the absence of committing a crime is a ‘nonevent’ and it is hard to measure if it is not there. It is a similar dilemma to measure police effectiveness in crime prevention because it is not easy to be certain how many potential events the police might have deterred or not. If the offender refrained from committing a crime, are the police the only deterrent effect? The court, prisons, religion, schools, family, friends, military, or other reasons may cause this nonevent. In fact, if we infer failure of the criminal justice system when we hear of a new crime occurrence, the reduction of fear of crime and/or crime rates (nonevent) can also be inferred as representing the efficacy of the deterrence system.



Although the efficacy of the deterrence theory is criticized (Levitt, 2002; Pratt & Cullen, 2005), a large body of deterrence study still evolves (Miller et al, 2008; Nagin, 1998). According to Miller et al. (2008), deterrence research can be grouped into four broad types (24). These are named as anecdotal studies relying on qualitative research, ecological studies of aggregate crime relying on tests of imprisonment and index crime rates, natural experiments examining change of crime level patterns, and sample surveys relying on self reported measures. In the opinion of Miller et al. (2008), anecdotal studies are weak in testing the deterrence theory; while ecological studies are suggestive but not conclusive. Experiments are more rigorous than ecological studies but provide indirect evaluation of the deterrence effect; and sample surveys are more direct but they are not conclusive, only suggestive (24-26). Deterrence theories accept free will and consider deterministic, environmental factors as a ground for decision making. And, crime is mainly considered as the result of ineffective deterrence. In Nagin's (1998) views, three distinctive areas are disconnectedly evolved in the deterrence research. These are listed as interrupted time-series, ecological, and perceptual studies. Nagin (1998) states that: "The largest body of evidence on deterrence in the ecological literature focuses on the police" (29).

### **2.3. Positivist School**

Positivism emerged by emphasizing the "identification of the patterns and consistencies in observable facts" (Miller et al, 2008; p.5). This school of thought differs from the classical school because crime is not seen as the result of free will. Rather, crime is seen as the result of variety of internal and external influences in positivist school. For example, crime is considered as another result of physical development of a person (Miller et al, 2008). This means as a kind of predetermined behavior of the person. In order to measure and understand crime phenomena,

scientific objectivity is emphasized as the major paradigm in this school. In the classical school, punishment is seen as barbaric and outdated (Coleman & Norris, 2000), whereas, punishment is indicated as rehabilitation or reform for a person to change internal and external conditions of his/her reactions in the positivist school (Miller et al., 2008). Specifically, Lombroso is accepted as the pioneer in this school of thought. His ideas about atavism received much attention after his publication of 'The Criminal Man' (1876). According to Coleman and Norris (2000), Lombroso's approach is very different than that of moral social statisticians and he thought that a criminal "could be the object of study for a new discipline" (21). They (2002) indicate that Lombroso's studies benefited from the thoughts of Darwin's evolution of species. According to Wolfgang (1961), Lombroso's study on biological influences is contributive to criminology in the search for causes of crime. Although Wolfgang (1961) criticizes Lombroso's ideas about the "born criminal" concept, he states that Lombroso redirected emphasis from the crime to the criminal. As to Miller et al., (2008), Lombroso's ideas were modified and enhanced by Ferri and Garofalo specifically in Europe. In particular, Ferri and Garofalo emphasized that sociological and psychological causes of crime also should be considered in addition to the biological causes of crime (Coleman & Norris, 2000). Later, Lombroso's claim of atavism was seen as an error (Thrasher, 1949) and Goring rejected his thoughts by examining both inmates and noncriminals at the same time. Thrasher (1949) states that, "Lombroso's theory was knocked into a cocked hat" (197). In sum, biological theories argued the role of the body, development of the body, inherited traits via genetics and recently, the level of hormones in the body (Miller et al., 2008, p.57). Miller and colleagues (2008) note that "biological theories are among our weaker and less supported theories of explaining crime" (58).

Differently, psychological theories of crime claimed that something might be wrong with the way of thinking and the mindsets of criminals. In this view, mainly individuals and family factors on crime have been studied. Biological and psychological factors and their relevance with the ongoing crime control efforts were studied by scholars (Feldman, 1977; Moffitt, 1993). Specifically, studies followed up some individuals from childhood to adulthood to understand the effect of psychological factors on crime overtime (Feldman, 1977). Noticeably, life course theory received support and attracted several researchers. For example, the study by Terrie Moffitt (1993) on life course identifies two groups of people with antisocial behavior. They are called adolescence limited and life course persistent. In her taxonomy (1993), the first group of offenders includes adolescents who tentatively show antisocial behaviors and become normal individuals in their adulthoods. The second group of offenders continues their antisocial behaviors, since a pathological personality emerges as the result of continuing interaction with the criminogenic environment. This means that biological, psychological and environmental factors all play roles in constructing criminal behaviors. In fact, the positivist school's pioneers, Darwin and Durkheim, explain crime and human behavior by biological, psychological and social factors (as cited by Albanese, 2005). Although psychological factors are considered to be explanatory of crime, these theories are not easily validated scientifically (Miller et al., 2008). Additionally, psychological factors may cause the crime but it is not easy to identify criminal mindsets.

#### **2.4. Chicago School**

Reviewing the social ecology of crime can facilitate comprehension of the current study because the study applies a macro level approach to understand crime change in U.S. cities and counties. Ecology refers to “examination of relations between an organism and its environment”

(Thabit, 2006). In this positivist perspective, crime is attributed to society as moral and asocial phenomena rather than to individuals. Quetelet (1831) is considered one of the pioneers of sociological analysis of crime with Andre Guerry (1833) by Beirne (1987). As mentioned by Eck and Weisburd (1995), Guerry (1833) and Quetelet (1842) are the earlier French scholars that analyzed the distribution of crime across the regions of France. They found social and ecological variations among the regions. In particular, Quetelet's criminological approach emerged when French penal code was in failure and statistics based social research expanded (Beirne, 1987). According to Coleman and Norris (2000) "Quetelet came to the conclusion that the causes of crime were to be found in social organization" (p.20).

In the U.S., this school of thought started to examine the population shift from rural to urban areas at the outset of the 20<sup>th</sup> century in Chicago. It was assumed that this rapid change from rural to urban may be the cause of increasing crime and disorder. In fact, the importance of urban characteristics on crime emergence was found in Chicago. Specifically, the study of social disorganization (Shaw & MacKay, 1942) received high attention among spatial based studies. Rooted within the positivist Chicago school of sociology, the social disorganization approach is seen as one of the prominent explanatory approaches to crime within the context of urban development (Chainey & Ratcliffe, 2005; Pratt & Cullen, 2005; Miller et al, 2008).

#### **2.4.1. Social Disorganization**

The assumptions of the social disorganization theory are different from those of the other theories. The social disorganization theory does not highlight whether biological or psychological deviances constitute causes of crime; instead, normal people are assumed to live in the communities, but larger social institutions may fail to keep maintaining the order.

Specifically, social disorganization theory is a macro level theory and its focus is the community. The city is considered as a natural laboratory reflecting the whole society where the components of structure are not stable (Thabit, 2006). For Miller and his colleagues (2008) the assumption of this theory is that “social organization – schools, churches, business, police informal networks of friends and neighborhoods, and government – when functioning normally enables a community to deal with problems of crime” (88). In fact, this is not the case all the time. In particular, social disorganization “links an area’s high crime rates to the inability of the community to organize in order to act collectively” (Miller et al., 2008, p.88). This can be interpreted as the “inability of a community to realize common goals and solve chronic problems” (Kubrin & Weitzer, 2003; p.374). In other words, the theory aims to explain why a community can fail. For example, if a market is unable to provide open jobs to the community members, its inability may constitute joblessness and poverty becomes widespread across the community. This does not mean that poverty will lead directly to crime increase; rather, this situation is supposed to make the community institutions and individuals more vulnerable to crime. In fact, three variables are found influential with respect to increasing crime under the social disorganization theory. These are poverty, residential mobility and ethnic heterogeneity (Shaw & MacKay, 1942). The social disorganization theory also received critiques from a few scholars (Bursik, 1988). First, adequate long term evidence was not presented to assume that stable ecological structures exist. Second, the assumptions of the study were claimed to be insensitive to the realities of the social and political life.

Several researchers have been recognized as the members of the Chicago School, such as Burgess (1925), Trasher (1927) and Shaw McKay (1929; 1942). In the last decades, many scholars (Bursik 1988; Flowers, 1989; Eck and Weisburd, 1995; Braga, 2001, Pratt, 2001, Pratt

& Cullen, 2005) have articulated the resurgence of the social ecology of the crime approach in explaining crime. As to Thabit (2006), the social disorganization theory has extended with the routine activities theory (Cohen & Felson, 1979) and collective efficacy (Sampson and Lauritse, 1997). Reviewing the views below may enhance understanding of the relation of social disorganization, place and crime.

Burgess (1925) examined growth of the city as a process within expansion, metabolism and mobility functions. Fundamentally, Burgess states that this growth “is the resultant of processes of organization and disorganization, like the anabolic and katabolic processes of metabolism in the human body”. A typical process of city expansion is presented in this study within a series of successive concentric circles. Five loops are identified in different roles which are, central business district, transition, workingman, residential, and commuter (see Figure 1 below). These successive zones are identified based on (1) a radial expansion from the central business district; the loop. The downtown area (2) encircled with a housing area is called transition zone which is invaded by business and light manufacture. The successive (3) area is inhabited by workers escaping from the deteriorating transition area and also searching for easy access to the industry. The next zone (4) is called residential area which is used by high class apartments and restricted single family housing. The (5) outer part of this zone and city limits is found—it is the final, area which is called commuter area. This area includes suburban and satellite cities that are set around thirty or forty-five minutes away from the central business district. In this study, (1925), the distribution of the population in different forms, such as labor and different social and cultural groups, is identified as urban metabolism which is measured by mobility. Mobility is defined as the change of movement in response to a situation and stimulation. In conclusion of this cross sectional study, the greatest mobility was found where

juvenile delinquency, crime, poverty, divorce and abandoned infant areas were also present: the transition area.

Frederic Thrasher (1927) studied 'gang' activity in Chicago. The map of the distribution of gangs, their history, types of gangs, life of gang members, social relations among gangs and members and some of the other characteristics were described based on observation of 1313 gangs between 1923 and 1926. This macro level study explored the structure of gangs, social patterns, and their leadership in Chicago.

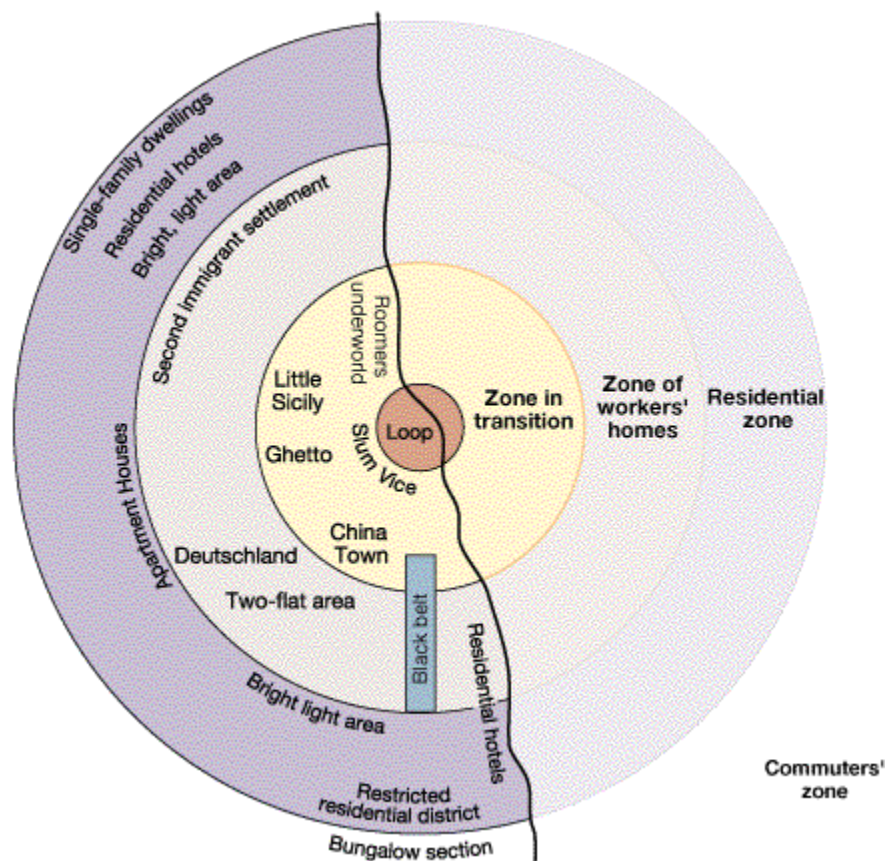


Figure 1: Burgess (1925) Concentric Zone Model

The figure was retrieved from: <http://www.yorku.ca/anderson/Images/Chicago20ecology.gif>

Shaw and McKay (1929) applied Burgess' (1925) concentric zone model (see Figure 1 above) in their study to understand delinquency rates of Chicago for the last thirty years. They did not find a permanent correlation among ethnicity, race, and delinquency rates; but crime rates were found to be related with social and economic characteristics. They found that some of the urban areas were fostering juvenile delinquency rates. Specifically, low crime rated areas reflected the existence of lively institutional structures; conversely, high crime rated areas were found to have ineffective or broken institutional binds in society. Notably, the newest immigrants to areas were the places with the highest rate of delinquency. Specifically, areas newly populated by African Americans were represented by high delinquency rates, whereas, old areas populated by African Americans were represented by low delinquency rates. Burgess' (1925) concentric model was confirmed by the findings of Shaw and McKay (1929). Their study indicated that crime rates were endemic to areas where newly arrived poor people could afford to survive. In detail, inner city areas were found to be more affected from high delinquency rates. The study showed that the mobility of the population in these areas was highly similar to Burgess' proposition. Finally, crime rates were found to be very stable in the long term in some areas although the ethnic characteristics of these areas changed considerably over time.

After the explanation of the Chicago school on the determinants of crime in the city (Coleman & Norris, 2000), a macro-level study approach on crime reemerged as a prominent criminological paradigm in the late 1970s (Pratt, 2001). In other words, the hope to defeat crime rose from the research on ecological variations of crime (Flowers, 1989, p.39-60). The general idea of ecological variation is that "crime is unevenly distributed among places and according to time," which means crime has some boundaries depending on some geographical areas under certain temporal conditions. It is also important to note that research in the ecology of crime



suggests changes in environment, places, and situations to reduce opportunities of crime, rather than providing suggestions on offenders or the rehabilitation of their behaviors (Miller, 2008, p.106).

Importance of place and crime theories have been emphasized and argued by scholars (Cohen & Felson, 1979; Brantingham & Brantingham, 1981; 1995; 2003; Eck & Weisburd, 1995; Rossmo, 1995; Maltz, 1999). According to Cohen and Felson (1979), a criminal act requires the convergence of likely offenders, suitable targets and absence of guardians. The place and time of crime is called the fourth dimension of crime by Brantingham and Brantingham (1981). The idea of crime prevention is that by “preventing victims and offenders from converging in space and time, police can reduce crime (Braga, 2001, p.105)”. If any violent crime happens at a place and a time (Rossmo, 1995), the study of crime is essential to cover geographic perspective.

Environmental criminology involves crime setting or places where and when crime occurs (Rossmo, 1995). Environmental criminology requires considering four dimensions of a crime for a full crime analysis. These are the legal, offender, victim or target and location dimensions (Brantingham & Brantingham, 1981). Place level explanations focus on crime events instead of criminals and they can focus on micro or macro level perspectives (Eck & Wesiburd, 1995). For Rossmo (1995), research in environmental criminology is categorized as the micro, meso and macro spatial levels of analysis. In general, hotspots are considered as micro level research on crime and research on place dates back to the nineteenth century (Eck & Wesiburd, 1995). Several micro level studies on crime and place were completed since then. The relation of urban design (Jeffery, 1999), defensible spaces (Newman, 1972) and criminality of places

(Brantingham & Brantingham, 1975, 1995) are some of the other micro based examinations. According to Maltz (1999), research examining the relationship of crime and geography is developing in two distinct lines. The first line follows 'crime opportunities' such as crime prevention through environmental design (CPTED) (Jeffery, 1999), geography of crime (Harries, 1974), routine activity (Cohen & Felson, 1979) and environmental criminology of crime (Brantingham & Brantingham, 1981). Maltz (1999) believes that the first line of research relies on rational choice theory and focuses on the immediate environment of crime in view of the offender. The second line of research relies on social disorganization direction to study correlates of delinquency.

A new perspective on the examination of crime headed toward the opportunity aspect of the crime. For example, public housing projects and their built environments were found effective in influencing crime by Newman in the 1970s. Newman (1972) conceptualized his findings as a defensible space concept. In fact, some of the principals of the urban design approach and its potential effect on crime had been mentioned before by Jacobs, such as eyes on the street (1961). Jeffery extended defensible space within the urban design approach in a wider concept and coined the term CPTED. Several other concepts contributed to the development of CPTED, such as broken windows (Wilson & Kelling, 1982), applications of architectural design and space management concepts (Crowe, 1991), but very few people attempted to examine its effect on crime (Gulak, 2004). Optimism about the effect of CPTED in reducing crime is high; however, there is little research examining this expectation. This stems from its wide scope on the environment and hardships in measuring its effects (Casteel and Peek-asa, 2000; Gulak et al, 2007).

Another perspective is the link of land use and crime that is affected by city politics (Feiock, 2004). In a study, Savolainen (2000) found that as the welfare of the state increases the homicide rates drop. Similarly, Stucky (2005) found that city spending on education, health and welfare has positive contributions to lowered crime rates. It is also mentioned within the study that mayor council administered cities support these issues significantly.

Several other theories are suggested by scholars in order to explain the relation of place and crime. According to Eck and Weisburd (1995), three theories are considered as influential to explain this relationship. These are rational choice, routine activity and crime pattern theories. According to Chainey and Ratcliffe (2005), acts of criminal behavior must have an impact on policing strategies in preventing and detecting crime. Therefore, they suggest considering rational choice, social disorganization and collective approaches as explanatory theories of crime in spatial based studies. Briefly, rational choice view assumes that offenders pick targets and places in a way that is rational and explainable. Specifically, Clark and Felson (1993) think that testable propositions for describing crime events can be developed if the rational choice perspective is used in conjunction with routine activity theory. According to Chainey and Ratcliffe (2005), routine activity and rational choice approaches are linked because they are more interested in opportunities for crime. Researchers of routine activity and rational choice approaches operationalize their dependent variables mainly as crime counts of an area because their researches are highly spatial in focus (Chainey & Ratcliffe, 2005).

Routine activity theory is presented by Cohen and Felson (1979, 1980) in order to analyze crime rates trends and cycles. According to Cohen and Felson (1979), a criminal involvement can occur when likely offenders encounter a suitable target in the absence of a

capable guardian (opportunity) within a space at a certain time. This concept is also well known as the crime triangle. Guardians, intimate handlers and place managers are considered secondary considerations of crime. The role of social changes in crime is also addressed as the development of facilitators or impeters of crime within routine activity theory. For example, the changes in the working habits of women changed the quality of life and burglaries increased in residences during the day time (Hirschi & Gottfredson, 1993). According to this approach, the absence or ineffectiveness of these element(s) can cause crime. Sherman (1995) believes that these three variables are very identical to the three elements of fire. The analogy of fire necessitates heat, fuel and oxygen all together, similar to the triangle of offender, suitable target and opportunity. From a larger point of view, crime pattern theory aims to explain the interactions of offenders with their social and physical environments (Brantingham & Brantingham, 1995). This is supposed to explain the influences of the environment on offenders' target choices. In other words, how targets are elected by the offenders is claimed as the influential point of distribution of crime. According to Eck and Weisburd (1995), the crime pattern theory combines rational choice and routine activity theory to explain the better distribution of crime. Routine activity theory is stated as having a lesser focus on formal and informal organizations than means of social control. Rather it aims to explain crime inviting situations (opportunities) and the impact of the large social changes on crime (Miller et al., 2008; p. 99). Specifically, the elimination of opportunities is emphasized in routine activity theory (Miller et al., 2008; p.104) because little control can be attributed to the potential offenders and suitable targets. From this point of view, the need for guardianship concept in routine activity theory also supports the importance of the police role in the community. However, the focus of the theory addresses mainly smaller spatial units to understand the immediate environment of criminal events within cities and counties such

as situational areas to explain opportunities. In this frame, the social disorganization theory provides wider explanatory ground for researches on places, while the routine activity theory provides an explanation for smaller units and situations (Miller et al., 2008; p.88).

Recent researches in disorganization have focused on external community dynamics and local political systems which are formal organizations and have the ability to organize the community against crime. These new directions in social disorganization theory are pointed out by Kubrin and Weitzer (2003). In their study, the focus of social disorganization is presented as neighborhood structure, social control and crime relations. While the informal control dimension of social disorganization is frequently studied (Bursik & Grasmick, 1999), formal control referring to practices of formal authorities to maintain order and enforce laws has been neglected (Kubrin & Weitzer, 2003; p.381). Specifically, the formal control dimension of the social disorganization theory is stated as being “important in two ways: (1) by directly influencing crime and disorder and (2) by influencing residents’ informal control practices..... Surprisingly, little research has been done on police practices at the community level...” (382). Furthermore: “The question remains: How important is formal control in reducing crime and disorder? (385)”. They (2003) also argue that both little or excessive police intervention may have negative effects on the support of informal control. Besides, “political and economic decisions may have direct effects on community crime rates....Urban economic reorganization thus indirectly increases neighborhood violent crime rates. (385)”. According to Stucky (2005, p. 52), internal community dynamics became the focus of earlier social disorganization research, and formal controls should also be considered. Complementarily, some scholars study collective efficacy that is regarded as the ‘reverse of disorganization’ or the ‘opposite of social disorganization’ theory (Chainey & Ratcliffe, 2005; 336).

## 2.4.2. Collective Efficacy

Collective efficacy is defined as “social cohesion among neighbors combined with their willingness to intervene on behalf of the common good” (Sampson & Raudenbush, 1997). Collective efficacy is claimed to be linked the reduction of violent crime in this study. This study (1997) did not focus on the efficacy of formal and external actions such as police crackdowns efficacy; rather, it focused on informal mechanisms’ efficacy in combating crime. The study finds that collective efficacy is a reasonable construct which can be measured reliably in neighborhood level studies. In this study (1997), individual level surveys are merged into the aggregate level that brought new explanations into neighborhood phenomena. The study on measuring collective efficacy with respect to violent crime (Sampson & Raudenbush, 1997) found that three stratifications of the neighborhood explain most of the collective efficacy in a neighborhood. These variables are concentrated disadvantage, immigration concentration, and residential stability. In particular, the collective efficacy variation in neighborhoods was explained in 70% of cases by use of three variables. It was also found that “collective efficacy was strongly negatively associated with violence collective”. Specifically, concentrated disadvantage and immigration concentration were negatively correlated with efficacy. And resident stability was positively relevant to collective efficacy. In turn, collective efficacy predicted lower rates of crime after necessary measurement adjustments were completed. The study also noted that the neighborhood was shaped by socioeconomic and housing factors that are brought into a wider political economy. Recognition of collective efficacy does not mean that formal social control strategies are useless or inequalities in communities can be neglected. As limitations of the study one can list that the analysis was cross sectional and causal effects were not proven. The indicators of the study were not direct; instead, they were inferred from

informant reports. The study was also held in one city and the political dimension of the study was ignored. Bandura (2000) studied the role of collective efficacy in the exercise of human agency. In this study, individuals are stated as being producers of experiences and shapers of events. Bandura's findings (2000) indicate that "perceived collective efficacy fosters groups' motivational commitment to their missions, resilience to adversity and performance accomplishments". Several other scholars examined the role of collective efficacy on disorder and crime in urban neighborhoods (Sampson & Raudenbush, 2001), homicide variation (Morenoff, Sampson & Raudenbush (2001), individual, family and neighborhood levels (Duncan, Okut, Strycker & Small, 2003) and partner violence (Browning, 2002).

Sampson and Raudenbush (2001) used the collective efficacy concept to examine the effect of disorder on crime in urban neighborhoods. The assumption was that social and physical disorder could lead to serious crime that was applied in 196 neighborhoods of Chicago. It was found that reducing the disorder level is indirectly relevant with reducing crime and this depends on the strength of the collective efficacy in stabilizing neighborhoods. Morenoff and colleagues (2001) examined spatial dynamics of urban violence in the context of neighborhood inequality and collective efficacy. Chicago neighborhoods were examined to predict variations of homicide rates between 1996 and 1998. Increased homicide rates were found to be related with spatial proximity to the homicide location. Concentrated disadvantage and low collective efficacy were indicated as independent predictors of increased crime. In general, inequality of social and economic capacity of neighborhoods was found to be explanatory of urban violence. Collective efficacy on individual, family and neighborhood levels was examined (Duncan et al., 2003).

While marital status and family income were examined in the family level, gender and age were examined on the individual level within 55 neighborhoods. Collective efficacy was predicted by

age at the individual level, by marital status at the family level, and poverty and gang activity perception at the neighborhood level. Considering the utility of combining different data sources on the neighborhood level, the study (Duncan et al., 2003) showed significant variation of families and neighborhoods. Browning (2002) examined partner violence by using the neighborhood level determinants of crime. The study found that collective efficacy is negatively associated with homicide rates and partner violence (nonlethal). Collective efficacy strength also increases women's expression of their conflicts probability to others in order to receive support. Overall, the collective efficacy concept is considered effective on crime because it is supposed to mediate individuals, families and neighborhood demographics based on reviewed literature.

## **2.5. Summary of Crime Theories**

Crime is a complex phenomenon resulting from a combination of several interrelated factors. That means considering all three schools of thoughts is essential to stay away from the pitfalls of researching crime. However, using one set of carefully combined theoretical factors can facilitate the control and communication in a research study. This small section summarizes deterrence, the positivist outlook, social disorganization, and collective views and provides the foundation for the selection of appropriate variables for the study.

The service of the criminal justice system to the community is to control crime (Donziger, 1996), and this role might contribute toward reducing crime rates by deterring relatively. Established on classical views, imprisonment may be considered politically an effective way to reduce crime by removing convicted criminals; nonetheless, this simplistic understanding may be deceptive. Although the criminal justice system fights against crime through the courts, the police and the prisons (Miller et al., 2008), their effect on crime varies



depending on several other factors. In fact, some criminologists have been arguing that overuse of the penalizing system can produce more crime than it is supposed to prevent (Donziger, 1996; p.33).

The positivist school is different from the classical school because the positivist philosophy relies on determinism instead of free will and rational decision making. This means that “human behavior was determined by a range of factors” therefore, all decisions of people could not be considered totally rational (Coleman & Burry, 2000, p.21). In fact, determinism contends “that human behavior is caused by biological and psychological factors specific to individuals and / or structural factors composing the environment” (13). Although the propositions of the positivist school are contributive to explaining crime to some extent, little can be explained without considering the criminal justice institutions and other societal variables.

The social disorganization theory mainly suggests that the community will not be able to constitute a general standard of behavior on the street if high degrees of heterogeneity and high turnover rates exist in poverty areas. Parallel to the social disorganization theory, five macro level predictors of crime are reported overall as stable and strong variables (Pratt & Cullen, 2005). These are “two indicators of racial composition (the percent nonwhite and the percent black), measures of family disruption, an indicator of economic deprivation (poverty), and one criminal justice system-related predictor”. Complementary to social disorganization, the collective efficacy focuses on willingness of the community members in favor of the common good (Sampson & Raudenbush, 1997). While the deterrence theory focuses on an explanation of formal organizations and the criminal justice system’s effect on crime, both social disorganization and collective efficacy focus on the effects of informal organizations on crime.

Polarization of interest groups is indicated (Coleman & Norris, 2000) while arguing for and against classical and positivist schools. Accordingly, in this debate are “judges, legislators, lawyers in the classical camp, a new breed of scientific experts in the positivist camp- vying for dominance” (21). And “much criminological research that was to follow can be seen as an attempt to find what to extent crime was due to the nature (inherent properties of the individual) or nurture (environmental factors)” (2000, 23). In sum, investigating a simple theory of crime may be misleading because crime is a varied phenomenon emerging from the complex interaction of multiple elements. Before selecting the appropriate theory and factors, identifying the most common risk factors of crime can increase reliability of a study.

### **2.5.1. Correlates of Crime**

Recent crime drop in America in the 1990s has received considerable attention from researchers (Blumstein & Wallman, 2000; Levit, 2004; Zimring, 2007). Reviewing some of these researches can facilitate the understanding of which major factors and other contributors might be explanatory for crime. Therefore, essential variables are selected at the end of this subsection for the current study.

Research for crime has attempted to explain several significant elements which may be independently or interactively contributive to explain crime phenomena. Neither of these elements is inherently supposed to exclude others powers in explanation, and this can indicate that there is no single explanation of crime. In fact, a variety of factors can be contributive to the explanation of crime on the national level in the 1990s. The first of these factors is that the study of ‘the crime drop in America’ (Blumstein & Wallman, 2000) reviewed potential contributors to

crime in the 1990s, such as handgun usage policies (Wintemute, 2000), incarceration (Spelman, 2000), the labor market (Grogger, 2000), and the roles of demographics (Fox, 2000).

Briefly presenting his case, Wintemute (2000) shows evidence on the effects of policies which deny handgun sale to risky people in reducing crime rates. Spelman (2000) calculates that approximately 25% of the crime rate decline can be attributed to incarceration although this benefit can be arguable due to its high social and economic costs. Grogger (2000) indicates a labor market model of violence that can be another small explanation for crime. This model infers that the expansion of the crack market increased when youth wages were deteriorated at the outset of the 1990s. However, this trend could have been cured when the youth wages were increased in 1993. This shows the interaction between age, crime and economic variables. Also, Fox (2000) indicates urban size as another explanatory factor of crime in his study.

In another study, Levitt (2004) examined the reasons for the crime rate drop in the 1990s in the U.S. Differently to other scholars, he indicates that the leading explanations for crime, which are "strong economy, changing demographics, better policing strategies, gun control laws, concealed weapons laws and increased use of the death penalty," have played only a little direct role in recent crime drop. Rather, he (2000) found that four major factors—increase in the number of police, increase in prison population, the diminishing crack epidemic and the legalization of abortion—have a large role in explaining the crime decline.

‘The great American crime decline’ is the other recent study (Zimring, 2007) that examined what happened in the 1990s in the U.S. Three databases used in the study were the Vital Statistics data, FBI crime indexes (UCR) and the victimization survey (NCVS) in order to cross examine the decline. Firstly, Zimring (2007) examines homicide rates by using vital

statistical data and reports more than a 70% decline in the homicide rate between 1992 and 2002. Then, he details how broad the decline was in other crimes. Considering the FBI crime index between 1990 and 2000, the crime decline is indicated to be between 23% and 44% among seven serious offenses. Finally, the findings of victim surveys confirmed the trends of FBI data and a downtrend of the crime was found in higher magnitude.

In terms of demographic variables, age, youth, gender, size of the city, regional patterns, imprisonment, and economy were indicated and measured variables in explaining crime rate changes (Zimring, 2007). The decline in homicide rate was reported to be around between 36% and 41% for persons over the age of 14. This decline variance was 42% for men and 33% for women, while 48% for nonwhites and 36% whites. High risk age groups between 15 – 24 and 15 – 29 were also examined by Zimring in order to understand their probable effects on crime rate change. Considering these age groups, there is a slight decline which provides a little support for the downward trend. This crime decline was a few percent for violent crime and 5-6% for property crimes according to Levitt (2004) as cited by Zimring (2007). Higher crime rate declines were reported for big cities (49%) than smaller cities (36%) where the population is between 25,000 and 50,000. Most regional patterns in crime decline were found flat except in the Northeast. In this region, crime decline in homicide, auto theft and burglary was reported to be considerably higher than in the other regions. Big cities which are identified to be populated by more than 250,000 people were also analyzed in order to achieve understanding of crime trends in these cities. Considering 15 largest U.S cities, New York City was ranked first or second in crime decline (Zimring, 2007). Specifically, the decline in homicide was 38% in the nation, where New York City experienced a 73% drop. The crime decline in the 1990s is identified as a process because the crime drop is addressed as a gradual and cumulative process instead of an

event based sharp decline. Considering the percentage of change in incarceration, Zimring finds a 54% increase between 1986 and 1990, a 38% increase between 1991 and 1995, and the lowest increase of 22% between 1996 and 2000. In fact, Canada prison populations stayed relatively stable while American prison populations increased significantly. Accordingly, Zimring (2007) concludes that the effect of incarceration is undeniable; nonetheless, it played a modest role in crime decline. In other words, the role of incarceration in the crime rate drop should not be overestimated; however, this role should not be expected to be less than 10% and more than 27%. In terms of the effect of economic growth on crime decline, Zimring reports a wide range from 1% to 40% between 1990 and 2000. Since the occurrence of some offenses increases and falls with the unemployment rate, he uses the unemployment rate as an explanatory factor of crime since it implies economic growth. In fact, economic growth and crime rates in the U.S. were similar to those in Canada; however, the unemployment rate was found significantly higher in Canada. Although the economic growth in the U.S. may be good news for the crime drop, the effect of economic growth on crime may not explain much of the changed crime rates in the U.S. Similar to this; New York City is indicated as another example. In fact, the crime rate decline was two times more than the national average; however, the unemployment rate in New York City stayed higher than the national average as well. He concludes that a combination of demographics, incarceration and economic growth might have a considerable effect on crime rate changes; however, these may not be major explanations for the great American crime decline.

Evaluating Zimring's (2007) New York City natural experiment can also provide a better understanding of crime in cities because the crime rate decline in this city almost doubled from 1990 through 2000. For New York City, Zimring (2007) evaluated three major elements of

policing: the number of police, tactical changes in street policing and management of police activity. Zimring thinks that measuring the effects of the increasing number of police and applied tactics on the national level may be inherently difficult in decentralized North America; nonetheless, he suggests municipal level research in order to understand the effect of police. The findings of his study for the New York Police Department show increasing police size by 35% while nine other large cities have increase the number of police by 14% on average. Secondly, many new policing tactics, order maintenance, zero policing, and quality of life type of policing tactics were in effect during this time period in New York City. Finally, the management quality of the police department has increased considerably as a result of the Compstat policing application at the organizational level. According to Zimring (2007), the convergence of a booming economy, decreasing population of high risk groups, and high incarceration levels prepared the ground for crime decline; however, changing police tactics is the most plausible cause for crime rate decline (151) where between 17% and 35% of crime decline is attributed to policing variables. There is no specific reference to the number of police, new policing tactics, and compstat policing understanding; rather, Zimring attributes the majority of crime decline to “a combination of three major shifts in the content of policing (that) had apparently major impacts on crime” (p.156). Specifically, “far from being one more urban legend about crime, the police changes were an important part of the city’s singular achievement” (p.168). Zimring (2007) concludes with seven lessons of crime decline in the 1990s and two of these lessons may contribute to the study. First, (2007, p.196) the crime decline in 1990s is seen as “a classic example of multiple causation, with none of the many contributing causes playing a dominant role”. Secondly, “whatever else is known about crime in America, the most important lesson of

the 1990s was that major changes in rates of crime can happen without major changes in the social fabric” (2006).

Summarizing the correlates of crime in prior research can simplify the selection of suitable variables. In reviewed studies, residential mobility (Shaw & MacKay, 1942), economic and racial composition of the cities (racial heterogeneity: percentage of nonwhites and percentage of blacks) (Shaw & MacKay, 1942; Miethe, et al, 1991; Liska & Champlin 1984; Pratt & Cullen, 2005), collective law enforcement activity (Ehrlich, 1973), poverty and income inequality (Flango & Sherbenou, 1976; Hsieh & Pugh, 1993; Pratt & Cullen, 2005), family disruption (percentage divorced) (Sampson, 1987; Sampson & Grove, 1989; Miethe, et al., 1991; Pratt & Cullen, 2005), unemployment and economic deprivation, resource deprivation (Sampson, 1987; Sampson & Grove, 1989; Land, McCall, Cohen, 1991), proactive policing arrest (Sampson & Cohen, 1988), police crackdowns (Sherman, 1990), change in women’s working habits (Hirschi & Gottfredson, 1993), household size (Miethe, et al., 1991), patrols and directed hotspots (Sherman & Weisburd, 1995), social interactions (Glaeser, Sacerdote & Scheinkman, 1996), immigration concentration, and residential stability (Sampson & Raudenbush, 1997), the effect of policies which deny handgun sales to risky people (Wintemute, 2000), incarceration (Spelman, 2000; Levitt, 2004; Qusey, 2000), labor market and youth wages (Grogger, 2000), differences in urban size (population) (Flango & Sherbenou, 1976; Fox, 2000; Nolan, 2004; Stucky, 2005, Zimring, 2007), the combination of land use and politics, (Savolainen, 2000), welfare of the state and spending on education and health by the city (Savolainen, 2000; Stucky, 2005), increase in the number of police (Levitt, 2004), increase in prison population (Levitt, 2004), diminishing crack epidemic and legalization of abortion, (Levitt, 2004)—all of these were found to be explanatory variables of crime.

There are also a set of variables frequently used in crime explanations. These are concentrated disadvantaged variables (Burgess, 1925; Shaw McKay, 1929; 1942; Miethe, et al., 1991; Chainey & Ratcliffe, 2005; Pratt & Cullen, 2005); collective efficacy (Sampson & Raudenbush, 1997, Bandura, 2000; Browning, 2002; Duncan et al., 2003); a combination of demographics, incarceration and economic growth (Zimring, 2007); as well as a combination of three major shifts (number of police, new policing tactics, and compstat policing) in the content of policing (Zimring, 2007).

In brief, racial heterogeneity, poverty, family disruption, incarceration, urban size, and policing tactics are identified as prominent variables based on reviewed literature. Overall, concentrated disadvantaged variables were found to be the strongest stable predictors of crime as macro characteristics (Pratt & Cullen, 2005). These variables involve racial heterogeneity, poverty and family disruption. Before making a selection, it is important to consider the warning of Fox (2000) about crime research. Fox studied the demographics of U.S. homicide rates and he asserts that erroneous analysis can occur if demographic subgroups of the population are not distinguished in studies (289). This necessitates the consideration of “age, sex, race, or ethnicity” variables for the national, state and local level studies.

## **2.6. Independent Variables**

The causes of crime are explained mainly by the use of three level variables - social, economic, and demographic (Mus, 2010). Considering prominent individual and sets of variables in previous studies, (1) family disruption and (2) ethnic heterogeneity and (3) poverty are used as the social and economic control variables of crime. As demographic variables of crime, (4) age, (5) gender, (6) urban size and (7) regions are considered. Considering the information



technology capacity theory, (8) form of government, (9) police expenditure (10) number of personnel in crime analysis and (11) education are addressed as explanatory variables.

Considering the effect of police strategies in reducing crime rates, (12) community policing and (13) problem oriented policing are used as control variables in order to discern the contribution of GIS use on police performance. Although these variables have been mentioned in their study settings, selected variables are explored in detail as two sets of factors below in this section. The first group includes presentation of demographical and societal variables (age, sex, urban size, regions, family disruption, ethnic heterogeneity, and poverty). The second group of variables represents information technology capacity based variables (form of government, police expenditure). Community policing and problem oriented policing variables are explained in the third chapter (Policing in the U.S.). Crime mapping, crime analysis and education variables are explained in the fourth chapter (geographic information systems).

### **2.6.1. Demographics and Crime**

The population variety of a geographic area is one of the main factors to consider withing the context of crime incidence (Etienne, 2006; Mus, 2010). Without considering adequate demographic dimensions of crime, the nature of crime phenomena cannot be explained sufficiently. By considering the demographics of an area, the profiles of criminals and victims of a crime can be better explained. In the current study, age, gender, race, urban size and regions are used to control variables of crime by keeping in perspective the warnings of Fox (2000) mentioned above. The data for the demographics are derived from U.S. Census Bureau..

### 2.6.2. Age

Certain demographics can explain increasing or decreasing rates of crime. Age is considered as one of the explanatory factors that play a role in crime. This is stated by The National Criminal Justice Commission (Donziger, 1996). Specifically, youth are referred to as one of the most affected groups from the risk of crime; thus, communities with a high population of youths are at more risk than other communities (Flowers, 1989). In particular, the peak age group of arrestees for violent crime is 17-24 and the peak age group of arrestees for property crime is 15-20 according to UCR (Flowers, 1989). In a wider view, youths aged between 15 and 19 remained under higher risk of homicide than other age groups between 1986 and 1992 (Donziger, 1996). Additionally, African American youth has experienced eight times more risk of being killed than white youth (131). According to Fox (2000), the rate of offending and victimization attributed to the age group of 14 and below is low and stable. At the same time, offending and victimization of people from the age group 25 and above have declined steadily over the past two decades. According to Fox (2000), the murder rate dropped from 9.8 to 6.3 between 1991 and 1993 in the U.S. and this low level of homicide rate was only last achieved thirty years ago. These age groups can be considered as late teens and early adults (Gordon, 2009); or they can be considered as adolescents (12-19) and young adults (20-40) according to Erikson's stages of psychosocial development (Erikson, 1950).

While the media have brought the claim that youth are committing more and serious crime than before, FBI's Uniform Crime Reports (UCR) do not confirm this claim (Greenwood, 2007). In fact, the UCR does not record details about the age of the offenders, but arrests rates and self-report studies have been providing these kinds of details. According to Greenwood

(2007), juveniles who are between 10 and 17 comprised 14 percent of the U.S. population, whereas, it shrunk into 11 percent for 1990. This rate stayed almost the same through the decade and it was accounted for 32% of all property crime and 16% of violent crime arrests. In fact, juveniles were accounted for 13.6 of all homicide arrests by 1990 (Greenwood, 2007).

Greenwood (2007) states that the U.S. juvenile system has been shifting away from its traditional focus, such as rehabilitation of children, and starting to apply harsher interventions on juveniles, by sending them to adult courts to adjust the severity of the sanctions. This may bring different outcomes to the community in the following years.

When we review the UCR records between 1993 and 2001, it is seen that youth tend to commit more property crime than violent crime. Specifically, arson, motor vehicle theft, burglary and robbery crimes are frequently committed by youth who are between the ages of 20 and 25. Motor vehicle theft is the most preferred crime among youth criminals.

**Table 1 Crime and Average Age**

Year	Violent Crime	Property Crime
1993	28.02	25.65
1994	28.13	25.38
1995	28.52	25.63
1996	28.6	25.47
1997	28.93	25.68
1998	29.18	26.07
1999	29.35	26.29
2000	29.56	26.28
2001	29.64	26.61

Data retrieved from FBI, UCR Records

Young adults tend to commit violent crime. Specifically, aggravated assault, forgery, fraud, gambling and sex offenses are committed by age of 30 and over. Gambling is the most

preferred crime by this group. Flower (1986, p 71) says that “the existence of age-crime curve is indisputable”; however, differences occur depending on types of offenses, periods of time, etc.

**Table 2 Crime under the Age of 30**

Motor Vehicle Theft	Arson	Burglary	Robbery
21.99	22.72	23.99	24.26
22.26	21.81	23.97	23.89
22.74	22.37	24.35	23.95
22.87	22.06	23.94	24.01
23.18	22.21	24.2	24.21
23.92	22.49	24.49	24.7
23.98	22.26	24.83	24.88
24.05	22.39	24.91	25
24.36	22.96	25.3	25.31
23.3	22.4	24.4	24.5

Data retrieved from FBI, UCR Record

Age patterns and victims are presented by NCVS for 1992 and 1994. In fact, persons around 18 to 21 tend to be exposed to a violent crime, specifically, if they are either Black or Hispanic or female (Perkins, 1997).

**Table 3 Crime above the Age of 30**

Aggravated Assault	Forgery and Counterfeiting	Fraud	Gambling	Sex Offenses
29.25	29.24	31.33	34.21	31
29.43	29.38	31.21	34.72	31.53
29.88	29.59	31.35	32.97	31.77
29.97	29.75	31.49	32.53	31.48
30.26	29.92	31.7	33.01	31.61
30.36	30.29	31.95	33.45	32.04
30.46	30.43	32.12	33.39	32.01
30.66	30.34	32.25	33.44	31.79
30.7	30.59	32.34	32.74	31.41
30.1	29.9	31.7	33.4	31.6

Data retrieved from FBI, UCR Record

### 2.6.3. Gender

Gender is considered as another determinant of criminality (Flower, 1989). Scholars indicate the existence of a gender gap in crime. The gender gap refers to the "low level of female offending in relation to that of males" (Steffensmeier & Allan, 1996; 467). The gender gap in crime between females and males is indicated as greatest for violent crime and lowest for mild forms of crimes, such as minor property crimes. This subsection briefly presents theoretical propositions (Hagan, Simpson, & Gillis, 1979; Hirschi & Gottfredson, 1993; Zager, 1994; Torgler & Valev, 2006) and empirical findings (Flower, 1989; Steffensmeier & Allan, 1996; Tittle, Ward, Grasmick, 2003) to explore the gender gap and its effect on crime variance.

Some scholars (Hagan et al., 1979) proposed that women have become more frequently instruments and objects of informal social controls, whereas, men have become more instruments and objects of formal social control. Formal social control refers to the law and its application while informal control refers to the family and kinship activity. Specifically, Hagan and colleagues (1979) find that both fathers and mothers control their daughters more than their sons. Besides, mothers' control on daughters is found to be more common more than fathers' control on the same. In fact, when the paternal control disappears, the maternal control continues for daughters. In socialization, delinquency has been perceived as fun by both females and males. In this process, daughters are denied the fun while boys are allowed to have fun until they encounter the police. Finally, the study finds that boys are more likely to be picked up by the police than girls.

The self control theory (Hirschi & Gottfredson, 1993) assumes that crime is affected by the level of self-control and opportunity (Zager, 1994). In this view, females are expected to have

higher self-control than males (Zager, 1994). In other words, female children are perceived more open to dangers and misbehaviors; therefore, they are more carefully monitored than boys (Tittle et al., 2003). And, the length of the monitoring can extend the childhood for girls. Besides, family members tend to impose more costly consequences and punishments when girls misbehave. As a consequence of all of these precautions females develop stronger self-control than males (Hirschi & Gottfredson, 1993). Zager (1994) concludes that if self-control is accepted as the only theory explaining female behaviors, the gender effect across the offenses must be the same. In terms of opportunity between males and females, there might not be so much difference (Zager, 1994). According to Torgler and Valev (2006), opportunity for females might be less than that for males considering the longer time they invested in their homes tending to their children. Accordingly, females can stay away from having criminal friends that may result in less social learning about crime than males (Torgler & Valev, 2006).

According to Steffensmeier and Allan (1996), the differences between male and female crimes are minor in general and the only exception is prostitution. Notably, a big change has been traced in the minor crimes for females. Among females, minor crime rates, such as larceny and fraud were 15% and 17%, respectively, in the 1960s and these crimes jumped up to 30% and 43% by 1990. Additionally, the number of arrested female juveniles due to violent crime has increased by 101% between 1988 and 1997 (Zager, 2000).

Analyzing the demographics of prisons in the U.S. can provide a closer representation of the potential prisoners (Flowers, 1989). Male domination is apparent in crime according to prison records and studies confirm the idea that men show a higher probability of committing crime than females (Tittle, Ward, Grasmick, 2003). According to the 1986 UCR records, arrested

males were 5.1 percent more than females (Flowers, 1989). Additionally, female dominant communities are found to be more at risk of being victimized than male dominant communities (Flowers, 1989). In fact, a female most probably will become a victim rather than a criminal. If the current trends continue, one out of fifteen people would be incarcerated according to the Criminal Offenders Statistics of 2001. These prisons' population would consist of 11.3% men and 1.8% women. As another characteristic, 32% of the black males, 17% of the Hispanic males, and 5.9% of males are supposed to enter prison based on current rates. In fact, 93.5% of inmates (197,523) are male and 6.5% of them (13,815) are female as of the June, 26, 2010 records of the Federal Bureau of Prisons.

Steffensmeier and Allan (1996) suggest that childhood abuse, personal maladjustment and victimization should be studied in order to better explain female crimes' relation to crime by males. They note that comparisons of crimes by females and males should be adjusted according to population subgroups, such as race, class and ethnicity because there can be some variation in these differences. For example, arrest rates of black females become higher than those of other females which might be a considerable point in this context. Considering the gender gap in crime (Steffensmeier & Allan, 1996) and the findings of the theoretical and factual studies mentioned above (Hagan, et al., 1979; Flower, 1989; Hirschi & Gottfredson, 1993; Tittle et al., 2003; Zager, 1994; Torgler & Valev, 2006), the current study uses gender (sex) as a control variable of crime and it is operationalized as sex rate. Sex ratio is defined as the number of males per 100 females between the ages of 15 and 59 (Messner & Sampson, 1991).

Using the sex ratio to evaluate the gender variation of a community can provide more value. Accordingly, sex rate varies from 84 to 132 across the cities. This variance is larger for the

black population. The ratio of black males per 100 females was found to range from 70 to 181. These variances show the importance of the sex ratio in the research on crime. It was found in the study that an increase in the number of men relative to the women reduces the number of single headed families. When the black male employment rate increased, the number of black female headed families significantly dropped. The sex ratio was found to be indirectly related with the family disruption variable. The study indicates that former studies could not find a significant relation between sex ratio and crime because they were not able to control family disruption adequately. This study is considering the effect of gender on crime by operationalizing it as sex ratio (Messner & Sampson, 1991).

#### **2.6.4. Racial Heterogeneity**

Race is considered one of the important motivators of both crime and police actions. Race mainly refers to color of the skin; whereas, the ethnicity refers to minorities and/ or racial composition. According to Sampson and Lauritse (1997) race is a socially constructed issue and the census bureau identifies race in several groups. These are White, Black, American Indian, Asian or Pacific Islander. Scholars consistently show convincing evidence on the effect of economic and racial composition of the cities on crime (Shaw & MacKay, 1942; Liska & Champlin 1984; Miethe, et al., 1991; Pratt & Cullen, 2005). This composition is mainly measured as racial heterogeneity: the percentage of nonwhites and the percentage of Blacks. Within the macro level analysis of crime, racial heterogeneity is indicated as one of the most stable and strong variables of crime (Pratt & Cullen, 2005). Specifically, several studies explain the realities of race (Donziger, 1996), the association between minorities and arrest rates (Crank, 1990), the relationship among inequality, crime and race (Sampson & Wilson, 1995), the



determinants of deadly force use (Jacobs & O'Brien, 1998), the association of race with policing (Sherman, 2002), and role of schools in predicting crime (Gottfredson, Wilson & Najaka, 2002).

According to the National Criminal Justice Commission report (Donziger, 1996), there are three realities about race in the criminal justice system (p.99). First of all, arrest rates indicate that African Americans are more likely to commit a crime than whites considering the national population. Secondly, there are more African Americans in the prisons that may not be explained only with committed higher crime rates. Finally, the causes of this situation may be several, but this reality might be the cause of a social catastrophe.

The study of (Crank, 1990) found that higher arrest rates are associated with lower per capita income and higher foreign language use (speaking) at home. Notably, the most consistent positive relationship was found between a higher number of blacks and increasing arrest rates. Specifically, both the number of blacks and per capita income was found to be associated with police arrest rates. In the study of Miethe and colleagues (1991), ethnic heterogeneity was found to be a stronger predictor of rates of homicide, robbery and burglary. Another parallel study on crime control efforts finds that arrest rates reflect economic and racial composition of the cities (Liska & Champlin 1984). Also, Sampson and Wilson (1995) examined race, crime and urban inequality. The study (1995) suggests that community level factors and local social organization factors provide a fruitful basis to understand the relation among inequality, crime and race.

Sherman (2002) examines fair and effective policing in reducing crime within the U.S. context. He states that although public trust in government declines in time, the majority of people prefer the role of police than that of courts and lawyers in practice. Sherman (2002) also articulates that “Americans even think that police are more effective at solving social problems

than churches, let alone other branches of government” by referencing to Morin (2001). One big exception to the idea in this regard is addressed as the minorities. Sherman thinks that African Americans think differently on this issue that might stem from frequent police actions on segregated communities for fighting crime. Several controversial issues are addressed in this review (2001) and findings suggest that the actual number of police may not be influential as much as the specific actions of police. In particular, police can be more effective when policing focuses on places, situations, times and vulnerable populations. Respectively, Compstat is mentioned as the most effective policing management process because it enables citywide objective analysis of crime and distribution of police resources by use of crime mapping. Notably, one of the criticisms of crime analysis, racial profiling, is countered by the statement that crime analysis does not constitute to this kind of problem if it is utilized correctly. Although the study shows the association of race in police stops, police arrests, and shooting people, race is identified as a correlate of policing, not the cause of it.

170 American cities were examined for the determinants of deadly force by Jacobs and O'Brien (1998). Stratified jurisdictions in terms of minorities were found to be more open to high use of deadly force. Police killings are greater in number where more minorities live. This means that racial minorities explain police killings. Cities having a black major have reduced police killings. Cities with more blacks and with a higher growth rate of the black population were found to be positively related with higher use of deadly force. Noticeably, the existence of a black major reduces use of deadly force. The police are most likely to use deadly force in the most populous cities. Higher divorce rates were also found to have an association with increased police killings. Similarly, the rate of black female heads of household was also found to be associated with deadly use of force, as well as economic stratification. Where economic

differences between Blacks and Whites are high, this reduces the black population's political influence. Cities with higher black populations have strong law enforcement organizations. The percentage of the black population was associated positively with the use of deadly force, all other variables held constant.

Gottfredson, Wilson and Najaka (2002) examine the role of the school in predicting crime, since some causes of crime can be seen as the schools. The examination of youth in schools reveals that males, predominantly African Americans who are students of a high school and preferring to buy lunch in schools (or who can afford to buy lunch/ who are not qualified for lunch support), will be exposed to more danger in schools and neighborhoods.

In light of the studies mentioned above, racial heterogeneity is one of the explanatory factors of crime in the current study. And it is measured as the percentage of nonwhites (Pratt & Cullen, 2005) to cover all subgroup races in the explanation.

#### **2.6.5. Family Disruption**

The distribution of crime variety can be better explained when social and economic characteristics are considered as well. Several studies have established importance of social and economic characteristics on crime (Liska & Champlin, 1984; Sampson, 1987; Sampson & Grove, 1989; Glaeser, Sacerdote & Scheinkman, 1996; Stucky, 2005). Sampson (1987) examines broken families and their relationship with crime. He finds that structural linkages, family disruption, unemployment and economic deprivation are the causes of high crime rates in black urban communities. Sampson and Grove (1989) also tested community structure and crime relationship by using the social disorganization theory. The study found that social

disorganization variables represent much of the effect of community characteristics on both victimization and offending rates. Another study on crime examined structural causes of crime control (Liska & Champlin 1984). The researchers found a considerable variation of arrest rates reflecting economic and racial composition of the cities without depending on crime rates and police size. According to a study on crime and social interactions (Glaeser, et al., 1996), petty crimes were found to occur more frequently when social interactions were the highest in the area. More serious crime was found to occur when the social interactions were moderate. In addition, murder and rape occurred more frequently when social interactions were the weakest. This can signify that inadequate social interactions can bring more violent crime to these areas. This brings to mind the effect of the heterogeneity variable of social disorganized areas where less interaction is expected to occur as the result of alienations among the residents of the community.

Specifically, family disruption is considered as one of the most stable explanatory factors of crime (Pratt & Cullen, 2005). Feldman and Weisfeld (1973) indicate that family responsibilities are a big and positive barrier to committing crime. A recent (2000) study examined parenting practices and their effects on youth (Griffin, Botvin, Scheier, Diaz, & Miller, 2000). The findings indicate that boys who live within a single parent family are the highest rated people engaging in problematic behavior. Less delinquency is associated with more parental monitoring. Unsupervised time within the house is associated with high smoking rates for girls. Finally, having family dinner was found to be related to a lower incidence of aggression.

Farrington (2002) examined families to understand the key factors in predicting offending behavior. The findings of the study suggest that criminal and antisocial parents, large family size, poor parental supervision, conflicts of parents and family disruption are strong predictors of offending behavior.

A recent study explains family disruption with three factors (Stucky, 2005). These are: first, broken homes which have less control on their children; second, social control at the neighborhood level is assumed weak where single parent families live; finally, non intact families are considered. In the social disorganization theory, the assumed control mechanism is informal. Stucky (2005) says that “city level studies do not usually have the data to assess this issue due to the difficulty and expense of collecting information on informal control in a large number of cities” (p.51). Studies operationalized family disruption as single headed families and percentage of divorced people (Sampson, 1987; Sampson & Groves, 1989; Miethe, et al, 1991; Pratt & Cullen, 2005). The current study uses the single headed family as the operationalization of family disruption (Messner & Sampson, 1991).

#### **2.6.6. Poverty**

Although an urban setting can be considered as a dynamic physical structure, it has been shaped by vibrant social, political, economic and other factors. Specifically, economic realities and inequalities, such as poverty, have a significant effect on the community, criminality, and policing. As the result of economic inequalities, both distressed communities and concentrated poverty areas become very fragile areas for crime. In other words, weak economic integrity in the community and the state of being poor on the individual level are provocateurs of crime (Acosta and Chavis, 2007; Cragila, Haining, Wiles, 2000; Hoffman, 1998).

At the individual level, being poor is not necessarily related with the crime. Instead, the vulnerable poor may be bound for crime if low education and unemployment are persistent. In other words, “the ethnographer's portraits of a vulnerable poor who do not start out on drugs, in gangs, or in jail, but have little opportunity to offset the concomitant effects of low education and unemployment, are persuasive.” (Marks, 1991) This can be interpreted as stating that living based on decency values is hard when jobs are not available (Marks, 1991).

At the macro level, local, state and federal authorities are also linked to economic viability. For instance, economic depression, recession years, and world wars, can bring major negative impacts on service delivery. In particular, using a new major technology in a police organization relies partly on budgetary support. This expenditure necessitates the support of political and administrative authorities (Kim & Bretschneider, 2004) that also depends mutually on the well-being of the community. Specifically, the inadequate economic ability of a community may not engender sufficient support to enhance policing services in fighting crime.

On the community level, community based development efforts of residents are expected to be supported by governmental institutions to revitalize distressed communities. Otherwise, neglected distressed communities may become fertile beds for crimes. For example, community based development efforts are one of the distinct strategies started in 1960s to fix the deficiencies of urban renewal programs. According to Accordino (1997), physically dilapidated but socially vibrant communities stood up against the ‘federal bulldozer’ and started to rebuild their environments by benefiting from federal and state funds. Similar to this view, community development has reemerged in the last decades as “a comprehensive, necessary, and sustainable approach to addressing crime and promoting justice in our nation” (Acosta & Chavis, 2007).

Notably, the idea of community development is perceived as very contributory to preventing crime because this understanding encourages community ownership by establishing sustainable and accountable institutions (Acosta & Chavis, 2007). In other words, the communities depend on available resources to revitalize distressed communities. Otherwise, crime can emerge as the result of unequal distribution of income. In particular, there is a link between market condition and crime (Partridge, and Rickman, 2006). For example, Grogger (2000) examined the drug market stabilization. Expansion of the drug market makes it profitable for its participants who are mostly young. In addition to this, fluctuating youth wages can exacerbate the participation of unskilled men in drug sales (p.286). Moreover, a correlation also exists between real poverty and crime victimization (Cragila, Haining & Wiles, 2000).

Specifically, poverty is one of the important explanatory factors of crime. Unequal distribution of wealth in a community might result in high crime rates and areas depending on several other factors. Two different terms are used while quantifying poverty as: absolute and relative poverty. Absolute poverty refers to a number of people or households living below the income threshold. For example; absolute poverty lines are often used in the U.S while implementing social policies. Relative poverty refers to defining a poverty line. For example, a researcher can define a specific point of income level as a poverty level. Such as, any income below 50% of the median income is considered under the poverty level. Recently Patterson (1991) examined the effects of absolute and relative poverty on violent crime and burglary. Absolute poverty was found to be more strongly associated with crime rates than relative poverty. Several other studies explored the effect of poverty on crime (Flango & Sherbenou, 1976; Hsieh & Pugh, 1993; Pratt & Cullen, 2005; Stuck, 2006).

Flango and Sherbenou (1976) evaluated situational determinants of crime in 840 American cities. In this study, six independent factors were considered and two factors, urbanization and poverty, were found to be the more important criminogenic forces. Similarly, poverty and inequality were found to be the more associated variables of crime than other social disorganization variables (Miethe, et al., 1991). Hsieh and Pugh (1993) reviewed macro studies and violent crimes by use of meta-analysis methodology. In the study, nearly 80 percent of the positive studies report at least moderate strength of poverty and income inequality associated with violent crime. They also note that the size of relationships may vary in studies based on the studied crime type. Pratt and Cullen (2005) also examined recent macro studies on crime and they found that poverty is one of the three most frequent motivators of crime. Finally, the findings of Stucky (2006) indicate that as a structural factor poverty is related with the form of government.

#### **2.6.7. Urban Size**

Studies show that the association between population density and crime is evident even when other influential characteristics are isolated from these factors (as cited Flowers, 1989; Smith, 1957; Beasley & Antunes, 1974). According to Sampson and Groves (1989), that capacity of informal social control was decreased as the result of urbanization. According to Fox (2000), urban size difference is indicated as a significant explanatory of crime. This is shown by the spread of crack and gun usage among homicide offenders by urban size. This infers that the spread of crack cocaine and guns starts from the largest cities towards smaller areas. Furthermore, Zimring (2007) indicates a significant relationship between urban size and variety of crime. Nolan (2004) tested the relationship between population size and UCR crime rates. He



found that “crime rate and population area clearly related”. This relation also depends on the jurisdictional status. Several other studies also indicate the effects of urban size on crime and differences in urban size have an effect on crime (Flango & Sherbenou, 1976; Fox, 2000; Nolan, 2004; Stucky, 2005).

From a different perspective, this association is not necessarily the case (Li and Rainwater, 2000). Rather, the low socioeconomic statuses of the delinquents are found to be more linked to high crime rates. In general, this means that urban areas are supposed to have higher crime rates than rural areas. Of course, resort areas where a large amount of transient populations visit seasonally are exceptional places although they are rural. It is also important to note that there can be a variation between the old inner city, outer city and rural areas.

City level studies generally operationalize the urbanization effect by including the size of the city population (Stucky, 2005). This implies that there is a positive relationship between population and crime. In other words, when the size of the population increases, crime rate also increases. The current study operationalizes urban size by population.

### **2.6.8. Regions**

Police innovations are influenced by both the immediate environment and the wider context of the event (Mazeika, 2008). This influence may come directly from formal control organizations such as, local, state, regional and federal entities as resource and policy guidance. Or, from informal control as environments can indirectly facilitate implementation and diffusion of the event. Innovations also can diffuse among the organizations via social learning and imitation (Grattet, Jenness & Curry, 1998; Roger, 2003; Mazeika, 2008) and other means (Berry

& Berry, 1999). This wide interaction is not limited to innovations and it is extended to crime distribution as well (Grattet et al., 1998). According to Grattet and colleagues (1998), “(t)he correlates of criminalization resemble those in many other diffusion contexts” (303). Specifically, Grattet et al. (1998) examined innovation and diffusion in criminalization. They considered criminalization as a process of institutionalization that “involves the diffusion of legal forms and practices.” A general template of a state is presented as the legal institutionalization power of innovations and other means. In particular, the content of the laws of states differentiate the innovations and crime (303). The current study considers that criminalization is influenced by the internal political structure of states in addition to states’ location (region) within the wider interstate system. This can be interpreted as stating that police innovations and crime variation can be shaped by regional, state and local authorities.

In this context, understanding the correlates of variation in crime rates of regions, states and cities is important. This can be achieved simply by considering aggregate level crime perspectives instead of individual perspectives (Pratt & Cullen, 2005). Macro social perspective as a reflection of social organization is claimed by Qusey (2000) as one of “the most prominent explanations of the observed aggregate-level variation in crime” (263). Macro social perspective relies on the idea that “crime rates are an aggregate level property that reflects the social organization of the community or society” (263). This idea differs from the individual oriented perspective that considers crime rates as a sum of the behavior of the individuals.

Aggregate level research on crime dates back to Quetelet (1831) and Guerry (1833). In the U.S., Redfield examined (1880) the distribution of crime rates as a macro level study (As cited by Qusey, 2000). In his study (1880), homicide rates were found to be concentrated in the

South. Using aggregate level data, several others focused on explaining distribution of homicide rates studies (Land et al., 1991; Grattet et al., 1998; Quesey, 2000); the situational determinants of crime (Flango and Sherbenou, 1976); the relationship between police and crime (Marvell & Moody, 1996); the reasons why more crimes occur in cities than rural areas (Glaeser & Sacerdote, 1999); whether crime waves are regional or national (Winsberg, 1993); and finally, why crime fell in the 1990s (Levitt, 2004) in regions, states and local units of the U.S.

In the study of Flango and Sherbenou (1976), the South was found to be exceptional in terms of urbanization and poverty; and the stage in life cycle factor was found to be more important in explaining crime. The authors suppose that this situation stemmed from having a lower standard of living culture in the South than in other regions of the U.S. In this study, a greater association between crime and socio economic variables also was found.

Land, McCall and Cohen (1991) used resource deprivation, the social stratification variable and percentage divorced, as the social control variable to examine homicide effects on U.S regions in 1960, 1970 and 1980. They found significant positive associations between both of these variables at the city, metropolitan and state levels. A new study was applied by the same researchers (1992) on different crimes (rape, robbery and assault) for the same time. The percentage of divorced individuals was found to be significantly associated with rape, robbery, and assault rates. Resource deprivation was also significantly associated with violent crimes.

The study of Glaeser and Sacerdote (1999) aims to explain why more crimes occur in cities than rural. In the study, serious crime was found disproportionately concentrated in urban areas (3). In fact, while approximately 75 percent of the U.S. population is classified as urban (U.S. Bureau of the Census 1991), more than 95 percent of all index crimes reported to the police

occurred in cities and metropolitan areas (U.S. Department of Justice 1997). The study (1999) reported that city size and crime connection effects 25 percent of the overall crime sphere and attempts to explain this relation. The study was able to explain 83.3 percentages at the best and 51.9 percentage of the city crime connection at the bottom case. It was found that crime occurs in cities because of higher benefit expectation (0.13-0.33), lower probability of arrest and recognition (0.08-0.2), and the presence of more female heads of households (0.33-0,5).

Qusey (2000) examined homicide rates between 1960 and 1997. This study found in general that serious crime rates vary by regions and the urban place's size. Specifically, the highest homicide rates were found to occur in the South and respectively, by the West, Midwest and Northeast. Noticeably, the South-based homicide rates were getting less distinctive than those in other regions over time. In terms of robbery, the South had lower crime rates than other regions. Burglary rates were the highest in the West until the 1980s. Since then the Southern states took the lead. The study (Qusey, 2000) also found variations in rates based on the city size. Homicide and robbery rates were highest in large cities with than one million residents. Burglary rates showed mixed results where the highest rate occurred in the medium sized cities. The lowest burglary rates occurred in small cities. Based on the findings, Ousey (2000) suggests cultural, social stratification and social control approaches as the most explanatory perspectives. In this study, the cultural approach is presented as the most common explanatory factor of regional crime variation. Social stratification is suggested as the most prominent approach for metropolitan and city level studies. The social control approach is suggested as the the most important contributor to neighborhood level analyses. Ousey (2000) indicates the generalizability of these three social organization approaches on similar units and time periods; however, he notes the limited impact of the factors between metropolitan areas and city level analysis (297).

Winsberg (1993) questioned whether crime waves in the U.S. are regional or national. Fluctuations in violent and property crimes were compared in 50 states for the period between 1971 and 1991. Noticeably, equivalent fluctuations were found in the majority of the states with respect to violent crime rates. There were also similarities in fluctuations in property crime distributions although some of the states had different annual rates than others. Interestingly, no explanations could be suggested about why these similarities were experienced although several dissimilar socioeconomic factors exist over time among the states.

Levitt (2004) also indicates differences in crime rates among the regions and large U.S. cities between 1991 and 2001. In this study, the crime decline of the 1990s is attributed mostly to the Northeast states where Midwest states are presented as laggard. Regarding urban crime rates specifically, metropolitan and large cities having populations of more than 25,000 experienced more decreases in crime rates. Rural areas also showed smaller declines.

Considering the reviewed studies above, the regional and state level contributors' influence on crime is obvious. Although some findings are presented also for variation of crime in metropolitan areas and cities in, findings are not as strong in this case as in others. The current study aims to examine cities and regions to control the crime variety in order to understand the contribution of GIS use to police performance in reducing crime. The primary focus of the study will be to measure the contribution of the use of GIS to police performance at the local level. Secondly, the regional level contribution of GIS use will be examined to provide a broader context and facilitate understanding of the study findings.

## 2.7. Effect of Politics on Crime

After reviewing social disorganization research, it is clear that cities with higher disorganization are supposed to have higher crime rates than others. Bursik and Grasmick (1999) point out that the social disorganization theory has neglected formal and informal networks shaping the community; therefore, it is limited in explaining internal community dynamics. To connect associations for effective community control, Bursik and Grasmick reformulate the scope of disorganization theory by encompassing formal city institutions such as schools, churches and police roles on the informal control dynamics. According to Stuck (2005) when the city population increases, the social disorganization also increases that necessitates in turn increasing the formal control (76). Although Wilson (1968) and Wilson and Boland (178) previously examined the indirect role of politics in policing, several recent studies (Stucky, 2005, Stucky 2005; Stucky 2006; Maguire, Shin, Zhao & Hassell, 2003; Velez, 2006; Zhao, He & Lovrich, 2006) focused on the direct effects of local politics on crime.

According to some scholars (Maguire & Uchida, 2000; Zhao et al., 2006), the study of Wilson in 1968 is known as one of the pioneer studies arguing the influence of politics on police. In this study, Wilson examined the effects of local politics on police tactics' variation. This study and its findings are detailed in the policing chapter. According to Maguire and Uchida (2000), Wilson posited that "local contingencies such as characteristics of the population, the form of government, and political culture shape agency behavior and therefore output" (516). Maguire and colleagues (2003) also indicate that the local political culture is the major determinant of variation in policing styles.

Similarly, Wilson and Boland's study (1977) examined the effects of police practices on crime<sup>1</sup> in 35 large American cities, considering the effect of politics on crime. The 'political culture' variable (used previously by Wilson in 1968) is defined as presence and absence of a professional city manager. They assume that city councils or mayors can increase the number of police numbers but the police can select how to use the existing police force, such as having one or two officers in a patrol vehicle. They found that professional municipal management systems more likely follow an aggressive patrol strategy (380). The size of the police was also found to be relevant to violent crime rates, and available tax-based funds. They conclude by saying that "the police do make a difference and that this is not entirely dependent on resources" (381). Although both police resources and police activities were independently found to have influence on crime, the effect of politics on police as a form of government was also indicated as an influential factor on crime.

In a study, Maguire and Uchida (2000) state that "(t)he structure of city governance, together with local political culture, also continues to have a significant effect on police organizations, suggesting that any comprehensive theory of police organizations needs to account for political effects" (533). In a national survey, Koper and Moore (2001) examined factors causing changes in the sworn force size. The findings of the survey indicate that police executives of both large departments (65%) and small departments (48%) stated the influence of the local elected officials and/or political leadership on the police staff increase.

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<sup>1</sup> Robbery rates are researched with the number of patrol units as the police resources and their degree of aggressiveness as the police activity. The main assumption of the study is that the police patrol may affect crime rates more if the focus of the police is "what they do" there rather than "how many of them [there] are" (370). At the first step, the effect of the policing strategies are examined in resulting arrests; then, these arrest rates are used to measure variances in crime rates. The researchers found that the arrest rate is influenced by the number of patrol units and how they are deployed.

Recently, Stucky (2005) examined urban politics, crime rates, and police strength. He articulates that “to date, however, no studies have attempted to develop a theoretical account for how and why crime and city politics should be related” (118). The assumption of the study (2005) is that some political systems such as the elected mayor, partisan elections and district based city councils—so called traditional governments—are more open to political pressure in comparison to other so called ‘reformed’ ones. This is justified by the author because the idea of the reform on government is stated to facilitate the burden of the interest groups on city management. Another hypothesis of his study is that city expenditures influence crime rates. The Black population, poverty, median income, unemployment, the female dominant youth population, and owner occupied houses were utilized as independent variables in percentages in the study. The study found that traditional governments boast lower crime rates than reformed governments. It was also found that the number of sworn officers increases when the traditional political government characteristics increase (114). This could be the result of having more open channels to the public than is the case with reformed governments. Specifically, the social disorganization effect on crime rates is lower in cities if the city has a mayor/council form of government. This shows the existence of a relationship between form of local government, social disorganization and crime (p.99). In other words, the variation in city politics has the capacity to affect residents’ ability to maintain social control that may lead to reduced crime rates (p.101).

In his study of “Local Politics and Police Strengths,” Stucky (2005) examines variances of police strengths based on the political context. Several issues were found to be significant in his research. First of all, “relationship between violent crime and total police employment depend(s) on the local political context”. This means that the number of police increases when



violent crime increases. In other words, the increase in number of police is greatest if the local government type is traditional and the increase is smallest if the government type is reformed.

Secondly, an interaction effect between property crime and local politics was found to be significant and negatively correlated depending on the local political context. Thirdly, a positive relationship between the percentage of Black and Hispanic populations and variation on police employment depending on the political system was found. It is also noted in the study that the extent of this relation depends on the type of government, traditional or reformed.

Velez (2006) studied public social control effect on victimizations. As a social control mean, residents of neighborhoods are deemed to have the necessary power to secure adequate external resources to reduce crime rates in the area. The author found that the disadvantaged community can be supported by empowering residents. This means that disadvantaged areas can be viable in the political context to secure their districts.

In 2006, Stucky studied the effects of “Local Politics and Violent Crime in U.S. Cities”. The study indicates how politics can have an effect on social and political outcomes that are supposed to effect crime rates. The study points out the need for direct examinations of the effects of political dynamics on crime. Specifically, the study examined 958 cities across the U.S. to understand the effects of local politics (direct and conditional) on violence. In the study, the direct and conditional effects of local politics on violent crime were found. Specifically, lower crime rates were found when some city council members were elected to serve in geographic districts. Increased representation of the district was suggested as the possible reason for reduction of violent crime rates. The effects of structural factors such as poverty, unemployment, and female head of households on crime were found to be important depending

on the local form of government. In sum, the study suggests expanding the traditional definition of crime by including the political structure's effects on it.

It is also essential to note that some studies found weak support for the effects of politics on police and crime. Using panel data provided by the LEMAS survey for 1993, 1996 and 2000, Zhao and colleagues (2006) retested Wilson's theory in contemporary police organizations. In this study, little evidence was found in support of Wilson's findings.

Considering the reviewed research which indicates the effects of politics on crime (Wilson, 1968; Wilson & Boland, 1977; Stucky, 2005; Stucky 2005; Stucky 2006; Maguire et al., 2003; Velez, 2006; Zhao, He & Lovrich, 2006), the effect of local politics on crime is considered as an explanatory variable in this study. Operationalization of the variable and the factual distinction for different forms of government are detailed in the next section.

### **2.7.1. American City Management**

The U.S. has an abundant number of localized police agencies, differentiated types of local authorities, and forms of governance (Stephens & Wikstrom, 2007). In general, local governments provide police, fire and public works services. These services have expanded based on the dynamic needs of the communities. This expansion and diversification is also affected based on the characteristics of collected taxes and fees. Increasing volume of public service and its delivery to large areas for huge populations has constituted complex municipal systems. This evolving system requires more professionalization in city management.

Depression affected delivery of public services in American city critically and most of them were able to continue their service delivery scarcely. The federal government constituted

funds to support continuous service delivery. This facilitated the municipal process; however, economic support was minimized throughout the years. Development of new technologies, increasing urbanization, and diversified services produced new trends in order to manage cities in more productive ways. In brief, the business type of governments, council-manager type of governments and the modern city management types emerged in these years (ICMA, 2010). These forms of governance are considered within environmental variables of the current study because the ITC theory indicates their effect on information technology applications (Kim & Bretschneider, 2004).

The private sector's success attracted considerable influence on city managements. The running-like-business type of city government took much support from the industrial age inhabitants of cities. In this system, elected representatives constituted the board of directors, the city manager acted like the executive director and people were regarded as the stakeholders of the government (Kemp, 1995).

The progressive reform movement focused on reducing the political authority of the local government over the public. The council manager form was proposed at this term. The idea was that the professional city manager would balance the political influences on service delivery via elected non-partisan representatives. Kemp (1995) says that “two key progressive ideals – equality of participation in the political process and centralized administrative authority– were well balanced in this form of municipal governance” (p.7). The modern city management requires the separation of policy making and implementation. This understanding, the separation of politics and administration, facilitated the growth of professional service delivery.

### 2.7.2. Form of Local Government

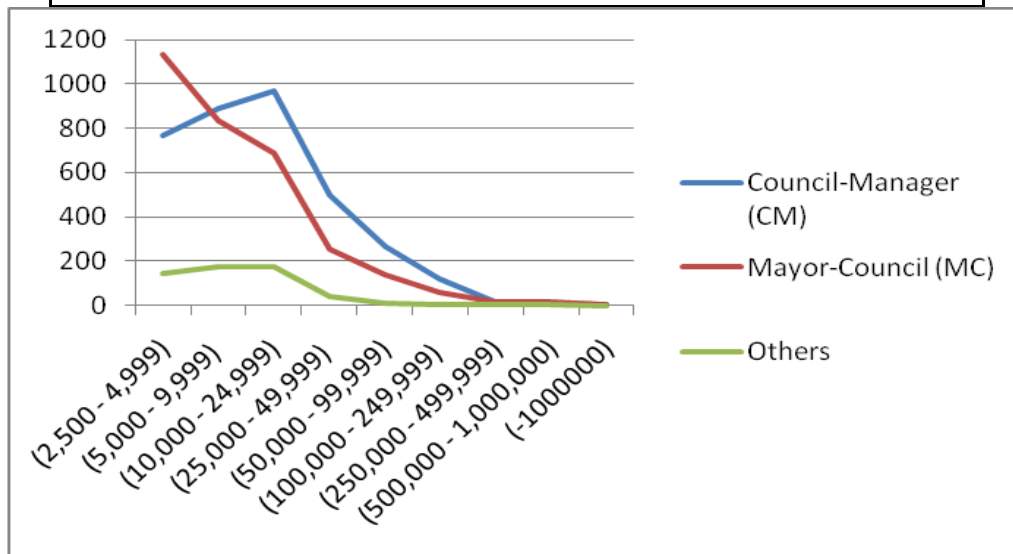
The form of local government is one of the environmental factors to be considered in explaining the impact of GIS in the police agencies of the U.S. Mainly, four forms of local government are widely used nationwide. These are: Mayor-Council, Manager-Council, the Commission and Town Representative/ Town Meetings. Strong and weak mayor forms can also be mentioned as another type of variation in the form of governments.

According to Kemp (1995), the commission type of government consists of nonpartisan elected members where they successively act as the head of the committee. At the Mayor-Council form of government, the mayor is selected separately by the public vote. Council members are also elected by at large, ward or via other techniques. The mayor holds the power to approve council policies and all roles are subject to change based on the localities. A strong mayor form refers to the “leader” of the city. The city council acts like a legislative body while the mayor serves as executive director of the locality. The mayor has power on the chief city officials and the budget with a little control from the council. In the weaker mayor form, the mayor has little power compared to a strong form of government. This means that both executive and legislative roles are provided by the council. The budget is also controlled primarily by the council. In the Council Manager form, a manager is selected by the council members. The council is elected by popular vote in a nonpartisan election. The mayor is known as the head of the council, the political and legislative leader.

The findings of the 2002 ICMA survey<sup>2</sup> show that 38% of localities have been governed by Mayor-Council type forms while 53% of them use the Council-Manager form of government. Remarkably, most of the municipalities (81.1%) employed a chief appointed official such as a city manager, chief executive officer, city administrator, chief administrative officer, town administrator, village manager, or a similar title.

**Table 4: Frequency of Form of Governments**

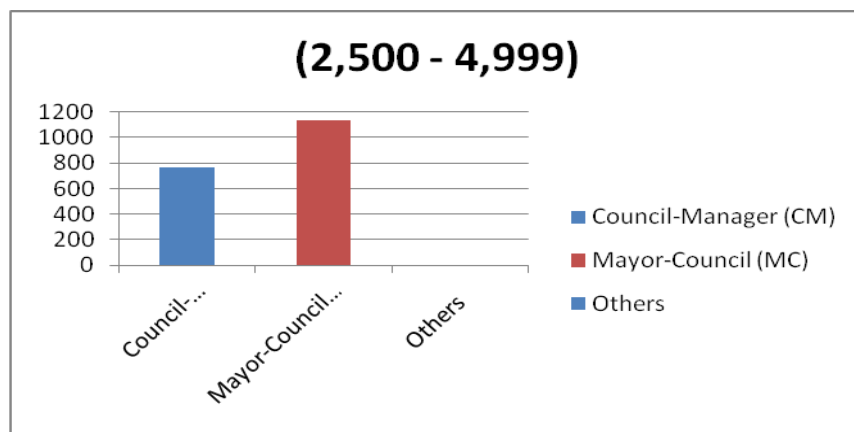
Population	Council-Manager (CM)	Mayor-Council	Others
(2,500 - 4,999)	769	1134	145
(5,000 - 9,999)	892	833	177
(10,000 - 24,999)	966	690	172
(25,000 - 49,999)	497	252	38
(50,000 - 99,999)	266	138	9
(100,000 - 249,999)	117	59	3
(250,000 - 499,999)	17	18	1
(500,000 - 1,000,000)	7	15	1
(-1000000)	3	6	1
Totals	3534	3145	547



**Figure 2: General Distribution of Form of Governments**

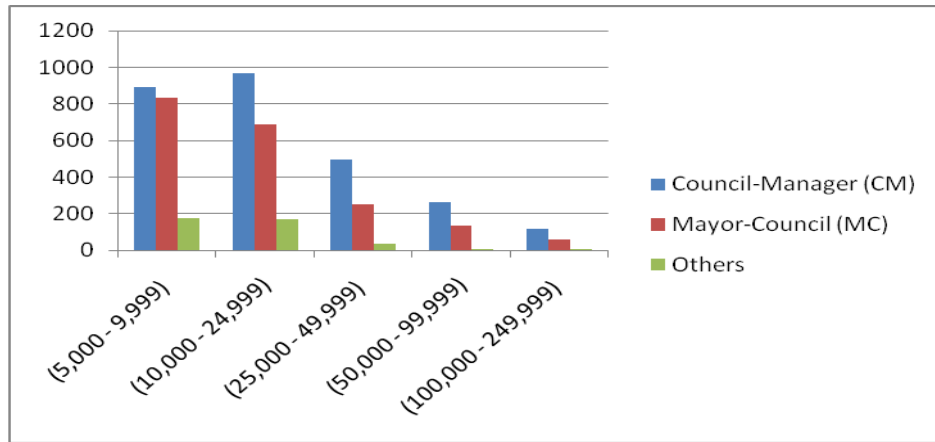
<sup>2</sup> The County Form of Government survey was conducted in winter 2002 and spring 2003 and mailed to all U.S. counties. Of the 3,046 counties that received surveys, 992 responded (32.6%).

Another key point is about the selection of these chief appointees. The appointed chiefs were selected by the council in 67.5% of the localities. The combination of chief elected officials and council selected the chiefs in 27.1% of localities. Currently, the council manager form of government is the most commonly used one. The Mayor-Council form of government is mostly preferred for large populations (500,000 and over), while the Council-Manager Form is preferred for the middle sized populations (5000 -250,000).



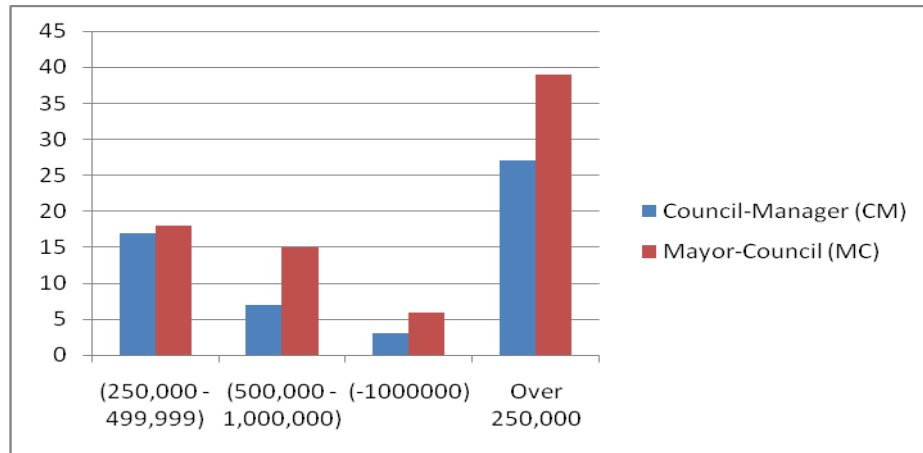
**Figure 3: Distribution of Form of Small Sized Governments**

In light of the information technology capacity theory, this study uses the form of city government as an environmental factor to measure impact of GIS use. In fact, the effective deployment of GIS projects can be successful if they receive adequate support from administrative and political authorities. The 2009 ICMA survey shows that 54% of municipalities, 2,738 out of 5,109 of the localities, with a population between 5,000 and 25,000, are under the council-manager form of government. In fact, the smaller (2,500 - 4,999) the size, the likely government type is the mayor council government. Remarkably, if the population size of the locality is mid size (5,000 - 250,000), the council manager form of government is the most widespread one.



**Figure 4: Distribution of Form of Middle Sized Governments**

Interestingly enough, when population increases, the mayor form of government becomes the most preferred one.



**Figure 5: Distribution of Form of Large Size Governments**

Perspectives are diverse in appreciating the form of governments' efforts. For example, a debate arose in San Diego where the city was governed under a council-manager form of government for more than 70 years. The mayor and council members are elected by the public and held accountable to the voters. The city manager can be hired and fired by consent of the majority of the council and mayor (Frye, 2004). In fact, this type of government is much common in the U.S. system where power is not identified. New proposed efforts attempted to give more power to the mayor that was named and criticized by the public as a "boss-mayor" type of government.

## 2.8. Effect of Increasing Police Expenditure on Innovative Technologies

Increased performance of police in reducing crime rates can be also explained by increased funds. Federal state funds and local expenditures by the police might have contributed to the fight against crime. In fact, the Violent Crime Control and Law Enforcement Act was signed in 1994 and encouraged an increasing number of police and community policing initiatives (Roth & Ryan, 2000; Skogan & Frydl, 2004). Soon after this legislation, the Department of Justice established the Office of Community Oriented Policing (COPS) to administer the grants and mandated objectives according to the acting director of the National Institute of Justice (NIJ) (Roth & Ryan, 2000). In this respect, scholars have examined the efficacy of the spending of provided funds (Brown, 2000; Zhao, Scheider & Thurman, 2002; Roth & Ryan, 2000) and police expenditures (Jackson & Carrol, 1981; Maguire, 2001; Koper and Moore, 2001) in increasing police strength.

COPS grants were examined after four years in 1998 and it was found out that “the COPS program had broad national impact on levels and styles of policing” (Brown, 2000). According to the Urban Institute report COPS grants received high participation by high crime jurisdictions, provided more officers on the street, and resulted in wider but uneven COP initiatives and limited productivity gains from new technology (Brown, 2000). The examination of COPS by Zhao, Scheider and Thurman (2002) indicates those provided grants, both for innovation and hiring more police, have resulted in significant crime reduction in local crime rates.

In 1995, the Making Officer Redeployment Effective (COPS MORE) program was established by COPS to fund innovative technology, civilians, and overtime (Roth & Ryan, 2000). In 1996, only 1 percent of the COPS MORE grants were used to implement geo mapping



(13); however, use of GIS in analyzing crime patterns increased considerably in the following years. In particular, use of GIS as a problem solving tactic increased from 39% to 74% between 1995 and 1998 while use of GIS in non-funded large local police organizations increased from 34% to 61% (205). Finally, 42 percent of fund beneficiaries reported that use of GIS was started and expanded via COPS MORE funds (Roth & Ryan, 2000).

Investments which are made in policing innovations can be risky if necessary political and community supports cannot be sustained. In fact, there are more contributors to be considered. Some of these contributors are articulated by Skogan in his recent study (2008), “Why Reforms Fail?” He states that “If reforms are to persist, the astute change manager has to ensure that they are the department’s and even the city’s project, not just their own. If they can build public and political support for reform, its budget may survive when money is tight and resources are hard to come by. Political support, and deep support from the community, is also a tool for beating back dissidents within the department when necessary” (Skogan, 2008)”.

### **2.8.1. Police Strength**

The last 30 years of research in police strength was examined to understand the influential factors of police strength (Maguire, 2001). Police strength is defined as an imperfect term and three most common operationalizations are stated in order to identify the term. These are “sworn police officers, the number of police employees, and the amount of police expenditure” (7). These are applied as rates per unit population per unit area, or raw levels. According to Snipes (1993), police size and police expenditure can be interchangeably used. In particular, the police size is defined mainly by the police organization and the expenditure is defined by the city government. Simplistic analysis in police strength is not seen as a useful

study type anymore. In this framework, prior studies examined the determinants of municipal police expenditures (Carrol, 1981), influential theories explaining police strength (Koper & Moore; 2001), evidence influencing police strength (Maguire, 2001), and the relation of police strength to crime change overtime (Chamlin & Langworthy, 1996).

Jackson and Carrol (1981) examined a sample of 90 U.S. cities to understand the determinants of municipal police expenditures. Study findings indicate that racial composition and the level of black mobilization were significant predictors of police expenditures. Noticeably, the effect of race related variables were found to be more influential than police salaries and operations related expenditures.

Koper and Moore (2001) summarize the philosophies of some influential theories in police strength. While rational public choice is addressed as linking the theory of police strength variation, crime and population size, conflict theory says that the police force increases as a response to growing populations' threats to the maintenance of dominant groups. In this frame, threatening populations are represented racially, as nonwhite groups or economically, the poor and unemployed. Finally, organizational theory is indicated as an explanation for internal organizational factors for the size of the police. Considering mentioned theories, Koper and Moore (2001) reviewed 50 empirical studies and found that the used variables have not been confirmed as consistent predictors of police strength. Koper and Moore (2001) claim that only lagged values of sworn police officers is a very reliable indicator of police strength. "Changes in crime, calls for service, and population were leading influences on growing agencies during recent years, while government finances and fiscal constraints were among the leading factors cited by shrinking agencies" (Koper & Moore, 2001,p. 40). Notably, the acquisition of new

technology was ranked as having little or no influence on staffing changes for half or more of the large and small sized agencies (32). Koper and Moore also analyzed the effects of elected officials and political leadership on police strength.

On the other hand, the basic implication of rational theories can be understood with the idea that police strength is developed in response to rising crime rates (Maguire, 2001). This relation between police strength and crime rates is described as “simultaneous or reciprocal casual relationships”(9). Chamlin and Langworthy (1996) examined police strength and crime over time between 1927 and 1977; however, they could not find a relationship between the two. The findings of the study (1996) indicate that this relationship may not be explained clearly through simplistic rational theories; however, it may be explained better if other social and political factors are also considered (Loftin & McDowall, 1982; Maguire, 2001).

Due to the fact that police size and police expenditures are interchangeably used constructs (Snipes, 1993), and police strength can be operationalized by number of (sworn) police officers, the number of police employees and expenditures (Maguire, 2001) in a police agency are selected and operationalized as an independent variable within the current study to control effect of the police strength (organizational size and expenditure) on crime.

The effect of the police on crime is obvious and has several dimensions that need to be considered. The unit of analysis for current study is police agencies in cities and counties of the U.S.; therefore, the following section will closely explore policing in the U.S. and its role in the fight against crime. For this reason, a separate chapter is devoted to reviewing research on the characteristics of policing in the U.S. This encompasses the evolution of policing, the effect of

policing in reducing crime, recent innovative policing strategies, and contribution of GIS use to police performance that is assumed to have effect in changing crime rates in U.S. police.

## **2.9. Crime Measurement in the U.S**

Crime can be measured for several reasons. Three general purposes for measuring crime are presented by Maxfield and Babbie (2008): monitoring, agency accountability and research. It is often the aim of descriptive and exploratory researches to count how much crime exists in a specific area. Explanatory studies focus on learning what causes crime by holding crime as a dependent variable. And, “applied studies often focus on what actions might be effective in reducing crime” (Maxfield & Babbie, 2008; p 145).

Three main issues are recognized as important to identify for a research on crime: What units of analysis are selected, what type of offenses are targeted to measure; and what the research purpose is in measuring crime (Maxfield & Babbie, 2008; p.146). In this study, local police agencies are studied within U.S. cities and counties. The assumption is that some of these agencies may be using the Geographic Information System (GIS) while some agencies may not. The overall crime rate is used as an outcome measure to examine the impact of GIS use on police performance. Mainly, two nationwide measures of crime are well recognized as the Uniform Crime Reports (UCR) and National Crime Victimization Survey (NVCS). The National Incident Based Reporting System (NIBRS) is a new methodological form of the UCR and its transition has been in progress since 1988. There are also self-reported studies which collect data for specific crimes and/or special designed studies.

Selecting the appropriate measure of crime is important for a research to increase its reliability and validity. Cities and counties are known as a group type of unit of analysis that is selected purposively for this study. Aggregated data is collected for group type units of analysis while disaggregated data is collected for individual units of analysis (Maxfield & Babbie, 2008). The focus of the study is not the individuals, such as victims, but the police agencies in cities and counties of the U.S. The strength of the UCR data specifically comes from the production type of data used for this study. The UCR program produces a summary based measure of crime – aggregated-data. This means the program reports the summary or total counts of the reporting agencies on the city and county levels. This enables a fertile ground for studying local authorities in cities counties of the U.S. Furthermore, the data can be aggregated upward to include states and regions of the U.S. (Wells & Falcone, 2002). In fact, “although the NCVS is a nationally representative measure of victims, it cannot estimate victimizations for states, or local areas” (Maxfield & Babbie, 2008, p. 172). Instead, the NCVS and self-report studies enable the study of specific offenses, offenders, victims, and incidents as the individual units of analysis. Therefore, this study selects the UCR data as the measure of crime because the UCR program collects nationwide aggregated crime data known to police from counties, cities, states regions of U.S. (Bureau of Justice Statistics, 2004).

Crime data collection is important as a measure of crime in order to shape policies and for funding allocations. Several sources such as the Congress report (James, Council, 2008), books (Maxfield, & Babbie, 2008; Albanese, 2005), and studies (Maltz, 1999) explored or focused on measures of crime to understand their nature and development. Some publications also focused on dark figures of crime such as ‘The Mismeasure of Crime’ to show the problems of police data (Mosher, Miethe & Philips 2002). It is important to explain for a measure of crime

what types of data are being used, how they are defined, what is being reported, how they are categorized, how they are collected, how they are processed, and what the limitations are (Gordon, 2009).

As measures of crime, the UCR, NIBRS, and NCVS are known as national data sources, and self-report studies are often known as data sources for specific and poorly represented crimes. These measures of crimes are presented in detail in the following section.

### **2.9.1. The Uniform Crime Reports Program**

The Uniform Crime Reports (UCR) is the first national program providing a standardized measure of crime. When it was conceived in the late 1920s, the idea was to create a “way to measure the effectiveness of local law enforcement and to provide law enforcement with the data that could be used to help fight crime” (James & Council, 2008, p.2). It was 1927 when the International Associations of Chief Police (IACP) formed the “Uniform Crime Records committee to set up a system on collecting uniform crime statistics” (UCR Hand Book, 2004). The most appropriate measure of the incidence of crime in the U.S. was determined to be offenses known to police by the committee at that time (Mosher et al, 2002). Seven serious and prevalent crimes were selected as Part I offenses because they are recognized by both victims and witnesses and are most probably reported to the police as criminal incidents (2008, 3). Arson also was added to the Part I crimes category by Congress in 1978 (James and Council, 2008, p.2).

Currently, the UCR Program collects data on known offenses and arrested persons by law enforcement authorities. Part I crimes, the so called FBI crime index, constitute the overall index

of crimes which is the primary tool of studies in measuring crime. However, the FBI stopped releasing a crime index in 2004. Part I crimes are listed under two main categories in the UCR. These are named as violent and property crimes. Violent crimes are defined as crimes against persons (Albanese, 2005). In particular, violent crimes include murder and non-negligent manslaughter, forcible rape, robbery, aggravated assault. Property crimes are defined as “property is taken or unlawfully and misused (Albanese, 2005, p.59). Property crimes include burglary, larceny-theft of motor vehicles and arson (Mosher et al., 2002, p.61). Other reported data is named as Part II crimes. These are mainly called ‘crimes against the public order’ that means actions which disrupt the peace of society (2005, 59). Part II crimes are required to be reported by UCR participant police agencies when an arrest is made. Since Part II crimes are not the focus of the study, the remaining twenty one crimes are not used in the study.

### **Development of the UCR**

According to the Congressional Research Service report (James, Council, 2008); 43 states and more than 400 police agencies reported crime data in 1930 and the FBI was designated as the clearinghouse of the crime data. Since then the UCR Program evolved and acquired several other features. Age, sex and race of the arrestees were reported for the first time in 1952 by law enforcement agencies. It was 1958 when the FBI started to estimate annual nationwide crime rates. National statistics on killed law enforcement officers (1960) and the Supplementary Homicide Report, SHR (1962) started to collect data based on the age, race and sex of the victims. FBI also asks for the data on the number of sworn officers and civilian personnel in charge. Hate crime statistics and the number of killed and assaulted law enforcement officers are data that are additionally collected and published by the FBI. “Crime in the United States” is the

annual publication of the FBI that provides data on the type of offense, arrest, clearance, SHR and number of sworn law enforcement officers (2008, p.8). In detail, “the UCR program provides crime counts for the nation as a whole, as well as for regions, states, counties, cities, and towns. This facilitates studies among neighboring jurisdictions and among those with similar populations and other common characteristics” (USDOJ, 2003).

### **How data is collected**

Monthly law enforcement reports or individual crime incident reports are submitted to the UCR Program by police agencies. Each report is examined for “reasonableness, accuracy and deviations” that may be signs of errors (Bureau of Justice Statistics, 2004). State UCR programs are qualified to collect data and transmit to the FBI if they comply with FBI requirements. These standards ensure the collection of consistent and comparable data. If a state does not have a certified UCR agency, law enforcement organizations can report directly to the FBI. (James & Council, 2008, P.5-8)

The UCR does not require law enforcement agencies to provide data to the program (UCR Handbook, 2004). In fact, 94.1% of the U.S. population, about 296 million, was represented by law enforcement agencies active in the UCR Program in 2004 (Bureau of Justice Statistics, 2004). It is important to note that police agencies may not submit all month’s data to the UCR. Some agencies may submit a few months of the data and some may submit only the offense data. In fact, larger police agencies serving more than 250,000 populations did not provide missing data between 1960 and 2003, whereas smaller agencies provided missing data. (James & Council, 2008, p. 19)



If an agency does not provide data to the UCR, the FBI utilizes imputation techniques to estimate the crime rates for that area. There are variations in reported months and their imputation techniques. An imputation technique implicitly accepts the same conditions for the all non-reporting cities in the same states. In fact, income distribution, population density, racial composition and unemployment rates may be different for each city (James, Council, 2008; Mosher et al., 2002).

### **How the data is processed**

The processes of crime reporting and recording are socially constructed issues based on definitions. This means interpretations are required while using crime classifications and scoring techniques. In a stepwise presentation, a crime report becomes the official data throughout five steps. According to Beirne and Messerschmidt an event (1) must be perceived as a crime; this event (2) must be heard by the police; the police should identify the event (3) as a crime; the crime (4) should be coded appropriately to the UCR program; and finally, the FBI should include the crime (5) in the UCR records (as cited Mosher et al., 2002, p.98).

Classification and scoring data is done by law enforcement agencies to maintain data integrity. Classification refers to “process of translating offense titles used in local and state criminal codes into the standard UCR definitions for Part I and Part II Crimes ” (James & Council, 2008, p.8). After this classification, the count of the number of offenses means ‘scoring’ offenses.

Three rules are used by the FBI to increase consistency in classification and scoring of the data; however, these rules also have some exceptions that produce limitations for the dataset.

These three rules are named as hierarchy, hotel and separation of the time-place rules. Some of these rules were changed in the transition to NIBRS and these are elaborated in next section below.

The hierarchy rule is applied in the UCR when more than one Part I crime is committed at the same time. The most serious crime is only reported to the UCR under this rule with a few exceptions. As a big limitation, remaining offenses stay unknown. As an exception, arson cases are reported separately in any cases without considering hierarchy rule since 1978. Secondly, if a motor vehicle is stolen in a larceny-theft situation, the motor vehicle theft becomes the only crime reported. Finally, justifiable homicide cases are scored as two offenses.

The hotel rule is applied only for burglary cases in the UCR. In specific, when multiple offenses are committed in a hotel, motels, and other lodging places, these are scored as one offense. This rule is not applied for leases, rental apartments or offices. If there are five offices or houses burglarized at the same time, these are scored as five different offenses.

The separation of time and place rule is applied when a criminal commits multiple offenses at a short period of time in different locations. Scoring of property and violent crimes is distinguished according to the UCR Program. Offenses against persons are counted separately, whereas, several offenses at a store is counted as one. The most serious offense is recorded at this instance as well. (James & Council, 2008, p. 9-11)

### **Transition to National Incident Based Reporting System (NIBRS)**

A study called “Blueprint for the Future of the Uniform Crime Reporting Program” was published in 1985. Recommendations of the study are that it addresses the fact that police

agencies should utilize incident based reporting systems for offenses and arrests. In addition, a quality assurance program's application is advised. In this respect, first testing was implemented in South Carolina. In 1988, national participants of the UCR Program conference approved full implementation of NIBRS, under the FBI management. An advisory committee was also agreed to be established to help on its implementation (James & Council, 2008, p.11-13).

Selective application of the hierarchy rule in the UCR (police discretion) has produced potential classification concerns on coder reliability because there is little control of the reporting compliance. Transition to the Incident Based Reporting System might be a solution for this concern. Albanese (2005) describes the transition as “to make crime data more useful for purposes of crime analysis, law enforcement, and the design of prevention programs , the National Incident- Based Reporting System is under development in the U.S. Department of Justice” (74).

It can be said that the incident based measuring system first started with the implementation of the Supplementary Homicide Reporting (SHR) system in 1961 at the FBI. In practice, SHR can be used for individual incidents, that is, for victims and offenders for only one type of crime; homicide. Efforts on transitioning the UCR Program entirely into the new National Incident Based Reporting System started in the mid-1980s; however, a gradual slow shift has taken place since then.

It is important to note that NIBRS participation of a police agency is supposed to result in an increase in crime rates (Maxfield & Babbie, 2008, p.152). This is due to the fact that the hierarchy rule is eliminated within the NIBRS and each of the crimes is reported separately according to one incident based reporting system (Mosher et al., 2002, p. 72). This slow

transition's underlying reasons can be better understood in a state level example. In the UCR Program, a summary of a measure of crime (in other words, aggregated data) is submitted, but in NIBRS, incident based individual data are submitted. In the example, Idaho would submit 95,000 incidents as 106 agency observation units; however, 95,000 separate individual units (in other words, incident based reports) would be submitted under the NIBRS. The main difference is reporting each crime incident, instead of reporting the total number of categorized crimes for each agency. (Maxfield & Babbie, 2008)

The transition from the UCR type data collection to the NIBRS program is not plain as it may be assumed. These difficulties may produce obstructions in the transition to NIBRS among police agencies because a law enforcement agency or local government may be held accountable based on crime rates. As of December 2003, 23 states and 5271 agencies were certified to collect NIBRS data (BJS, 2004). In fact, 31 states accomplished NIBRS compatible certification as of August 2007; however, only 17 % of the population data was collected by NIBRS (James & Council, 2008, p.17). This implies that the transition to the NIBRS may take a longer time to implement than it is assumed.

### **2.9.2. National Incident Based Reporting System**

NIBRS was introduced in 1988 to overcome some of the shortcomings of the UCR. An incident is the basic unit of a crime that consists of more than one victim or offender at the same time and place. In this reporting system, agencies are submitting detailed information about the incidents (Maxfield & Babbie, 2008). The crime is supposed to be better measured in true volume when NIBRS is fully implemented because NIBRS covers more crimes than the UCR.

More in depth data is being collected in the case of the NIBRS than via the UCR. Detailed data on offenders, victims, arrestees and property involved in an offense are collected in the NIBRS.

The UCR Program collects data on Part I offenses and arrests (that is, for eight types of crime) and Part II offenses (that is, for 21 crimes). Differently from the foregoing, two main categories classified as Part A for 46 and Part B for 11 offenses are reported by the NIBRS. In NIBRS, offenses are classified as Group A and Group B (that have been identified as Part I and Part II crimes, respectively, in the UCR). Incident based reporting systems enable descriptive and exploratory studies of individual events.

### **How data is collected and processed in NIBRS**

The NIBRS requires a specific certification of a state before data submission. It is also important to note that a state may be a NIBRS compliant state; however, this does not mean that all complied law enforcement agencies are reporting in this way. If a state has a certified agency for processing the NIBRS data, all law enforcement agencies are required to send their data through the state NIBRS program. If a state has not complied with the NIBRS yet, the FBI allows large police agencies servicing more than a population of 100,000 to submit data directly to the federal NIBRS program. Self-reporting police agencies are also supposed to have an NIBRS-compliant IBR system. This allowance discontinues when the state complies with the NIBRS certification program (James & Council, 2008, p.14-15).

Classification and scoring are processed by law enforcement agencies similarly to the UCR. The hierarchy rule is not applied in NIBRS because all of the offenses are reported in detail in the incident based reporting system. The hotel rule is still in use in NIBRS and its

definition is expanded. Rental self-storage houses are also reported in the same manner under the hotel rule in the NIBRS. The separation of time and place rule is also in effect in NIBRS. An offense or a group of offenses are distinguished based on this criterion. The distinction of the crimes against people and property scoring is the same in NIBRS. One additional new category is in use with NIBRS that is called “crimes against society”. In this category, “drug/narcotics offenses, gambling offenses, pornography/obscene materials, and prostitution offenses” take place. (James & Council, 2008)

### **Strengths of the NIBRS compared to the UCR**

Studies indicate that the NIBRS has several new strengths that make it preferable to the UCR program (Mosher et al., 2002; Maxfield & Babbie, 2008). Methodology change, increase in collected crime variety and depth, are usability in geographical based analysis comprise the majority of these strengths. Collection of detailed information for each incident as each offense, offender and victim based on a large number of offenses are the other significant changes of the NIBRS than the UCR program (James & Council, p.13).

Methodology change can be considered as the backbone of the NIBRS. Application of the hierarchy rule is dropped in the NIBRS; instead, the incident based reporting type is applied. Elimination of the hierarchy rule makes offense clarifications exclusive. This is the main change in collecting data from aggregate numbers to individual incidents. Collection of data on individual crime incidents provides more details for better analyzing (Albanese, 2005). The number of offenses is wider than the UCR and not limited to certain categories. In this system, definitions of offenses can become more compatible with state and local crime.

The NIBRS records more offense than the UCR which makes it more reliable than the UCR. More geographical and analytical links can be created on specific incidents are based on arrests and clearances. Interrelations of offenses between victims, offenses, offenders and property can be more clearly traced in examinations. Detailed crime analysis efforts such as strategic and tactical ones can be executed on local regional levels by use of the NIBRS data.

The addition of a new crime category as Society/Public for victimless crimes is another strength of the NIBRS. Additionally, attempted and completed crimes can be identified in NIBRS. Furthermore, providing auditing standards and requiring records on computer readable data additionally enhance the reliability of the NIBRS.

### **Limitations of the NIBRS**

Three issues mainly stemming from the implementation difficulties of the NIBRS may produce problems (Maxfield & Babbie, 2008). A few hundred summary reports are the outputs of the UCR; however, huge amounts of data as incident reports are required to be submitted in the NIBRS. The implementation of the NIBRS requires enormous effort by law enforcement agencies. This transition also requires new or the adaptation of capability systems for data processing. In this system, smaller departments are supposed to comply with the NIBRS more easily when compared to larger police agencies because larger ones have already developed customized recording systems. The adaptation of these new rules with the existing systems may be difficult and costly.

The NIBRS is using a selective process in crime reporting and recording. This may show the existence of the discretion problem potential similar to the UCR to some extent. The NIBRS is a voluntary program and police agencies are not required to report (Maxfield & Babbie, 2008).

### **Efforts on Increasing Accuracy of the Data Known To Police**

Police records, ‘crimes known to police’ constitute very a wide measure of crime. This term, ‘crimes known to police,’ involves both observations of the police and reports from the others, such as victim and witnesses. Although some criticisms take place on the accuracy of the police records, the UCR program is coordinated and executed by the FBI under several official guidelines. Specifically, the FBI is implementing different programs, such as QAR, in order to increase validity and reliability of the data (Maxfield & Babbie, 2008).

The UCR Data Quality Guidelines<sup>3</sup> for statistics includes mainly four procedural steps in order to increase accuracy of the data. The first one is the UCR Data Design/Structure (Methodology) phase which is abbreviated as CSMU. At this step, the reported data are reviewed to “determine adherence to UCR policy, conformance to UCR definitions and principles, and consistency with established statistical methodologies and norms” (9). Errors and anomalies are verified by the reporting local agency before entering the data. After these checks the data are uploaded or entered manually to the national database. After entering the data, reasonableness, quality and validity of the data is reviewed within a multilayered process check by the CSMU. On site reviews of the records are executed by the CJIS Audit units. Specifically, the FBI developed the Quality Assurance Review (QAR) to provide accuracy in classifying and scoring crimes in 1997. This voluntary review started to assess the “validity of crime statistics through

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<sup>3</sup> [www.fbi.gov/ucr/guidelines/02DataQualityGuidelinesDownloadable.doc](http://www.fbi.gov/ucr/guidelines/02DataQualityGuidelinesDownloadable.doc)



on site review of local case reports” (Mosher, 2002, p. 69). The team of auditors of the QAR sends back evaluation reports to local agencies showing the performance of the agency in reporting. The FBI also provides training to voluntary police agencies in order to increase the quality of crime reporting. Extensive auditing and monitoring may increase the data quality; however, the developments in quality may remain susceptible to interpretation errors if the police data is not fairly open to public scrutiny (Mosher et al, 2002, p.99). The UCR program has shortcomings, nevertheless, “[it] is still a very useful measure for researchers and public officials” (Maxfield & Babbie, 2008, p.150).

### **Discussion on Problems and Limitations of the Police Data (UCR)**

Crimes known to police are considered as the most widely used data (Maxfield & Babbie, 2008; p. 148) and “the best official measure of the nature and extent of crime” (Mosher et al., 2002, p 83). However, police data is inadequate for several reasons (Albanese, 2005; p.67) “as a measure of the true extent of crime” (Mosher et al., 2002, p.83-84). The gap between reported crime and the true extent of the crime often receives adequate attention from the researchers (Maltz, 1999; Albanese, 2005; Maxfield & Babbie, 2008; James and Council, 2008). Specifically, ‘The Mismeasure of the Crime’ is one of the well recognized studies debating this gap with the use of the metaphor: ‘dark figures of crime’ (Mosher et al., 2002).

According to Maxfield and Babbie (2008), the UCR cannot be clearly identified as an exhaustive or exclusive measure of crime (151). Its validity is under question because it does not count all crimes. Its reliability is also open to criticism because all law enforcement agencies do not submit complete crime reports to the FBI. Furthermore, the data quality is arguable because inconsistencies exist in recording and reporting crime. Naturally, the reliability of the UCR is

under risk as well, when police officers process crime reports with discretion without any public scrutiny.

It is possible to upgrade the UCR data; however, it is not possible to downgrade the data. In other words, the UCR data is limited with the analysis of “units as cities, counties, and regions.” For these reasons, the UCR data “cannot represent individual crimes, offenders, or victims as units” (Maxfield & Babbie, 2008, p. 152).

Variations in citizen reporting; police recording; race and social class biases; inability to count all reported crimes; conceptual and methodological problems; different interpretations of crime definitions; classifying errors in crimes under hierarchy rules; political manipulation, fabrication; the data submission process; and missing data and imputation procedures are presented as major problem sources with police crime data in studies. (Mosher et al., 2002; James & Council, 2008)

Three main limitations are presented as variations in citizen reporting and police recording. These are the “inability of police to observe all criminal activity, the reluctance of crime victims and witnesses to report crimes to the police, and variations in the recording of ‘known’ crime incidents due to police discretion” (Mosher et al., 2002, p. 84). It is important to be aware that all crimes are not known to the police and some crimes stay unreported. The police agencies are limited with the reported offenses. In fact, citizen complaints and calls for services are indicated as the main sources of known crimes (Mosher et al., 2002, p. 84). In general, a crime mainly stays undetected if the victim and witnesses fail to report it. Naturally, police observation is also another factor that enhances crime reporting—in this case crimes are reported right away when the situation arises.

Varied reasons exist for unreported crimes known to the public, some of which are lack of trust in the police, fear of the offender, and involvement in the crime as stated by Mosher et al., (2002, p.84). Victimization surveys show that the size of the unreported crimes exceeds reported crimes. In fact, 57.4% of all crimes were not reported to the police according to the National Crime Victimization Survey of 2005 (James & Council, 2008, 18). This is evidence that the UCR undercount crimes when they are not reported.

There is evidence of race and social class bias in police reporting (Sampson, 1987; Smith, 1986). Considering the differential of police focus on minority groups, Mosher claims that these biases may produce at least some crime rate variation (2002, p.87).

Limited coverage of different crime types is one of the other weaknesses of the UCR Program. The UCR does not cover and measure all reported crimes known to police, only Part I and Part II crimes—if a person is arrested and charged—are counted in the program (Maxfield & Babbie, 2008). In specific, crime data on frequently heard crimes, such as bribery, child pornography and kidnapping are not collected in the UCR program (James & Council, 2008). Mosher states that the UCR focuses mostly on street level crimes and lacks inclusion of federal and political crimes. Additionally, corporate and occupational crimes, such as price fixing, fraud and theft by employees are undercounted in the UCR data system (Mosher, 2002 p. 86-87). This means that a large number of crimes are not measured in the UCR program.

Conceptual and methodological problems are the other concerns of the UCR program. Definitions of crimes and classification of offenses are main problematic issues. The UCR crime definitions may not be understood or followed closely by reporting agencies and this may result

in misreporting (James & Council, 2008, p.18). Coding guidance exists for classifications and counting rules for scorings, yet, these are still open to interpretation (2002, p.87).

Classification and scoring are the essential components of the UCR program to maintain the integrity of the data. In practice, coding crimes into defined categories may produce a complex product in different local agencies as the result of varied interpretations. The causes of interpretations vary, specifically, with respect to crime incident definitions, the hierarchy rule, the record keeping system, and the competence of follow-up actions (Mosher et al 2002, p.65).

The operational definition of crime differs from state to state and this is also subject to police discretion. Police discretion is essential while reporting crime. Although some crimes are clearer to code in certain categories, some issues may be confusing. Mosher (2002) states specific examples of miscategorization potentials on homicide in timing, forcible rape in comprehension, robberies in force use, aggravated assault in injury, burglary in entry, larceny theft in definition and estimation of the stolen money, and arson in the intention (65-69). The discretion of the police in recording reported crime “is a major source of inconsistency in official counts of crime” (Mosher et al, 2002).

In the UCR program, crime rates are calculated per 100,000 people based on census records. When census records are not available for a year, the UCR program uses techniques in order to estimate the population. These estimations are sometimes criticized and may be seen as problematic (Mosher et al, 2002; Maltz, 1999).

Political manipulation and fabrication of the data is another remarkable problem presented by police data. Evidence shows that police reporting practices, for example,

manipulation of the crime reports, such as the result of political pressure, may affect the accuracy of the UCR data (James & Council, 2008, p.18; Mosher et al., 2002). In practice, police departments are generally evaluated based on crime rates (Roberts, 2006). This produces pressure on the police and on the effectiveness of police activities. Police discretion may be used in favor of the police agency to keep the crime rates down under this kind of pressure. For example, Justice Magazine of 1972 mentions this kind of crime downgrade for large police departments (Mosher, 2002, p.92). Specifically, not reporting all crimes, combining separate events, reporting “unfounded” crimes, and downgrading major Part I offenses are mentioned as ways in which localities undercount crime incidents. On the contrary, Chambliss (1984) thinks that it may be in the interest of the police to report the increasing crime rate in order to have a large share from the budget (2002, p. 91).

### **Search for Alternative Measurements**

The Uniform Crime Reports program may produce misleading conclusions if it is accepted as the only entire source on crime without criticism (Albanese, 2005). In fact, concerns about the reliability and validity of the UCR program have provided the ground for development of the self reports and victimizations surveys. Self-report studies (1940s) and victimization studies (1960s) have emerged throughout the years (Albanese, 2005, p.75). Three different crime data sources, the UCR and NIBRS, NCVS and self-report studies are used to measure crime from different perspectives in the U.S. In practice, the UCR data is reported by police departments, victimization data is based on household surveys and self-report studies are based on offenders’ responses. The differences between the police data, household surveys and self-report studies show the difficulty of measuring the true extent of crime (Albanese, 2005). It is

clear to consider that social measurements rely on human decisions based on interpretations and errors (Mosher et al., 2002, p. 5). For example, between 6.4 and 8.6 million people were not counted in the United States 2000 Census and according to Holmes (as cited by Mosher et al., 2002, p.10), 4 million people were counted twice

### **2.9.3. Measuring Crime through the National Victimization Survey (NCVS)**

The limitations of the official measure of crime were clearly felt when escalations of crime and urban unrest were apparent in the 1960s. It was 1972 when the U.S. Census Bureau first conducted the National Crime Victimization Survey. The primary reason for this survey was to illuminate ‘the dark figure of unreported crime’ (Maxfield & Babbie, 2008, p.156).

The NCVS is a representative survey of the nation based on selected sample of households. Households are interviewed based on uniform procedures that provide reliable data on individual units to study. The victim survey asks households whether they became a victim of crime or not (2008, p.155). The NCVS survey provides information on crimes which may not be known by the police. In fact, the victim survey has the potential to collect the data on victims as well as offenders and incidents. Limitations also exist in the NVCS at different levels. All crimes cannot be measured in the NCVS since interviews are selected based on a sample of the population. The NCVS excludes many types of crime in its survey which produces a validity problem. Specifically, business and commercial crimes cannot be counted in NCVS since the counted victims are only the householders. Homeless victims are not counted in this context either. Victimless crimes, such as drug sale, may not be measured via the NCVS to their true extent, either.

The NCVS collects data by asking for information limited to the last six month of period. This may produce several shortcomings and reliability problems. Recalling problems, such as forward and backward telescoping, are some of these main concerns. Counting or reporting a series of victimizations may also be another difficulty of the NCVS. Finally, the NCVS underestimates offenders' and victims' recognition because they may know each other. This may produce reliability issues; for example, domestic problems, sex offenses and similar private matters may not be adequately counted in the NCVS in this manner. The NVCS revised the survey starting from the 1990s in order to respond to and address criticism directed at the former NCV Surveys. Researchers (Lauritse, 2005; Cantor and Lynch, 2005) still examine these changes to understand their affects (cited by Maxfield and Babbie, 2008, p. 157).

### **The NCVS and Crimes Known To the Police**

It may advance the understanding of the NCVS and the UCR data to know how differences, strengths and weaknesses compare to each other. The UCR program provides summary based measures on aggregate units while the NCVS provides disaggregated data of individual victims, offenders, and incidents (Maxfield and Babbie, 2008, p. 160).

Although the NCVS provides national estimations based on a nationwide sample, this sample does not represent localities. In other words, "it is not possible to use survey data to study victimizations at the local level, because the National Crime Victimization survey is just that: a *national* survey" (Maxfield & Babbie, 2008, p. 161). Specifically, the NCVS is unable to present statistically reliable crime estimations for most cities, counties, or states. Maltz's (1999) statement confirms this reality by clarifying that 10 largest states' victimizations can be estimated by use of the NCVS.

The NCVS survey has limitations because it cannot cover victimizations under the age of 12. Specifically, collecting data on domestic violence, child abuse and similar crimes may be difficult in the NCVS because of its household based design (Maxfield & Babbie, 2008, p. 161).

Although the NIBRS is not still widespread in most states, it has a very large database potential to enable examinations on specific geographies at the local and state levels. In fact, the NIBRS complements the NCVS by providing incident based disaggregated reports for localities and states, including crime reports against children under 12 (Maxfield & Babbie, 2008).

Comparing the UCR data with the NVCS data is not advised in studies by the FBI because applied methodologies and crime coverage have differences at the nation's two crime measures (Bureau of Justice Statistics, 2004). Procedural and definitional differences are considerable and they may produce discrepancies. In particular, the police collect data as reported crimes to police, while the NCVS collects data both on reported and unreported crimes. Additionally, crime rates are calculated in different scales within both programs. Specifically, crime rates are calculated per 1,000 households in the NCVS, and per 100,000 inhabitants in the UCR program. The NCVS estimates the crimes based on a sample of interviewed people that is subject to error. However, the UCR relies on actual counts of official reported crimes (Bureau of Justice Statistics, 2004).

#### **2.9.4. Self-Report Surveys**

Alternative measures of crime may be collected for specific research and policy purposes. Self-Report Surveys are mainly used by researchers to collect data in order to learning about committed crimes. In other words, “self-report data measures of crime provide valuable



information that is not available through other measures” (Mosher et al., 2002, p.131). Although some self-report studies collect nationwide data on youth (Albanese, 2005, p.75), these studies have not been able to collect systematic nationwide data in most crime categories (Maxfield et al., 2008, p.162).

All crimes require offenders but may not have clearly identified victims. Additionally, all crimes are not observed by police, witnesses or victims. Self-reports are mainly supposed to measure offenders. In practice, people may not be responsive in the case of crimes that they have committed. However, some may want to report or even exaggerate the number of offenses that they have committed.

According to Mosher (2002), self-report surveys are complementary instruments attempting to measure poorly represented crimes. These crimes may be public order crimes, delinquencies, prostitution, drug use, shoplifting and drunk driving. Limitations also exist in self-report studies. Researchers and other self-report users should be critical while using them. Specifically, their specifications in regards to strengths and weaknesses must be known adequately and need to be approximated as much as possible to provide ideal “methods, sampling and instruments” (Mosher et al., 2002 p. 132). Overall it can be summarized that:

*“Of the methods of counting crime examined here, the accuracy of police statistics on reported crimes is far less likely to be challenged in mass media stories, academic research, and general public discourse than either self report or victimization results. In fact, through their connection with the FBI, UCR data have a unique aura of legitimacy that furthers their immunity to widespread immunity to widespread scrutiny. Even when the shortcomings of police are identified in media or academic accounts, UCR data are still treated as “objective” measures of the extent of crime. By identifying the various classification and counting problems with UCR data and their susceptibility to political manipulation and distortion, we hope our efforts help curtail uncritical acceptance of police statistics as an accurate measure of the extent and distribution of crime “. (Mosher et al, 2002, p. 190)*

A presentation of the major crime measurements in major categories may provide more clarity:

**Table 5: The Crime Measurements**

<b>Known To Police</b>	<b>Units</b>	<b>Target Population</b>	<b>Crime Coverage</b>
<b>UCR</b>	Aggregate: Reporting agency	All law enforcement, Agencies; 98% reporting	Limited number of reported and recorded crimes
<b>SHR</b>	Incident	All law enforcement, Agencies; 98% reporting	Homicide Only
<b>NIBRS</b>	Incident	All law enforcement, Limited reporting	Extensive
<b>NCVS</b>	Victimization, Individuals and, Households	Individuals in households	Households and Personal crime

The table was adopted from a study by Maxfield & Babbie (2008, p. 172).

## CHAPTER 3

### Policing in the United States

#### 3.1. Introduction

The deterrence theory which refers briefly to fear of punishment under the criminal law is linked to the rate of crime (Shinnar & Shinnar, 1975; Levitt & Lochner, 2000; Witte & Witt, 2000; Vollaard, 2005). Becker's (1968) path breaking economic model of crime helps to explain the effects of incentives for criminal actions. According to Freeman (1999), labor market activities, sanctions, incarceration and risk of being apprehended influence decision making to commit crime. This study mainly considers the policing dimension of the criminal decision. The examination of the relation between policing and crime level is continual (Ehrlich, 1973; Wilson & Boland, 1977; Marvell & Moody, 1996; Vollaard, 2005). Although the efficacy of police in reducing crime has been questioned for a period of time in previous research (Hirschi & Gottfredson, 1993; Bayley, 1995), former studies were found to be biased because of specification problems (Marvell & Moody, 1996). Rather, the effect of police on most crime types is indicated as 'substantial' (Marvell & Moody, 1996). The effect of police on reducing crime has been touted as more obvious in recent researches (Gallo, 1998; Eck and Maguire, 2000; Levitt, 2004; Weisburd & Eck, 2004; Braga & Weisburd, 2006). In this chapter, the evolution of policing in the U.S. is reviewed in the initial part. Respectively; effect of policing in reducing crime and the introduction of recent policing innovations are presented. All of these aim to lay the foundation to measure the impact of geographical information systems (GIS) on police performance in the U.S. police agencies.

Policing is a dynamic service delivery provided to enforce the law and keep the order in an area via law enforcement agencies (Skogan & Frydl, 2004). The police service may be

delivered via either centralized or decentralized police agencies of an area. For example, one centralized police organization, the Turkish National Police, serves mainly the Turkish Society in urbanized areas; and another centralized police agency, Gendarmerie, serves in rural areas (Haberfeld & Cerrah, 2007). Conversely, numerous decentralized police agencies serve in states and local governments of the U.S. (Wilson, 1972; Miller, 1977; Skogan & Frydl, 2004). In centralized policing, police innovations can be easily applied uniformly across the all city agencies when a pilot application becomes successful. For example, Mobile Electronic Systems Integration (MOBESE<sup>4</sup>) is a recent and costly police innovation in Turkey that has been applied countrywide by central government because it was perceived as successful in reducing crime and fear of crime in Istanbul (Demirci, 2003). Differently, there may be a rich variety of police innovations' applications across the U.S. because decentralized police agencies are open to influences of different forms of governments and communities (Reisig & Correia, 1997). In this regard, the comparison of diverse police service deliveries among U.S. localities may provide a clear picture of the contribution of policing innovations on crime levels.

The comparisons of multiple organizations or the same organization for different time periods are essential to “understanding social science explanations” (Maguire & Uchida, 2000, p.514). According to their (2000) study, differences among police organizations can be explained significantly by using 14 variables. These are (1) organizational size, (2) city governance, (3) region, (4) concentration, (5) crime patterns, (6) organizational age, (7) political culture, (8) population size, (9) population heterogeneity, (10) poverty/income, (11) urbanization, (12) span of control or supervisory ratio, (13) time, and (14) vertical differentiation. All of these factors may not be influential on police organizations at the same time; however, these are frequently

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<sup>4</sup> The Mobese project is mainly an infrastructure which aims to maximize the efficiency and effectiveness of the law enforcement units (Cilingir & Kuschu, 2004, 4).

used as significant variables that are worth considering in studies depending on the focus area and based on the relevant theoretical grounds. Refining the listed 14 variables, Maguire and Uchida (2000) emphasize the consideration of at least organization size, region, form of city governance, and organizational age in organizational research on police (p.533).

Police agencies in the U.S. are empowered and managed by different forms of government administrations (Reisig & Correia, 1997; Stephens & Wikstrom, 2007). This status is articulated by Loader (2000) as: “We are living in the midst of a potentially far-reaching transformation in the means by which order and security are maintained in liberal democratic societies, one that is giving rise to the fragmentation and diversification of policing provision, and ushering in a plethora of agencies and agents, each with particular kinds of responsibility for the delivery of policing and security services and technologies” (323). Although this diversity may emerge as naturally advantageous as the result of the U.S. constitution, this fragmented structure also can limit “the ability of the federal government to spark innovation or encourage uniform and progressive police policies” (Skogan & Frydl, 2004, p. 2). For example, the varying distribution of the federal, state and local resources to police organizations may produce diverse results with respect to success of police innovations on crime. In this respect, the purpose of the study is to explore the impact of GIS use to local police agencies’ performance in regards to reducing crime rates. In the current study, use of GIS combines both GIS adoption and use of GIS in all levels of police agencies (Skogan & Hartnett, 2005). Before exploring the contribution of GIS use to police performance that is assumed to have an effect on crime rate, it is essential to review policing in the U.S.

This chapter describes policing in the U.S. in five sections to lay out the appropriate

focus. Additionally, the effect of police on reducing crime is discussed. Innovative policing strategies which show evidence of reducing crime, such as community policing and problem oriented policing, are explained in detail as the control variables of crime. Specifically, the first section introduces police organizations, the objectives of the police, and characteristics of police personnel. The second section narrates the evolution of policing between the 1890s and 1980s. The third section presents the types of police behavior and background of police innovations until the 1990s. The fourth section analyzes the policing innovations starting from the 1990s to date. The final section, 'police innovations,' set the main basis for the study to facilitate examination of the impact of GIS use in local police agencies toward reducing the crime rate between 2000 and 2007.

In detail, police organizations in the U.S. (Skogan & Frydl, 2004; Reiss, 1992; Loader, 2000; Reaves, 2007; Hickman & Reaves, 2006; Helsley & Strange, 2004; Skogan, 2008), the objectives of the police (Fogelson, 1977; Cordner & Hale, 1992; Goldstein, 1979; Richardson, 1980; Manning, 1978; Goldstein, 1977; Sherman, 1980; Wilson, 1972; Cordner & Hale, 1992; Sherman, 1980), two cultures of the police as operation and administration (Holdaway, 1977; Cordner & Hale, 1992; Reuss-Ianni, 1993; Manning, 2001; Manning, 1978; Skogan & Frydl, 2004), the evolution of policing between the 1890s and 1980s (Monkkonen, 1992; White, 2007; Miller, 1977; Walker & Kartz, 2002; Fogelson, 1977; Uchida, 2004; Kellinbg & Moore, 1988; Stevens, 2008), the types of police behavior (Wilson, 1972; Langworthy, 1985; Slovak, 1986; Skogan, 1976; Wilson & Boland, 1977; Crank, 1990; Sampson & Cohen 1988; Sherman, 1993; Skolnick & Bayley, 1988), the background of the police with respect to innovations (Skolnick, 1988; Weisburd, Uchida, 1993; Packer, 1964; Eck, 1993; Manning, 1978; Reppetto, 1976; Richardson, 1980; Weisburd et al 1993; Skogan & Frydl, 2004; Braga & Weisburd, 2006; White,

2007; Kelling & Wycoff, 2002; Ryan, 2003; Bayley, 2008; Stevens, 2008), the inefficiencies and overestimations in traditional policing strategies (Eck & Spelman, 1986; Hirschi & Gottfredson, 1993; Greenwood & Petersilia, 1975; Greenwood, Petersilia & Chaiken, 1976; Eck, 1983; Skogan & Antunes, 1979; Loftin & McDowall, 1982), emerging police innovations (Skolnick & Bayley 1988; Sherman 1993; Weisburd & Eck 2004; Skogan & Frydl, 2004; Bayley, 2008; Weisburd & Braga, 2006; Bayley, 2008; Mazeika, 2008) and their effectiveness as explanation for the crime drop in the 1990s (Bratton 1999; Blumstein & Wallman 2000; Eck & Maguire 2000; Kelling & Sousa 2001; Goldstein, 2002; Skogan & Frydl, 2004; Bayley, 2008; Braga & Weisburd 2006) are presented as a review of the relevant literature.

### **3.2. Police Organizations in the U.S.**

The responsibility of police areas is mainly divided among federal, state and local governments (Skogan & Frydl, 2004; Reiss, 1992; Loader, 2000; Reaves, 2007). Federal level police service delivery is held by 69 law enforcement agencies (Skogan & Frydl, 2004); however, their responsibilities are very specific. Because of their heterogeneity in scope, such as the Customs Bureau, Immigration and Naturalization Service and FBI, this study excludes Federal level law enforcement agencies. Besides, there are many different types of police agencies across the states and localities of the U.S. (Hickman & Reaves, 2006; Skogan & Frydl, 2004; Shearing 1992; Strange, 2004). These are categorized from sheriff departments to police departments in addition to municipal police, primary state agencies, tribal police and regional police according to the Law Enforcement Management and Administrative Statistics (LEMAS) (Hickman & Reaves, 2006). As of 2000, 955 large law enforcement agencies which have 100 or more sworn officers were examined with the response rate of 94.7%, according to the LEMAS

dataset. Among these large police agencies, 65% of them (574) were local police departments, 35% of them (332) were sheriff departments and 5% of them (49) were primary state law enforcement agencies. According to The National Research Council, state law enforcement agencies are divided into two servicing categories (Skogan & Frydl, 2004, p. 49). Around half of the state agencies are held responsible primarily for traffic enforcement and others are held responsible for general law enforcement services. Special district authorities also provide independent/semi-independent policing services, such as tribal policing agencies, special district police, public school systems, transportation systems, and campus law enforcement agencies (2004, p. 50-51). These special districts may also have specialized areas with limited responsibilities. There are also private policing organizations more apt to servicing the market which were studied by Shearing (1992) and recently by Helsley and Strange (2004); however, this aspect of policing is not in the scope of the current study. Therefore, this study narrows its scope to local law enforcement agencies (cities and counties) in order to have more homogeneous units to study.

Local governments deliver the bulk of the policing service in the U.S. (Reiss, 1992; Loader, 2000). In 1988, 77% of the 784,371 police protection employees were provided by local governments (Reiss, 1992, 62). In 2004, there were 17,876 state and local law enforcement agencies of which 12,766 (71%) were local police departments, according to the Census of State and Local Law Enforcement Agencies (Reaves, 2007). In particular, local law enforcement agencies enforce laws, maintain order, and provide miscellaneous services on a daily basis (Skogan & Frydl, 2004).

The greatest control of local law enforcement agencies is held via local governments



(Skogan & Frydl, 2004; United Nations, 2006; Skogan 2008; Reiss, 1992; Reynolds, 1999; Skogan, 2008). Policy guidance, budgetary support and election of police executives are some of tools of this control. The police management is accepted under the sphere of the state and local governments. Their policy guidelines are released by their legislatives and applied via elected and assigned authorities. This may bring an impact on the politics and management of the police. For example, changes in chief officials of the police can largely impact the use of policing innovations (Skogan, 2008). In particular, the chief local government officer, which may be a mayor, city manager or elected council member, is held responsible for the police operations of the agency (United Nations, 2006; Skogan 2008). And, the police chiefs are appointed or elected (as sheriffs) by local governments depending on the community (Reiss, 1992; Reynolds, 1999; Skogan & Frydl, 2004).

### **3.3. Objectives of the Police**

Studying policing is not an easy process because its meaning has changed over time (Skogan & Frydl, 2004; Fogelson, 1977; Cordner & Hale, 1992; Goldstein, 1979; Richardson, 1980; Manning, 1978; Goldstein, 1977). The term, 'police', represents multiple objectives which complicates its definition and its measurement (Skogan & Frydl, 2004). This is described by Skogan (1979) as: "the police perform multiple tasks and pursue multiple goals." In fact, to protect, serve, enforce the law and maintain the order is some of its well known short objectives (Fogelson, 1977) that involve its conflictive nature (Cordner & Hale, 1992). For example, policing has a conflicting responsibility in a community where it is supposed to protect the order and individual liberties as public values at the same time (Moore, 1995). In a wider concept, the objective of policing is identified as to prevent and control misconduct, which is recognized as

threatening to life and property (Goldstein, 1977; p. 35). In fact, police goals and functions were frequently questioned (Goldstein, 1979; Richardson, 1980) and interpreted in different ways (Fogelson, 1977; Manning, 1978). Skogan and Frydl (2004) also question the arguable role of police by saying: “What maintaining order might encompass!”

According to Manning (1978), the police are assigned with the task of preventing and detecting crime, and the apprehension of criminals. He thinks that the police are supposed to stake out “a vast and unmanageable social domain” (191) relying on discretion and control. Considering occupational culture, the police are expected to develop strategies and tactics to fulfill their task within the legal framework. Strategies are described as the means of police to cope with the persistent problems of society and exercise control. Allocations of resources, behaviors and pronouncements of police organizations are some of these strategies (Manning, 1978). Tactics are defined as “the means by which strategy is implemented” by Manning (1978). Comparatively, strategies are defined as general forms of actions where tactics refer to specific steps or actions to achieve desired goals in policing. Simply, policing activities are compiled as uniformed patrol, traffic control, crime prevention; investigation and information process (Skogan & Frydl, 2004).

However, the police mission is not clear. If the satisfaction of the public is intended as the task of the police with the aim of crime control, this could be fraught with difficulties because of the social organization of the communities (Manning, 1978; 98). Accordingly, the claim of controlling the social process that “beget the illegal acts” was an impossible task. Manning’s (1978) position is clear in stating that the police mandate is full of contradictions. These contradictions enclose the complex nature of law and order, police discretion, arguments in law

enforcement versus peace keeping policing functions, and apolitical locally controlled agencies. As organizational actors, police administrators and operative street officers can also perceive their objectives differently (Cordner & Hale, 1992). Even residents of different communities (Sherman, 2002) can perceive the objectives of the police in dissimilar ways. In summary, vagueness, conflicting objectives, lack of consensus in organizational environmental factors and competing interests of pluralistic society members produce a slippery ground on which to comprehend and measure the performance of police (Wilson, 1972; Cordner & Hale, 1992; Loader, 2000).

### **3.4. Two Cultures of the Police**

It is also important to indicate that police service delivery has two main perspectives as operations and administration levels (Holdaway, 1977; Reuss-Ianni, 1993; Cordner & Hale, 1992). This produces tension (Manning, 2001) and leaves wide room for discretionary decisions (Manning, 1978; Skogan & Frydl, 2004). Two cultures of policing, a street cop culture and management cop culture, were shed light on by Reuss-Ianni (1993). This is “characterized by competing and often conflicting perspectives on procedure and practice in policing”. Reuss-Ianni suggests (1993) that the management cop is more sensitive to politics and public opinion, whereas, the street cop still have old ways of doing things. In ‘What works in policing?’ policing as operations and administration was examined by Cordner and Hale in 1992. In that study (1992), a police operation is defined as “aspects of policing that involve delivery of services to the public”. And police administration is defined as “administrative activities crucial to successful police performance, despite the fact that they do not include direct service delivery to

the public” (1992, 85). The determination of the two cultures in policing is important because the assumption of policing as one culture may be prevalent, which is not the case most of the time.

The typology of police officers may be diverse and it has been explained by several studies (O’Neill, 1974; Muir, 1979; Hochstedler, 1981; Wexler, 1985). O’Neil, (1974) examined 187 police officers from Oakland, California to understand the typology of police roles based on officers’ discretionary actions. The study found that the “formation of police role expectations appears to be a function of communication and interaction among peer groups”. Muir (1979) indicates four characteristics as typology of police officers: appealing, intuitive, logical and undeniable. These all were assumed to rely on perspective and passion dimensions. Hochstedler (1981) tested Muir’s typologies and their dimensions. Hochstedler (1981) finds that these typologies cannot be confirmed in his method and two dimensions cannot represent empirically all issues at once. Wexler (1985) studied women patrol officers’ relationship with male officers to understand how women officers would cope with the conflictive nature of gender and occupational responsibilities. In the study, four styles were identified for the women officers: neutral-impersonal, semi masculine, feminine, and mixed. Each technique was emphasized based on assigned priorities. Overall, women officers did not indicate any specific attachment to the proposed styles in the study.

The tension between managerial and operational levels was analyzed by Manning (2001). Manning (2001) thinks that the tension reflects the contradictions of “the paramilitary imagery, wide latitude to make unreviewed decisions, high ecological dispersion single units, and evidence of the rather creative, subtle management by officers of police-police and police – public interactions.” Manning’s study (2001) reveals that the operational level officers have high discretion as a result of working away from the command center. This all shows that a

monolithic view of police may be misleading (Hassel, 2006.) In fact, both the police administration and officers have some discretion in how to apply existing laws (Wilson, 1972; Wilson, 1986; Slovak, 1986; Weisburd and Craig, 1993; Eck, 1993; Kelling & Wycoff, 2002). According to Manning (1978), the policy of administrative police “may prescribe that the patrolman overlook certain types of illegal acts... minimally enforce particular laws or be sensitive to and strictly enforce others” (113). Noticeably, the patrolman is described as the “lowest man in the hierarchy ... the key position of exercising the greatest amount of discretion” (Manning, 1978, p.111). The National Research Council (Skogan & Frydl, 2004) indicates that unsupervised discretion can result in difficulties in ensuring fair and effective policing service delivery. Therefore, the current study will consider the existence of managerial and operational perspectives of the police to interpret findings.

### **3.5. History of Policing in the U.S.**

Describing policing history with empirical knowledge can provide a deeper and common background (Monkkonen, 1992). Several scholars have addressed policing history with different perspectives (Miller, 1977; Fogelson, 1977; Goldstein, 1979; Moore & Trojanowicz, 1988; Kelling & Moore 1988; Reiss, 1992; Reynolds, 1999). Notably, three policing eras categorized by Kelling and Moore (1988) have been frequently used as the paradigms of recent policing studies (Williams & Murphy, 1990; Bazemore & Griffiths, 2003; Oliver, 2006; Bayley, 2008; White, 2007, Stevens, 2008). Recently, Stevens (2008) attempted to adopt a fourth era to these paradigms. In this sense, this section narrates the general history of policing in the U.S. between the 1830s and 1980s.

“Evolving Strategy of Policing” is a historical study of American policing in the twentieth century (Kelling and Moore, 1988). In this interpretive reading, policing history is examined within three main eras by use of the corporate strategy methodology (p.2). These eras are classified as the political era (from the 1840s to early 1900s), the reform era (1900s to 1970s) and the community problem solving area (1970s to 1988). Each policing era was analyzed through the lenses of authorization, function, organizational design, relationship to environment, demand, tactics and technology and outcome as measures throughout the study. According to Williams and Murphy (1990), “(t)his attempt to create paradigms (referring to Kelling & Moore,1988), as with all such attempts, should be seen metaphorically, providing us with ways to crystallize the complexities of history in simplified terms. Seen in this way, their analysis provides useful insights and a clearer interpretation of the changing role of police in American society-at least with respect to the majority in that society”. The same authors (1990) also criticized the study of Kelling and Moore, (1988) saying that the utility of this analysis may be quite limited to the extent of blacks and other minorities focused researches. More details can be found about Kelling and Moore’s (1988) “Evolving Strategy of Policing” study in the notes<sup>i</sup> section.

Stevens (2008) proclaims the fourth era of policing in addition to Kelling and Moore’s three eras. Accordingly, the fourth era which is called the quality of life, starts from the 1990s and continues to present times. In his evaluation, leadership in this era is seen as decisive and there is managerial accountability. Specifically, public spaces are controlled and the police make detective, proactive arrests to prevent and control serious crime. As regards organizational design, the hierarchy of command is reduced and the span of control is expanded. The relation to the community is minimized; conversely, communication with private, local, and federal security

departments is increased. The pro-arrest policy, swiping loitering areas, surveillance, tactic units, computers and communication are frequently applied. Lower crime rates, higher arrest rates, resident and officer satisfaction and order in public spaces are targeted. In this era, crime rates drop; managers and officers are professionally trained. As a result more police power is expected while less community participation is desired.

In order to review essential points in the U.S. police system, this section narrates the history of urban policing in the nineteenth century (Monkkonen,1992), the establishment of British and U.S. professional police service (White, 2007), the differences between British and U.S. policing (Miller, 1977), political influences on policing at the end of the nineteenth century (Walker & Kartz, 2002), and progressives' and police intellectuals' efforts for police professionalism (Fogelson, 1977; Monkkonen, 1992; Uchida, 2004;White, 2007).

The 'History of Urban Police' in the nineteenth century is portrayed by Monkkonen (1992). He expresses that the U.S. Constitution did not mention the police, but the police forms were already in effect as night watches and constables in the nineteenth century back in the time of Shakespeare's writings. At this time, constables represented responsible police to civil and criminal courts. And, night watch servicing was recognized as an alarming task undertaken by select people in case of an offense or fire. Four innovations are attributed to the mid 1800's by Monkkonen (1992) as the changing powers of the nature of the policing service. These are addressed as (1) the move to the hierarchical organization of policing similar to the military with a strong command and communication structure; (2) functional differentiation; (3) uniformed service; and (4) regularized salaries. Skogan & Frydl (2004) state that "public policing as we

know it was invented only about a century and a half ago, and prior to that time, enforcement of criminal laws lay in the hands of private parties” (56).

Although some scholars have mentioned that the Bow street runners were the first professional police force of London (Critchley, 1967; Tobias, 1979; Newman, 1972), the establishment of the metropolitan police of London in 1829 has been considered precedent to the U.S. professional police in several studies (Miller, 1977; Kelling & Moore, 1988; Monkkonen 1992; Reynolds, 1999; White, 2007). Similar to England, large cities in the U.S. felt the necessity to have a full-time professional police force when urbanization and industrialization caused new problems (White, 2007). After visiting the London police, the New York City officials established the first formal police department in 1845 (Miller, 1975). Other large cities such as Boston, Chicago and Philadelphia followed the trend (White, 2007, 70). Reynolds (1999) recognizes Philadelphia police as the first British model example as of 1833, then Boston Police in 1838 and New York Police six years later. He (1999) also notes that “all of the nation’s largest cities had adopted the model of full time police departments” by the 1870s (Klockars, 1980).

Although the establishment of the U.S. professional police forces followed the British Metropolitan Police, there were noticeable differences between them. Miller (1977) illustrates these differences under five major points for the period of 1830-1870s. First of all, the British police were representatives of the institutional authority, the Crown, whereas, the U.S. police represented local authorities relying on their individual authority. Secondly, the London police was a highly centralized organization relying on headquarters’ decision making, while the New York police was a highly decentralized organization relying on precincts’ operations. Thirdly, the London police was able to stay away mostly from the influence of politics because of its



strong links with the national government. Conversely, the U.S. Police was very open to local political influences. Fourthly, the British police did not provide firearms to its police. In contrast, the police was armed with fire guns in the U.S. Finally, the London Police sought to control police discretion and decision making whereas the U.S. police had tremendous discretion in the performance of its duties (Miller, 1977; Kelling & Wycoff, 2002).

According to Walker and Katz (2002), “politics influenced every aspect of American policing in the nineteenth century and inefficiency, corruption and lack of professionalism were the chief results.” Furthermore, the intention for employment of new full time police was to neutralize the police in politics (Reynolds, 1999). Professional policing was more arguable at that time because police officers were selected based on political connections (Walker & Katz, 2002) instead of out of a consideration for professional standards such as education, health or moral codes (White, 2007). Interestingly, a person could be a police officer in New York and Chicago by paying money in the late nineteenth century (Reynolds, 1999). Monkkonen (1992) summarizes the general picture of the late nineteenth century that the police were seen as “civil servants of general resorts.”

Two reform movements are recognized in policing between the 1890s and 1970s by Fogelson<sup>5</sup> (1977). According to his evaluation, the first reform movement took place from the 1890s through 1930s that was initiated with homogenous commercial, civic and religious groups. The second term was led by the more heterogeneous intellectuals as law enforcement leaders

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<sup>5</sup> Fogelson (1977) describes the details of reforms and changes in policing in the study titled “Big City Police.”

Please see notes section<sup>5</sup> for further details.

from the 1930s to the 1970s. In fact, emerging police scandals that discredited politicians provided an adequate opportunity to initiate reorganization of the police, a reform into professional forces (Fogelson, 1977). According to Reynolds (1999), the first reform movement can be defined as militarization and the second is professionalization (13). In general, the first reform effort is credited to the ‘progressives’ to isolate the government free from politics (Fogelson, 1977; Uchida, 2004). Reynolds (1999) states: “The primary task of American police administrators during the first half century of policing was to gain as much control of the police organization as from the control of politicians”(14). But the first reform effort was identified as a failure in forty years by Fogelson (1977). Uchida (2004) confirms by saying that “(s)eparating the police completely from politics could not take place” (18).

The second reform effort came from a small group of police intellectuals led by August Vollmer, and initiated more organized modern professional police efforts in the 1930s (Uchida, 2004; White, 2007, p. 75). According to Walker (2008), Vollmer garnered national applause when he transformed the California police department between 1905 and 1925. In this duration, he advocated the employment of middle class graduates instead of the working class. In addition to hiring strategies, Vollmer also supported a variety of technological innovations utilized in the police, such as bicycles, motorcycles, automobiles and fingerprinting (330). O.W. Wilson, who was an early proponent of crime prevention, also articulated the idea of using motorized patrol in the police. According to Walker (2008), O.W. Wilson made vehicular patrol and rapid response to service calls a central concept of the police management theory. Although the views of police officials, Vollmer and Wilson, were contradictory at some points (Reynolds, 1999), the police intellectuals’ efforts were more successful than those of the progressives’ (Uchida, 2004). In

summary, the police intellectuals can be defined as being more autonomous from politics than progressives and they became more influential on professional policing efforts after the 1920s. Reiss (1992) identifies police professionalization, in other words, the reform era defined by Kellings and Moore as “the centralization of command and control in a police bureaucracy.” Despite some continuity with past forms and functions, the police organization in the twentieth century has evolved in response to changes in technology, social organization, and political governance at all levels of society. Major developments in police organization have occurred in the areas of command organization and mobilization of patrol officers, the organization and work of patrol officers, and the access and use of information systems by all levels of personnel (Reiss, 1992).

In these years, technological changes also promoted police reforms toward professionalism. Use of the “patrol car, two-way radio, and telephone altered the way in which the police operated and the manner in which citizens made use of the police” (Uchida, 2004, p. 20-21). According to White, 2007, “(t)he reforms of these police leaders were facilitated by technological advances that helped shape the professional model of policing. Three innovations, in particular, came together to lay the foundation for the reactive, incident driven style of policing” (p. 74). These are identified as the inventions of telephone, automobile, and two way radios in the 1930s. According to Manning (2003), the car and driver were seen as “the center of the complex symbolism of policing since American policing became motorized in the 1920s” (110). Manning also indicates the effect of other technology such as uniforms and equipment on the police culture. Walker (2008) emphasizes August Vollmer’s quote that “ideas about technology contributed to significant transformation of police practice” (331). In fact, the realization of these technological suggestions by O.W. Wilson shifted the community oriented

foot patrols away and headed toward “roving, rapid response vehicular patrols” (331). These technologies were described as contributive and shaped the police practice (Fogelson, 1977; Manning, 2003; Uchida, 2004; White, 2007; Walker, 2008), as well as remained static as the dominant tools of policing until the 1960s.

Professionalization has different effects on policing (White, 1972; Holdaway, 1977) for managers (Reynolds, 1999), practitioners (O’Neill, 1974; Muir, 1979; Hochstedler, 1981; Wexler, 1985). It is neither easy to know what to expect from professionalized police officers nor to measure a professionalism success at this concept. She (1972) concludes her study by saying that professionalization takes various operationalized meanings depending on the role of police. This implies that more than one model of policing can take place in police organizations. The effects of professionalization in the police were examined also by Holdaway (1977). In this study, the professionalism of British police was considered within two titles: ‘managerial professionalism,’ referring to supervisory officers and ‘practical professionalism,’ referring to the workforce. It was found in the study that occupational values are dominant factors when compared to police professional services.

A four year degree education was suggested as a requirement for all new chiefs of police in 1976 by the Police Chief Executive Committee (Reynolds, 1999, p. 61); however, the implementation is taking time. In this regard, a professional profile of police administrators was examined by Reynolds (1999) in Virginia. Reynolds (1999) suggests that the profession of police administration requires extensive education and often specialized training (8); and administrators were conceptually accepted as “a person who is expert at his or her work” (9). In the study, 136 police chiefs in the town, city and counties of Virginia were analyzed. This study revealed that 49% of chiefs qualify with high professionalism standards when education and experience are

considered. Today, the current level of professionalism in police administration can be assumed to be higher than those findings.

Although the quality of police in terms of structure, personnel and function depending on the size of the city were reorganized considerably during reforms, criticism increased in regard to police professionalism in the 1970s (Fogelson, 1977; Goldstein,1979). As said by Fogelson (1977; p.187), “The police could not alleviate poverty, stamp out prejudice, cure mental illness, care for neglected youngsters, and otherwise solve the social problems that gave rise to criminal activity. These were jobs for the families, churches, schools, hospitals, and other institutions”. Similarly, Stone, the director of the International City Managers Association (ICMA), reported that “the crime rate reflected not only the caliber of the prosecutors, courts, and other outfits besides the police, but also the impact of social economic and other changes over which the police had little or no control” (as cited by Fogelson, 1977, p.264). In 1978, Herman Goldstein released his study: ‘Improving Policing: A Problem-Oriented Approach’. Considering the professionalism movement, he stated that the police efforts exclusively focused on internal management constituted a minimal level of order and accountability of the agencies. He thinks that police reforms were focused extremely on means such as staffing, management and organization of agencies. His suggestion was that the police should target the ends not means of policing. In order to meet this need, the development of a more systematic process was recommended by Goldstein:

*“Perhaps the closest police agencies have come to developing a system for addressing substantive problems has been their work in crime analysis. Police routinely analyze information on reported crimes to identify patterns of criminal conduct, with the goal of enabling operating personnel to apprehend specific offenders or develop strategies to prevent similar offenses from occurrence”* (Goldstein, 1979, p. 243).

Goldstein's emphasis on the importance of crime analysis lies in parallel with this dissertation's objective of exploring the impact of GIS use on the efficacy of police.

### **3.6. Effects of Environmental and Organizational Variables on Varieties of Police Behavior**

While measuring the effects of policing on crime, it is essential to know the nature of police behavior and factors affecting policing in the U.S. The researches on policing have explored a variety of police behaviors in cities (Wilson,1968); the effect of political culture on police styles (Wilson & Boland,1977; Langworthy,1985); the organizational and environmental factors influencing policing (Slovak, 1986); the efficiency and effectiveness factors of big city police departments (Skogan,1976), the effects of organizational and environmental factors on police styles (Crank, 1990); and the effect of community characteristics on the police (Wells, Falcone & Rabe-Hemp, 2001). All of these researches have contributed to identifying the determinants of police behaviors (Sherman, 1980) and provided explanations to various police behaviors in different situations (Hochstedler, 1981).

The term 'varieties of police behavior' was initially used by James Q. Wilson in 1968. Considering the diverse ways of police response to discretionary situations, Wilson (1968) examines the general typology of police styles. In his study, the policing style is posited as an organizational phenomenon, not an individual one. In particular, three policing approaches are suggested as service oriented, legalistic, and watchman-like policing to distinguish police departments. In this context, the police are identified as watchman-like departments when they deal with the serious requests as if they do order maintenance tasks rather than law enforcement. Secondly, the police are identified as legalistic departments, if they primarily focus on law enforcement "as if there were a single standard of community conduct" (1972, p.172). Finally,

some police organizations take the all requests as order maintenance and law enforcement seriously, but are less likely make arrests or impose formal sanctions. In this approach, the police agency produces appropriate services of policing that meet the demand. This type of policing is called a service oriented policing style. Additionally, Wilson identifies legalistic departments as proactive and watchmen-like departments as reactive agencies. He uses 'police aggressiveness' and 'substantive legalism' as measures to determine this distinction. In conclusion, a variety of police behaviors was found in U.S. cities. Names and definitions of these pattern behaviors were identified by the study. As a result of Wilson's study, the 'myth of police homogeneity' everywhere was exploded with these findings (as cited in Slovak, 1986). In summary, various policing behaviors to respond to different urban cultures' needs can be considered as the key message of Wilson's analysis.

Wilson and Boland (1977) examined the effect of political culture on policing. They operationalized 'professional' city manager, called 'reformed,' by including both council and manager forms of government. Other forms of government, e.g. the mayor, were considered nonprofessional management and these could not be measured adequately without using expensive opinion surveys. This operationalization could help to explain why some cities have an aggressive patrol strategy. In Wilson's former study (1968), a higher arrest rate had been found under professionally managed cities. In this study (1978), both the number of cars and the political culture are found to be significant variables in the explanation of high rate ticketing. An increase in the number of police and aggressive policing strategy would be seen at the implementation of these reformed forms of government. In summary, a combination of the enhanced police number and aggressiveness strategy resulted in more arrests that led to reduced robbery rates (Wilson & Boland, 1977). Langworthy (1985) replicated Wilson's police behavior

study. Findings show evidence of existing diverse police behaviors which are constrained by the political culture. His study confirms the empirical findings of Wilson and indicates that Wilson's approach is a central tendency theory. The findings of these studies (Wilson, 1968; Wilson & Boland, 1977; Langworthy, 1985) indicate that political culture as a form of government must be considered as an explanatory variable while explaining crime rates in cities. Therefore, the current study needs to consider the form of governments as a significant variable to control the effects of the political culture on police.

The study of 'varieties of police behavior' also became the focus of Jeffery S. Slovak's study, 'Styles of Urban Policing,' in 1986. The purpose of the study was mainly to examine the police styles in Elyria, Columbia, and Newark in terms of organization and environment. In his study, police styles were defined as "sets of activities patterned by force common to the otherwise varied individuals who engage in them" (1986, p.64). Specifically, "police style is conceptualized as at least "(1) a behavioral pattern that is (2) totally or nearly so, and (3) that is characteristic among aggregates of police officers" (p.108). Slovak (1986) hypothesizes that "a more legalistic form of policing are registered in cities administered by appointed city managers rather than elected mayors" (132). Less aggressive policing like the watchman style is supposed to be administered under an elected mayor since the police executive is directly appointed by the mayor. Slovak also notes that there may be some conflicts between individual officers and the police administrators. He assumes that these conflicts are resolved "in favor of the demands of the police hierarchy" (109). As Hirschman stated in 1970, the police are supposed to remain more loyal to superiors than to the voices of protesters. Slovak also enlightens Wilson's statement: "(t)o the extend the administrator can influence the discretion of his men, he does so



by allowing them to ignore many common minor violations... to use the law more as a means of maintaining order than of regulating conduct..” (1972; p. 40).

Slovak’s (1986) study confirms Wilson’s finding that “the style of the police work varies from one city to the next [but it also reveals] that police styles vary somewhat within a given city as well, depending on the kind of neighborhood—downtown, business or residential—in which they are enacted” (1986, p.2005). These findings are also confirmed by Sherman (1986) in the study, 'Policing Communities: What works?' Specifically, six police agencies and a supervisory span of control are being mentioned as “prime movers” of police aggressiveness by Sherman (1986). Furthermore, the relations of police, city executives and the degree of civilianization of the police department are mentioned as players holding the same role in substantive police legalism (Slovak, 1986). Overall, organizational factors were found to be more important in producing a legalistic type of policing style on a sample of 42 sizable American cities. In this study (Slovak, 1986), the substantial importance of organization in addition to the environment emerges in the structuring patterns of local police actions.

The efficiency and effectiveness of big city police departments was examined by Skogan (1976). It was found in the study that some departments are more successful in converting crimes into arrests at lower costs. Noticeably, efficient departments were found also to be effective departments. Less effective departments were found to be inadequate in “engaging civilian skills, recruit minority personnel, employ sophisticated record keeping systems, and enjoy firm budgetary support” (285). Institutional support to police departments in terms of money and manpower also was found to be contributive to efficiency and effectiveness of the agencies. A large size police department also was found to be supportive in the case of provision of special

services and innovative policies that might provide more effective and efficient crime control. As a result, the institutional support, civilian personnel, sophisticated record keeping systems, budgetary support, and the size of police department can be considered contributive factors to measure efficiency and effectiveness in large police departments for major crime.

The effects of organizational and environmental factors on police style in urban and rural environments were examined by Crank (1990). The arrest rate was used with police discretion as the measure to identify police style in Illinois (Crank, 1990). Seven variables were utilized to explore environmental factors. These are racial cultural heterogeneity (operationalized as percentage of black, percentage of Hispanic, and foreign language); economic conditions (operationalized as per capita income and unemployment); and managerial style (operationalized use of contrast codes). Organizational factors were measured by use of four factors. In this study, police strength was calculated with the ratio of the number of full time police to the population. A multiple regression technique was used in order to examine the impact of organizational and environmental factors. Findings indicate considerable variety in urban and rural police styles. In rural communities, a higher arrest rate was associated with a higher percentage of blacks, per capita income and a city manager style of government. This implies that research of large metropolitan areas may be misleading if the study scope also involves changing the effects of rural departments without control. Thus, the current study focuses on only large police agencies which have more than 100 full time police officers and excludes rural areas in order to keep the homogeneity of the study.

In urban areas, higher arrest rates were associated with lower per capita income and foreign language usage at home (Crank, 1990). Increasing economic distress measured by unemployment was less associated with a legalistic type of policing. The most consistent

relationship found in the research is a positive relationship between the increase of the black population and increasing arrest rates. In fact, both Blacks and per capita income were found to be associated with police arrest rates. This indicates increasing social control role of the police in places where high levels of income inequality exists. A similar relationship was not captured for Hispanics in the study. Another parallel study on crime control efforts (Liska and Champlin 1984) finds that arrest rates reflect the economic and racial composition of the cities without depending on crime rates and police size. Therefore, the current study utilizes environmental and organizational factors such as race, poverty, managerial style of government, and police strength variables to control crime while measuring the impact of GIS utilization by the police.

The role of police in crime prevention naturally reflects the effect of community characteristics as well as its organizational culture. Community characteristics and organizational factors were examined with respect to their relevance to policing to understand the form and content of effective policing (Wells & Falcone & Rabe-Hemp, 2001). 194 suburban police departments of Chicago were surveyed and other relevant data was collected from governmental sources on communities. Multiple regression technique was used as statistical tool to evaluate relevant factors. The findings of the study (Wells et al., 2001) indicate that community context factors are more important than environmental and organizational factors in predicting how police departments are set up and operated. Organizational size was found to be the most significant single predictor on the operational style (Wells et al., 2001). Therefore, community size (as measured by population) and organization size (as measured by police strength) are used in the current study to control the variety of policing effects on crime.

### 3.7. How to Measure Police Behaviors?

Sherman (1980) found five determinants of police behaviors in his research. These are: (1) individual characteristics of police officers, (2) situational, (3) organizational, (4) community characteristics and (5) legal characteristics. The organizational level approach (Sherman, 1980) refers to the “attempts to explain rates of police behavior across either sub organizational units or entire police organizations” (70). The community level approach refers to the “attempts to explain rates of police behavior across municipal police departments with the characteristics of the communities they police, such as economic and demographic composition, political ethos, or structure of government”. In particular, Sherman (1980) suggests that “the community level of explanation should receive the most attention” (94) to explain police behavior. In fact, community level analysis is shown theoretically as the “most powerful level” which “is assumed to shape the casual factors at all of the other levels” by Sherman. As a macro level study, both organizational and community level characteristics may be considered as research perspectives for the current study. Specifically, the current study identifies police organizations as the units of analysis, and attempts to explain the contribution of GIS use in policing performance which is measured by crime rates in cities and counties of the U.S. Therefore, the study employs a community level approach which considers macro level determinants of the crime in large U.S. counties and cities between 2000 and 2007.

In the community level setting, the police are recognized as a formal social control mechanism influenced by several factors, such as community crime patterns and social disorder (Klinger, 1997; Klinger, 2004; Hassell, 2006). Klinger (1997) argues that these two factors are the causes of variance of police practices in different precincts by use of a negotiating order approach. Negotiated order (Strauss, 1978; Eisenberg & Riley, 1988) has been used in several

studies (Hogelucht & Geist, 1997; Owens & Sutton, 2001; Wolfe, 2002) and in policing (Klinger, 1997; Hassel, 2006) to comprehend relevant structural formal and informal factors. In his study, Klinger (1997) produces a casual model of policing to explain police patrol variations. This approach enables him to consider criminological, organizational and ecological factors at once. Klinger (1997) found that informal structure and police practices vary within this organization. There is also evidence showing interagency variations.

Similarly, Hassel's study (2006) focuses on the relationship between organizational, ecological and criminological factors to explore and examine their influences on police and patrol practices at the precinct level. Hassel (2006) benefits from interacting formal and informal structures that are supposed to constitute a social order via these new constructed meanings. Hassel's chemistry analogy explaining different emerging policing behaviors is noticeable. Naturally, a compound becomes a unique property when it combines two or more other elements. According to Hassel (2006), all mentioned levels of analysis – individual, situational, neighborhood, organizational and legal – are indicated as significant in affecting police practices (34). He says that the change in these structural level arrangements causes changes in policing practices. Relying on Follet (1918) and Fry's (1984) works, Hassel (2006) also indicates the groups' contributive role in constituting social order that cannot be achieved by individuals alone.

Similar to the negotiated order approach (Klinger, 1997), the information technology capacity (ITC) model (Kim & Bretschneider, 2004) (Further details of ITC can be seen in the methodology section) attempts to comprehend most relevant factors to better explain their contributions to the information technology capacity of an organization. This overall information technology capacity is supposed to make a contribution to the outcomes of the policing agency.

In fact, deployment and maintenance of GIS in an organization is a costly process awaiting support from organizational, ecological, and other factors such as political and social institutions. This support is also critical in maintaining adequate fund flow and to hire and train adequate human resources to adapt, operate, and develop applied GIS based systems adequately. This study is an attempt to explore the impact of the increasing use of GIS toward police performance. If the contribution of GIS can be determined, the findings can highlight the potential of GIS as a central tool in policing to interrelate organizational and ecological factors for a smoother policing process. Currently, the police administration, officers, political organizations and citizens have been benefiting mostly from the basic contribution of GIS. Its contribution to policing and to the community can vary based on its features' full utilization. These include using descriptive, analytical, and interactive capabilities of GIS in mapping (McEwen & Taxman, 1995). According to Klinger (2004), there is interplay of the police with other criminal justice actors such as corrections, environment and politics. He confirms the effects of both organizational and environmental forces on police behavior. In fact, Klinger (2004) found little evidence on which aspects have more of an effect on police practices. He concludes by saying that "In the empirical realm, the challenge is to develop and execute research plans that can both inductively inform the development of such theory and deductively test it. The opportunity is that such research holds great promise for increasing our understanding of policing as we move into the twenty-first century" (Klinger, 2004, p.133).

### **3.8. The Role of the Police in the Context of Police Innovations**

Before explaining the literature on efficacy of police innovations in reducing crime rates in the following section, it is important to portray the evolving role of the police towards police innovations. In general, the police are required to maintain order in a democratic society and to

consider legal norms (Skolnick, 1988). The balance of maintaining order versus legality has produced the so called crime control versus due process debate in the U.S. criminal justice system (Weisburd, Uchida, 1993). These two models can be summarized shortly as follows: the former emphasizes that the criminal justice system should stress on strict enforcement with the prosecution of the crime and the second model advocates limiting the span of the laws to focus on individual liberties (Packer, 1964). Packer (1964) suggests: “what we require is a set of criteria for distinguishing the "mandatory" uses of the criminal sanction from the "optional" ones” (p.67). This debate is dynamic and has become a fertile ground to bring better ways to the police for crime control efforts that are presented in the section below based on evidence and critiques of findings.

Although the democratic society fosters initiatives of individual and diverse groups, the police authority is supposed to be on top of the exercise of rights to maintain the order. The presence of power may result in tension between members of the society and the police. Some scholars consider this tension as a problem of the police (Skolnick, 1988; Weisburd, Uchida, 1993). This tension may be more evident and risky when the police needs to intervene in demonstrations to enforce current laws for the sake of order maintenance. In fact, the policing authority and its limits have produced concerns both in the streets and in the courts (Weisburd and Craig, 1993; Eck, 1993). Several scholars have questioned the control and limits of the U.S. police authority (Repetto, 1976; Weisburd et al 1993).

When institutions face problems or new ideas, they can innovate to improve their service (Braga and Weisburd, 2006). According to Braga and Weisburd (2006), race riots, Vietnam War oppositions, and the mistrust in the criminal justice system caused the crisis in policing. Hence,

they have led to police innovations. Both the 1967 President's Commission and The Kerney Commission report portrayed similar concerns on the community and policing interactions. At that time, the police were seen as the symbol of oppressive government (White, 2007; p.80). In fact, the civil rights movement, the opposition to the Vietnam War and the Black population's frustration due to the lack of economic opportunity—not the police—were mentioned as the causes of unrest in the 1960s (White, 2007).

However, the responsiveness of police was naturally considered “part of the problem” as noted by the Kerner Commission in 1968 (Weisburd et al., 1993; Braga & Weisburd, 2006; White, 2007). In other words (Kelling & Wycoff, 2002), “(w)hile few blamed the police for the social conditions that led to the riots, every major riot was triggered by police actions in minority communities” (26). Ryan (2003) believes that 911 emergency calls were so exhausting for the police in the 1960s that the police stayed mostly reactive and believed in its inability to respond adequately to all calls without having more police officers. In practice, the response of police to incidents became faster as the result of 911 instructions; however, the interaction of police with the community and the collected information from the community diminished (Fogelson, (1977). In fact, “(m)any of the problems that police encountered in 1960s developed from their [the police] alienation from minorities and the poor” (Weisburd et al., 1993). According to White (2007): “It was no longer enough merely to respond 911 calls for help by citizens, the police were expected to become partners in effort to rehabilitate urban communities” (1993, p.4). Therefore the frequent use of proactive police operations on minorities and the poor generated general resentment (Skogan & Frydl, 2004).

As a response to social movements, the Civil Rights Act of 1964 outlawed employment discrimination which changed the employment practices of law enforcement agencies (Skogan &



Frydl, 2004). Underemployment of Black officers was addressed by the President's Commission in 1967, as well as the Kerner Commission of 1968. In 1968, Indiana Police established patrol task force for full time women in the police force. Although the women's role was debated, Bloch and Anderson's study (1974) did not find significant differences between men and women police practice (as cited by Skogan & Frydl, 2004, p.79). In fact, "the increase in both women and minorities into American police agencies is entirely due to legal mandates in the form of affirmative-action" (Bayley, 2008). The decay in many inner cities was stated as another reason for the need for different types of policing considerations in some areas (Weisburd et al., 1993). Another reason for the emergence of police innovations can be credited to the increased amount of available resources to the police. According to Teichman (2005), dedicated resources to the criminal justice system more than quadrupled between 1982 and 2001 in the context of the escalating war against crime. Particularly, the federal government funded around 10% of state and local law enforcement services (Skogan & Frydl, 2004, p. 53). According to Hassel (2006), the importance of the role of police in the community was emphasized in the mid-1990s because the Office of Community Policing Services (COPS) was established and the police was funded around \$6 billion to redeploy its resources into community policing. In particular, \$12 billion were invested since COPS was established in 1994 "to add community policing officers to the nation's streets, enhance crime fighting technology, support crime prevention initiatives, and provide training and technical assistance to help advance community policing" (COPS, 2009).

Drivers of police innovations are attributed also to various reasons. In the book, "Fairness and Effectiveness in Policing: The Evidence" (Skogan & Frydl, 2004), drivers of innovations are presented as edicts; Supreme Court decisions; civil court suits; increasing academic research in policing; congruence of research findings; policing practices and technological developments;

external social and political environments penetration to policing, such as movements; guidance and accreditation of auditing organizations such as International Association of Chiefs of Police (IACP), the Police Executive Research Forum (PERF), the National Sheriff Association (NSA), the Accreditation for Law enforcement Agencies (CALEA) and the process of social learning via professional associations; and the stimulation of the federal government such as the case of COPS. Morabito (2008) also confirms the significant effect of the political environment in the adaptation of police innovation. On the other hand, Bayley (2008) claims the provenance of innovations to be idiosyncratic. After these new establishments mentioned above, policing remained under the systematic scrutiny of researchers.

Increasing research efforts have contributed considerably to the development of modern policing. According to Stevens (2008), the scientific police management trend was started with the act of the Omnibus Crime Control and Safe Streets Act in 1968. This enactment enabled extensive professional research in crime and criminal justice by establishing the National Institute of Justice which provided evidence for better decision making (Skogan & Frydl, 2004). According to White (2007), the media and public scrutiny on policing and the findings of the commission reports encouraged a wealth of social research (p. 84-85). In fact, the legislation of The Omnibus Crime Control and Safe Streets Act enabled more research in the Department of Justice and traditional policing remained under more systematic scrutiny to date (Weisburd & Braga, 2006).

### **3.9. Inefficiencies and Overestimations in Policing Strategies**

Increasing research has found inefficiencies and overestimations in used policing strategies that can be another reason to search for innovations in policing. Scholars indicate (Eck

& Spelman, 1987) and confirm (Bayley, 2008) that “researchers steadily undermined five basic premises of police crime control practice” until the emergence of police innovations (p, 35). These five critical research topics are (1) random patrol services in cars, (2) rapid response time to calls, (3) nonemergency calls for service, (4) limited benefit from forensic support to investigate and solve, and (5) the inability to follow up unsolved crime. The literature review below sheds light on influential studies presenting inefficiencies and overestimations of policing strategies until the 1980s. This includes the evaluation of random patrol cars in Kansas City (Kelling, Pate, Dieckmann & Brown, 1974), the efficiency and effectiveness of big city police (Skoga, 1976), the response time of police (Tien, Simon & Larson, 1978; Dean, 1980), the influence of citizen reporting compared to the police response time (Spelman & Brown, 1984), the distinction of nonemergency calls in police response (McEwen, Connors, & Cohen, 1984), the limited ability of the traditional criminal investigation process (Greenwood & Petersilia, 1975), the need for a new unit to process information and evidence (Greenwood, Petersilia & Chaiken, 1976), the need for changes in the investigative process (Eck, 1983), the selection of follow ups to increase efficiency (Greenwood & Petersilia, 1975; Eck, 1983), the need for better strategies in collecting more information to solve crimes (Skogan & Antunes, 1979), and the police strength effect on crime (Loftin & McDowall, 1982). These influential findings undermined the understanding of trust in traditional policing. The details of these studies are presented in the notes section<sup>ii</sup>.

In summary, responsive type of policing (Weisburd et al., 1993; Braga & Weisburd, 2006; White, 2007), changing the employment practices of law enforcement (Skogan & Frydl, 2004), and the decay in many inner cities were stated as more reasons for the need for different types of policing considerations in some areas (Weisburd et al., 1993). Furthermore, the

increased amount of available resources to the police (Skogan & Frydl, 2004; Teichman, 2005; Hassel, 2006; COPS, 2009), increased research efforts (Skogan & Frydl, 2004; White, 2007; Weisburd & Braga, 2006; Stevens, 2008), and clear inefficiencies in policing approaches forced the politicians, police and community to search for innovations on the fight against crime.

### **3.10. Police Innovations**

The 1990's are seen as "the most innovative period in American Policing" (Weisburd & Eck 2004; Kappeler and Miller, 2006; Hassel, 2006). Many authors have agreed with this statement in the last three decades (Weisburd & Uchida 1993; Moore, Sparrow, and Spelman, 1997; Blumstein & Wallman 2000, Eck & Maguire, 2000; Skogan & Frydl, 2004; Teichman, 2005; Weisburd & Braga, 2006). In fact, "the United States has been the source of most of the big new ideas in policing in the past half century" (Bayley, 2008; p. 21). Naturally, police innovations have become often the focus of researchers (Kings, 2000; Levitt, 2004; Weisburd & Eck 2004; Skogan & Frydl, 2004; Bayley,2008; Rosenbaum, 2007; Mazeika, 2008) and innovations have been mostly contrasted with the standard model of policing in search of reducing crime (Eck & Maguire, 2000;Weisburd & Braga,2006).

A consensus on the definition of a police innovation has not been made yet. According to Kings (2000), police innovations have been defined differently and considered as a process which requires big change (Wilson, 1968); a product or program which is new for the organization (Rogers, 1976); and "a product or program that is state-of-the-art for possible adopters" (Kimberly; 1981). Kimberley's definition has been used lately by Weiss (1992), Zhao (1996), Moore et al. (1997), Mullen (1996) and King (1998; 2000). Weisburd and Braga (2006) conceptualize innovations as reconsiderations in "fundamental police mission, the nature of the

core strategies of policing, and the character of their relationships with the communities they serve” (1). This study uses their (2006) definition as policing innovation since their study “Police Innovation: Contrasting Perspectives” is a recent and comprehensive effort. Several innovations are discussed among scholars such as King (2000), yet, early innovations such as team policing<sup>iii</sup> and minor innovations are not magnified in the scope of the current study.

Rather, major and popular police innovations are considered as the focus of the study. Specifically, community oriented policing (COP), problem oriented policing (POP) and hot spot policing are identified as major innovations over the last three decades (Weisburd and Eck 2004; Skogan & Frydl, 2004). Some expand these innovations by adding broken windows policing, pulling lever policing, third party policing, compstat policing, evidence based policing and intelligence led policing as more recent innovations (Kappeler & Miller, 2006; Weisburd, and Braga, 2006; White, 2007; Gul, 2009). In a wider view, Bayley (2008) nominates nine police reforms/innovations and extends the time period until the President's Commission on Law Enforcement and Criminal Justice in 1967. In fact, mainly major police innovations have become the focus of researchers as explanatory of the drop in crime rate (Bratton 1999; Blumstein and Wallman 2000; Eck Maguire 2000; Kelling and Sousa 2001; Goldstein, 2002; Skogan & Frydl, 2004; Bayley, 2008; Braga and Weisburd 2006).

In the following section, the link between police innovations and crime reduction is addressed. In turn, general approaches on categorization of police innovations are summarized. Respectively, major and relevant police innovations as community oriented policing, problem oriented policing, broken windows policing, compstat policing and hotspot policing are

discussed in detail to explain why some of these innovations are considered in this study as control variables of the crime reduction efforts while some of the others are not.

### **3.10.1. Police Innovations and Crime Reduction**

Although the effect of police on crime was questioned by some scholars at some point (Klockars, 1980; Hirschi & Gottfredson, 1993; Moran, 1995; Bayley, 1996), several studies provide evidence indicating the efficacy of police in reducing crime rates (Marvell & Moody, 1996; Gallo, 1998; Eck and Maguire, 2000; Levitt, 2004; Weisburd and Eck, 2004; Braga & Weisburd, 2006). Although the public expects the police to reduce crime and disorder and fear of crime (Skogan & Frydl, 2004); neither the community nor the police must claim full responsibility in the fight against crime (Bayley, 1988). In recent studies, the role of the community (as an informal social control) (2000, Quesey) and the role of the police (as formal controller) have been more often addressed (Levitt, 2004). According to Levitt (2004) “the single most frequent explanation given [to crime] is the innovative policing strategies put into place” in the media (p.163). It is obvious that not only the police but also the community and other environmental factors address crime in several ways (Fogelson, 1977). For example, state sentencing policies were found related to prison crowding (Wooldredge and Gordon, 1997). The highest explanatory variables of crime decline for the 1990s are increased incarceration, deployment of more police, the decline in crack use and legalization of abortion (Levitt, 2004). It is also important to know that “the police could reduce the opportunities but not the motives for crime” (Wilson and Boland, 1977; p.187). Noticeably, some known factors: strong economy, changing demographics, innovative policing strategies, gun laws and emphasizing capital punishment were found as the least important variables (Levitt, 2004). Eck and Maguire (2000)

insist that “(o)verall, police agencies might have had an impact on violent crime- there is too much supportive evidence to assert that the effect of police on crime is a myth” (p.245). In fact, the view of “nothing works” in policing has changed with the decline of the crime in the 1990s (Braga & Weisburd, 2006, p.348).

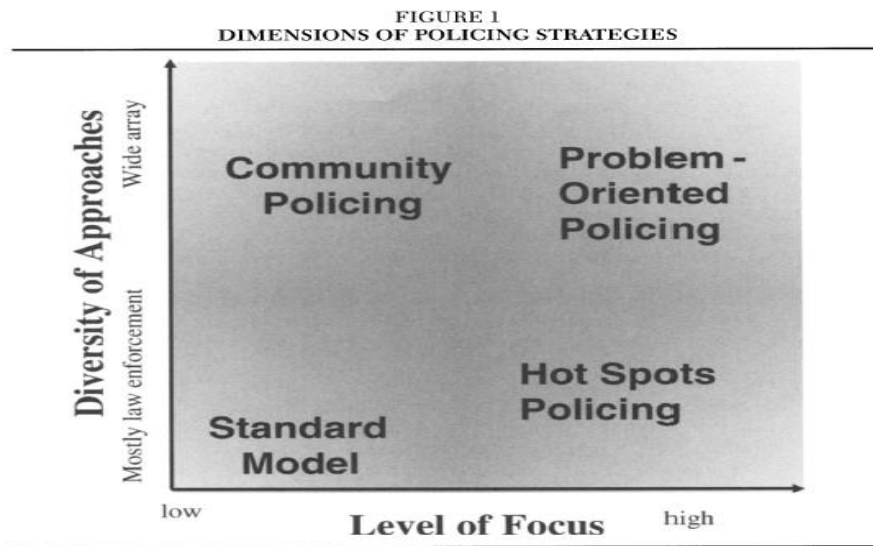
This section aims to explore only the effect of police innovations as one of the factors affecting crime and other major factors are addressed in another chapter. Specifically, this section focuses on the standard model of policing, community policing, problem oriented policing, broken windows policing, compstat policing and hot spot policing to review the different positions on the expected and evidenced effects on crime. Before passing to the abovementioned models directly, the categorizations of police innovations are presented to set the proper frame.

### **3.10.2. Categorizations of Police Innovations**

Innovations in policing have been defined and categorized in various forms by many scholars (Eck & Maguire, 2000; Weisburd & Eck, 2004; Moore, Sparrow & Spelman, 1997; King, 2000; Bayley, 2008; Braga & Weisburd, 2006). Changes in policing were examined by Eck and Maguire (2000) under two categories. The first is called ‘generic changes’ in American policing and the second is called ‘focusing police on repeated places and people’. Similar to the standard model of policing, ‘generic changes,’ involves the size of the police agency, aggressiveness, order maintenance policing strategies and community policing (2000). ‘Focusing police on repeated places and people’ involves policing strategies aimed at specific places, offenders, offense and times. The study (2000) found “*little evidence that generic changes in policing are responsible for reducing violent crime. There is greater evidence for focused*

*policing strategies contributing to the drop in violent crime, though there is still a great deal of uncertainty about these strategies' effectiveness" (p.245).*

The expansion of the standard model of policing was examined in two dimensions by Weisburd and Eck (2004). These are the diversity of approaches and the level of focus. In this study, the 'diversity of approaches' concept indicates two main points: (1) mostly the law enforcement nature of policing and (2) the use of a wide array of policing tools. A wide array of policing means a departure from the classic law enforcing mindset such as meetings with the public to listen to and inform people. The 'level of focus' concept indicates the low and high focus of the directed policing practices. In this context, the standard model of policing, community policing (COP), problem oriented policing (POP) and hot spot policing are evaluated as major innovations.



**Figure 6: Dimensions of Policing Strategies**

Source: Weisburd, D. Eck, J.E. (2004). What can police do to reduce crime, disorder, and fear? *Annals of the American Academy of Political and Social Science*, 593(1), 42. This figure was also used by The National Research Council Committee (2004, p.248)



In the figure above, the vertical axis represents the diversity of used policing approaches from traditional policing tactics to a wide array of policing tools (Weisburd & Eck, 2004). The horizontal axis represents the focus of police practices. This figure illustrates that hot spot policing employs a high focus on crime fight areas, whereas, it utilizes low level diversity as a different policing tool. Problem oriented policing is rated high in both focus and tools diversity. Without considering problem oriented policing, sole community policing implementation stays high in use of diversity of the policing tools, but it is not found well focused on crimes. While illustrating mentioned relations of police practices, the boundaries presented in the figure are seldom clear and frequently overlapping in practice.

Police innovations are distinguished into four main categories as administrative, programmatic, technological and strategic innovations, in the opinion of Moore and colleagues (1997). In this frame, administrative police innovations refer to how the police prepare operations and are held accountable for them. This result a in new measures of performance for individual and overall departmental policies. Programmatic innovations involve applying new operational techniques in the use of organizational resources to achieve aims. For example, drug education and victim resistance training can be provided to youth, the elderly and women. Technological innovations refer to the application of new capital equipment, such as weapons, DNA identification, or mapping software. Strategic innovation refers to new approaches changing fundamental understanding of the organization, such as shifting to problem oriented policing.

King (2000) focuses on measuring police innovation; therefore, he categorizes them by use of Damanpour's fourfold innovation classification. This involves radical, administrative, and technical and program innovations similar to Moore et al.'s (1997) propositions. Only, strategic

innovation is different from radical (King, 2000) where radical innovation refers to “massive restructuring or changes in the organization” (308). King examines the 431 largest municipal U.S. Police departments. Findings indicate that police innovations are not one-dimensional; rather, they are multidimensional constructs. Finally, innovations were found to be splinted in ten subgroups by King.

Considering the last forty years, Bayley (2008) groups big police reforms as strategies, standards, and management. Strategies are presented as COP, POP, broken-windows, hot-spots and spouse-assault approaches. Standards are addressed as internal discipline and external accountability, while management is addressed as Compstat and diversity approaches.

A recent book, ‘Police Innovation: Contrasting Perspectives’ (Braga & Weisburd, 2006), reviews eight innovations widely. These all are considered strategic innovations in the publication because they represent attempts to change policing means and ends (40). Nonetheless, their effects on police performance are stated as “not straight forward”. According to Braga and Weisburd (2006), innovative policing does not leave core standard policing responsibilities; rather, these responsibilities are rearranged, prioritized and expanded. The claim receives support from the study of Zhao, He & Lovrich, (2006) by stating that “police core function priorities have remained largely unchanged” between 1993 and 1996. On the other hand, a non criminal and non emergency policing service approach receives more attention in new policing innovations compared to the standard model of policing services (342). According to Braga and Weisburd (2006), an innovation can be easily adopted if it requires “the least radical departure from their hierarchical paramilitary structures, continue incident driven, and reactive, strategies, and maintain police sovereignty over crime issues (346)”. Kennedy’s assumption of “law enforcement like enforcing the law” is underlined (346), and hotspot

policing, broken windows policing, and pulling lever policing are claimed as more promising innovations in police appeal (Braga & Weisburd, 2006). In this frame, community policing and problem oriented policing are indicated as radical departures from the standard model of policing. It is also noted in the study that COP receives resistance at the adaptation phase by the police agencies because its philosophy is seen as the most radical departure from the standard model of policing (Braga & Weisburd, 2006).

### **3.10.3. Standard (Traditional) Model of Policing**

In the literature, traditional policing practices are named as either standard operating procedures (Skolnick and Bayley 1988; Hirschi & Gottfredson, 1993; Sherman 1993) or a standard model of policing (Weisburd & Eck 2004; Weisburd & Braga, 2006). This study uses the term ‘standard model of policing’ (Skolnick & Bayley, 1988) as it is more recent and frequently used. The standard policing model has been identified lately (Weisburd & Eck, 2004) as a “one size fits all application of reactive strategies to suppress crime and continues to be the most dominant form of police practices in the United States” (44). The standard model of policing assumes that these generic strategies can be the solution to all levels of crimes within a region regardless of other variations on the nature of crime (Eck & Maguire, 2000; Weisburd & Eck, 2004, Skogan & Frydl, 2004; Weisburd & Braga, 2006). In this classical bureaucratic model, crime control strategies are developed at police headquarters that are supposed to be “applied uniformly everywhere” (Skogan, 2003; p.169). In this frame, police management set as a top down, command and control type is organized like paramilitary organizations. The standard model of policing indicators are described as increasing the number of police, random motorized policing, rapid emergency response, and evidence based policies (Skolnick & Bayley, 1988; p. 212).

Maguire and colleagues (2003) examined changes in the structure of police organizations in the 1990s. Findings indicate that significant decreases in centralization and civilianization occurred in large municipal police agencies. Nonetheless, the number of command level officers did not change significantly and flattening did not occur in police hierarchy. Conversely, the social distance between the top level and the bottom level increased significantly (271). Spatially speaking, the existing beat coverage stayed the same, whereas the number of mini stations and police stations has increased.

The National Research Council Committee (Skogan & Frydl, 2004) reviewed researches on the effectiveness of the standard model of policing. They relied on the five characteristics of the standard policing model to measure this. These are: (1) increasing the size of police agencies, (2) random patrol across all parts of the community, (3) rapid response to calls for service, (4) generally applied follow-up investigations, and (5) generally applied intensive enforcement and arrest policies (p. 224). Referring to the increasing size of police, inadequate evidence was found to draw strong policy conclusions from researches about the relationship of police strength and crime rates. The supportive evidence for random patrol practices was also weak. The effectiveness of rapid response did not find adequate support in the committee, either. Limited research is reported on the effectiveness of the police investigations to draw conclusions. On the other hand, a recent study (Klick & Tabarrok, 2005) found “an increase in police presence of about 50 percent leads to a statistically and economically significant decrease in the level of crime on the order of 15 percent, or an elasticity of (3).”

In another study, Weisburd and Eck (2004) question “What can police do to reduce crime disorder and fear?” They express that “using the standard model can lead police agencies to

become more concerned with how police services are allocated than whether they have an impact on public safety” (p.47). They found little evidence of the simple standard model in reducing crime disorder and fear of crime (Weisburd & Eck, 2004). In general, police innovations including more focused, tailored actions and a wider array of the policing toolbox constituted stronger evidence in providing safer communities than simple law enforcement agencies.

Overall, The National Research Council Committee (2004) concluded that “such approaches (standard model of policing approaches) are generally not the most effective strategy for controlling crime and disorder or reducing fear of crime” (p.246). During the current study, all policing agencies are considered as a standard model of policing providers (coded 0) unless employment of an innovation is indicated. If a policing innovation is reported in the LEMAS dataset, this innovation is considered (1) and examined accordingly.

#### **3.10.4. Community Oriented Policing**

Community Oriented Policing (COP) is addressed as one of the most prominent innovations of policing since the 1970s (Fogelson 1977; Bayley, 1988; Kelling & Moore, 1988; Maguire & Mastrofski, 1994; Oliver, 2000). Although the application and meaning of community policing varies across the U.S. (Maguire & Mastrofski, 1994; Maguire & Kuhns, Uchida & Cox, 1997), the Office of Community Policing Service defines it as “a philosophy that promotes organizational strategies, which support the systematic use of partnerships and problem-solving techniques, to proactively address the immediate conditions that give rise to public safety issues such as crime, social disorder, and fear of crime” (COPS, 2009).

Community oriented policing is presented within three generations by Oliver (2000). Accordingly, the first generation is called 'innovation' that was experienced between 1979 and 1986. The second generation is called 'diffusion' that was experienced between 1987 and 1994. The third generation is called institutionalization that was started in 1995 and is still in progress. Notably, Oliver (2000) predicts that community policing will go into an obsolescence phase similar to former innovations. Considering the views expressed by Yin (1979), Zhao (1996), and Pelfrey (1998), Oliver (2000) concludes that COP may disappear during this third term and be replaced by other paradigms; otherwise, it will go on to the fourth generation (384).

Skolnick and Bayley (1988) argue in 'Theme and Variation in Community Policing' that the relationships of the police and good intentions of the community are seen vital to prevent crime and apprehend criminals. The claim is that the police, at least, decrease fear of crime by mediating several social issues within the community through policing although that may be perceived as a faraway construct from what police is supposed to do. This cooperation is roughly named as "community policing" and lack of consensus on the meaning of community policing is frequently criticized. Not a single program but various programs initiated by the police should be envisioned and activated cooperatively to maintain order. The emergences of four main frequent characteristics of the COP concept are indicated. These rely on community based crime prevention, reorientation of patrols according to emergencies, accountability of the police to the public, decentralized police forces and sometimes civilianization (Bayley, 1988). In fact, COP "represents the most dramatic change in strategic vision since the rise of "police professionalism" in the early twentieth century" (34). Bayley notes that "community policing is no substitute for social and economic change". In summary, COP is regarded as a significant and positive innovation for all parties.

Patterns of community policing practice vary both in urban (Bayley, 1988; Maguire & Mastrofski, 1994) and nonurban areas (Maguire & Kuhn, Uchida & Cox, 1997). While the term ‘community policing’ is summarized as a mechanism to solve problems, forge better relations, reduce crime and fear of crime (Maguire & Mastrofski, 1994), it was found that there may not be one uniform COP adoption in police departments. Besides, COP may vary temporally based on clients and problems within the same community (39). Maguire and Mastrofski (1994) advise focusing on macro level longitudinal studies on stable samples and stable instruments to truly understand patterns of community policing (40) in this varied environment. Notably, the current study uses macro level determinants in the longitudinal study setting on the large police agencies to understand the impact of GIS use in police performance.

Nonurban COP practice was examined by Maguire and colleagues (1997). Findings indicate that the western part of the U.S. and large police agencies participate more in COP practice. As to the study, 80% of the police agencies are making partnerships with other government agencies. And, 12% of surveyed agencies report that they have a strategic community policing plan. 31% of them have provided training COP to police officers while 51% of the police organizations have met with the public to explain crime prevention techniques.

According to a study on ‘structural change in large police agencies’, more optimism was found for COP in the 1990s (Hassel, Shin, Zhao & Maguire, 2003). This means that large police organizations tend to be less centralized with more civilian employees, while their level of formalization stays unchanged. In fact, more mini police stations are established within the community but their beats remain almost the same. They (2003) also note that the causal

environment of the police is changing and “(t)he proliferation of information technologies.... exerting a profound influence on police organizations” (272).

According to Skogan (2006), COP is seen as a bottom up approach to the problems compared to the top down centralized nature of the traditional policing. He thinks that the centralized structure is a mismatch to the fight against crime. Matrofski (2006) believes that COP has not yet been transformed into a common structure. According to Skogan, COP cannot be identified as a set of specific programs; rather, it is as an organizational strategy which is a process consisting citizen involvement, problem solving and decentralization (2006, 28). He points out the national pervasiveness of COP implementation. In this survey, more than 90% of large police agencies which serve communities with more than 250,000 people are reported to have trained full time COP officers.

Community policing is argued as an explanation for the reduction of crime by several scholars. According to Bayley (2008), “community oriented policing was inspired by the research of the 1970s ... (and)... core strategies of effective policing were not as effective as claimed” (7). MacDonald (2002) examined the effectiveness of COP in reducing urban violence in 164 large American cities by the use of LEMAS, UCR and Census data. The study (2002) findings suggest that having a community policing plan and training police officers on problem solving methods have little effect on reducing violent crime rates. However, proactive police strategies based on the arrest rate indicates effectiveness in reducing crime rates over time. A more recent study (Connell at al., 2008) questioned whether a community policing initiative can reduce serious crime or not at the beat level. The study relied on the official crime data and interviews of police officers for an eight year period compared to two control beats. Findings indicate that COP has the capacity to affect violent and property crime rates but not drug crime



rates. Noticeably, COP was applied via a specialized unit in the entire police organization. As a limitation, the level of crime reduction was measured at the beat level, not at the entire police department level.

The National Committee reviewed COP strategies based on the existing research and stated that COP cannot be directly evaluated (Skogan & Frydl, 2004, p.46). They reported that some of COP strategies may be effective in reducing crime; however, overall results were mixed. The committee found evidence on the efficiency of COP in reducing fear of crime.

In summary, community oriented policing is found as a very prevalent major policing innovation in the U.S. (Maguire et al., 1997; Skogan, 2006), and its effectiveness is reported in reducing fear of crime (MacDonald, 2002; Skogan & Frydl, 2004, 46) and some of the crime rates (Connell et al., 2008). Therefore, the current study utilizes COP as a control variable in reducing crime.

### **3.10.5. Problem Oriented Policing**

Goldstein (1979) criticized that the police was dealing with more means than ends in his influential article titled, 'Improving Policing: A problem Oriented Approach'. Problem Oriented Policing (POP, 2009) is an approach focusing on incidents deeply by use of the microscopic approach and crime analysts to discover more effective strategies against crime. Goldstein (2006) advises that the police should refocus on problems rather than deal with organizational concerns, such as staffing, management and procedures. In other words, the police can have an impact on crime but policing should change its fixed ways against crime (Weisburd & Braga, 2006, p.16). According to Bayley (2008), POP is "the second reformulation of basic police strategy."

POP has been applied by police agencies in diverse forms based on community characteristics. According to Eck and Spelman (1987), POP is “a state of mind, and not a program, technique, or procedure”. In fact, three key elements of POP are summarized by them (1987). First, problems are defined explicitly. This includes the collection of some of the new crime characteristics as location, time motivation, behaviors, etc. Secondly, information about the issues are gathered not only from internal sources but are also provided by the external parties. This includes government agencies and private parties. Finally, solutions are searched for not only in the criminal justice system, but also within the alternative public and private parties. This process is supposed to include others who may find interest in resolving issues. Eck and Spelman (1987) stated that “full implementation of problem-solving will be a slow and sometimes difficult process. No agency will be able to “adopt” problem-solving simply by making a few changes in standard operating procedures, or just by telling officers to go to it.... however, careful planning can yield great benefits for an agency that works to solve its community’s problems” (49).

Problem oriented policing is stated as a paradigm close to the community policing approach with lower involvement of the public (Skogan 2003). As to Kappeler and Miller (2006), COP changed over time and has been frequently used in combination with other programs, such as POP (13). This combinational usage makes it difficult to distinguish community policing from similar practices. In fact, it had been articulated (Eck & Spellman, 1987) before that “(p)roblem-oriented policing relies on and supports community policing, but it is not synonymous with community policing” (46).

The adoption of the POP concept has been discussed because it redefines the policing mission (Eck, 2006). Another criticism of POP is addressed as the change from routine law

applications to a scientific approach in order to prevent crime. Because the police officers are not recruited and managed for scientific ends, POP may not be supported adequately by available human resources and the standard police structure in the realm of high level work flow. A final concern addresses the change in the role of police within the criminal justice system via POP. POP pushes the police from being a gatekeeper to a central place in the criminal justice system. However, Eck (2006) mentions the effectiveness of POP relying on the committee's view (Skogan & Frydl, 2004) and in a former study (Weisburd & Eck, 2004), he criticizes POP as a "too difficult (approach) to implement" (127). Finally, Eck (2006) expresses that POP is not an 'unrealistic' approach but "requires diligence, hard work, and a great deal of patience" (128). Similarly, concerns about "top-down management, unsupportive reward systems, clumsy and imprecise measures of achievement" are also stated for POP applications (Bayley, 2008).

Parallel to these concerns, Braga and Weisburd (2006b) worry that POP can be an unrealistic approach if detailed POP processes are expected to be achieved in the line level. They also warn that "it is time for police practitioners and policy makers to set aside the fantasy of street level problem oriented policing" (149). They (2006b) think that the POP application can be successful on a larger scale with the involvement of academic researchers, crime analysis, and administrative staff support. They think that beat officers can solve problems but sophisticated problems should be solved at the organizational level. Moreover, POP is seen as more effective if it focuses on high risk places, individuals, and high risk times (Weisburd & Braga, 2006).

The efficacy of POP practice in reducing crime has been examined by scholars. Read and Tilley (2000) find general support in U.K. police practice in favor of POP; however, high quality POP applications are found to be still exceptional in the field. Only one unit out of 24 initiatives is found successful in the study that reflects the assumed theoretical values of POP. A general

lack of analytical capacity is also addressed for most areas (31). Increasing evidence has been found on the effectiveness of problem oriented policing in reducing crime (Weisburd & Eck, 2004). Finally, the review committee (Skogan & Frydl, 2004) indicates a growing body of research supporting problem oriented policing as an effective way of policing.

The SARA method, which refers to Scanning, Analysis, Response, and Assessment and PAT, which refers to the Problem Analysis Triangle are frequently used and well known POP practices (La Vigne, 1999; Cordner, 2005; Bayley, 2008). According to Bayley (2006), POP understanding was institutionalized by Police Executive Research Forum (PERF) (9). La Vigne (1999) links problem oriented policing with GIS use by portraying its essence in the SARA process. In brief, GIS is used for problem identification, analysis, development of an intervention and assessment of the intervention in POP. The Law Enforcement Management Administrative Statistics survey (LEMAS) has collected periodical data about the use of SARA. Considering evidence on the efficacy of POP in reducing crime (Read & Tilley, 2000; Weisburd & Eck, 2004; Skogan & Frydl, 2004), POP is used as another control variable of crime in the current study. POP is operationalized as a SARA model because this model is commonly used in the practice (La Vigne, 1999; Cordner, 2005; Bayley, 2008) of POP in the U.S. and is measured by a LEMAS survey.

### **3.10.6. Broken Windows Policing**

The 'Broken Windows' approach received huge publicity in the media when it was first mentioned (Kelling and Wilson, 1982). Although it is not recognized as a major police innovation by the national research committee (Skogan & Frydl, 2004), claims of its efficacy in terms of reducing crime are notable. The link between disorder and crime is claimed as the

philosophy of the Broken Windows metaphor which signifies the importance of minor happenings (1982). If minor issues, such as uncivil and petty crimes, are not taken care of adequately, they may cause fear of crime, urban decay and more crime (Kelling & Wilson, 1982; Kelling, 1996; Sousa & Kelling, 2006). In this context, Kelling and Wilson (1982) suggested that policing could prevent crime by paying attention to minor offenses such as graffiti, panhandling and deterioration. This implied that policing should consider order maintenance to prevent crime in neighborhoods.

Crime reduction and restoring order efforts have been revisited in ‘fixing broken windows’ by Kelling in 1996 and by Sauso and Kelling in 2006. The general idea relies on focusing on the communities; specifically, public spaces before crimes occur. Another assumption of the study is that all social classes and ethnic groups demand order. Based on this view, it is advised that the responsibility of community crime control is given to communities. Therefore, this argument is assumed to facilitate the accountability of the criminal justice system and the police to the residents of the communities. In 2006, Sauso and Kelling indicated that “disorder and fear of crime are strongly linked; different neighborhoods have different rules; untended disorder leads to breakdown of community controls.” The study (2006) suggests that the broken windows approach may reduce fear of crime as well as some of the street crimes. It is also important to note that the broken windows policing concept is perceived and applied under different names and in different ways. The broken windows approach is considered as an order maintenance approach (Skogan & Frydl, 2004), applied similarly to zero tolerance policing (Greene, 1999; Bowling, 1999; Eck & Maguire, 2000) and quality of life policing (Katz, Webb & Schaefer, 2001) in different police departments. According to Bayley (2008), this understanding is referred to as ‘signs-of-crime policing’ and ‘reassurance policing’ in England.

The broken windows strategy is not considered as a major police innovation as mentioned earlier; rather, it is categorized under the standard model of policing activities within tough policing strategies by the National Committee review (Skogan & Frydl, 2004). Notably, the committee addresses the effectiveness of the order maintenance approach in reducing crime and enhancing the public feeling (Skogan & Frydl, 2004, p.61). Also, Weisburd and Braga (2006) identify broken windows as one of the strategic innovations and highlight its effectiveness. Considering the confusion on its categorization and efficacy, it may be beneficial to discuss this approach further in the light of literature.

A case study conducted in New York (Greene, 1999) focused on zero tolerance policing and identified the city's approach as quality of life policing. This definition (Greene, 1999) can be debated because it downgrades police strategies as if all are the same, compact one. In fact, policing has a very extensive toolbox to intervene on individuals, cases, groups, crowds, neighborhoods, etc. In conclusion, the study (1999) suggests strong evidence on the crime control effect of "a more problem oriented community policing strategy".

Bowling (1999) examines the fall and rise of New York homicide rates in order to understand the effect of zero tolerance policing between 1991 and 1997. He examines the idea that the police made all of the difference. Although he finds some support to the effect of zero policing on reducing crime, several other factors, namely the rise and fall of crack cocaine, rejecting guns by the young generation, changing the social context and the combined effect of local communities on crime prevention are indicated as the factors contributing to the decline in homicides in New York in between 1991 and 1997.

The broken windows approach is examined as zero tolerance policing under generic changes by Eck and Maguire in 2000. Their study considers broken windows approaches as aggressive strategies. Referencing Cordner and Massing (2000), they define the concept as one to “impose order through strict enforcement” (224). New York police department’s ‘quality of life enforcement strategy’ is used as an example of this understanding. The debate is whether the decline of crime in New York in the 1990s can be attributed to aggressive strategies or not. Although there might be some decline in crime by the use of aggressive strategies, their effects on crime could be short term (tentative). Overall, mixed evidence was found for the efficacy of zero tolerance policing. Notably, zero tolerance and compstat policing were addressed by Eck & Maguire, 2000) as the “least plausible candidates for contributing to the reduction in violent crime” (245).

The New York City Police Department’s reforms were examined by Sousa and Kelling in 2001 in order to understand police the intervention (broken windows) effect on crime decline in the 1990s. This was operationalized as law enforcement against minor crimes. The examination of crimes between 1989 and 1998 indicated a significant and consistent link of declines in violent crime with broken windows policing. The study (2001) closed with a note to consider the potential effects of other policing interventions, such as Compstat, that were implemented at the same time.

Katz, Webb and Schaefer (2001) assessed the impact of quality of life policing that was derived from the broken windows approach. A call for service data was used to examine crime and disorder depending on a quality of life initiative. Ten crime categories were analyzed by the use of time series analysis on four targeted areas. The study suggests that two categories of crime show a significant effect as the result of quality of life policing approach practice. These two

crime types are public morale and physical disorder. The diffusion of benefit from the application of the quality of life approach was also found in this study while the impact on serious crime was minimal. Worrall (2002) examined broken windows policing in the counties of California as a macro level study. This study confirmed (2002) the broken windows posit in reducing serious crime. In particular, more arrests for misdemeanors reduced frequency of certain serious property crimes in California.

Corman and Mocan (2005) examined the misdemeanor arrests to test the broken windows policing effect on crime in New York. Time series analysis was used to examine data between 1974 and 1999. Misdemeanor arrests, number of police and prisoners were used as deterrence variables while the unemployment rate and the real minimum wage were used as economic variables. This study validates the effect of the broken windows approach on some of the crimes such as grand larceny, motor vehicle theft and robbery.

On the other hand, several studies criticized the broken windows approach. According to Panzarella, tough strategies have received criticism from the public; specifically, its effect on minorities has been perceived as harassment policing (Manning & Harcourt, 2000) that may lead to hostility (as cited in Eck and Maguire, 2000; p.226). According to Sherman, the high arrest rate of misdemeanor offences would also criminalize new people because of increasing arrestee records. Some of the offenders would be more angry and defiant as the result of increasing arrest and these arrests also could increase the rate of domestic violence (2000, 228). Harcourt and Ludwig (2006) assessed Sousa and Kelling's (2001) study on broken windows. They found no empirical evidence on shifting police and police spending for minor disorder offenses to improve violent crime reduction. The National Research Council Committee (Skogan & Frydl, 2004, 60) indicated the resemblances of zero policing tactics to the 'aggressive preventive patrol' of the



1960s. Taylor (2001) critiques the broken windows approach as an incivilities thesis. Incivility reduction is presented as a response to the urban riots that took place in the 1960s. Empirical support for disorder reduction over time was found to be weak (Taylor, 2001). Its reproduction as zero tolerance policing seems to exacerbate the problems. Rosenbaum (2007) assesses the effectiveness of police innovations for the period after 1980. In assessments of broken windows policing, mixed results are presented and its efficacy is questioned. Specifically, crime and disorder reduction, and the role of the application in strengthening the informal social control, are addressed as questionable. Rosenbaum (2007) concludes that implementation of broken windows policing depends on the style of policing in addition to “types of norms and behaviors the police are being asked to enforce” (22).

Considering the reviewed literature (Greene, 1999; Bowling 1999; Eck & Maguire, 2000; Sousa & Kelling, 2001; Katz, et al., 2001; Taylor, 2001, 2002; Worrall, 2002; Corman & Mocan, 2005; Harcourt & Ludwig, 2006; Sauso & Kelling, 2006; Rosenbaum, 2007), the broken windows policing approach has presented mixed evidence in reducing both crime and fear of crime. In fact, the National Research Council Committee (2004) considers this policing strategy under the standard model of policing. Similarly, Eck and Maguire (2000) also categorize the broken windows approach with order maintenance, quality of life and zero tolerance policing as generic changes. These imply that consideration of the broken windows policy is possible within standard model of policing. Therefore, the broken windows approach is not considered as a major police innovation in this study and this approach is not used as a crime control variable.

### 3.10.7. COMPSTAT

Computer comparison statistics (abbreviated as Compstat) is defined as “a goal-oriented strategic management process that uses technology, operational strategy and managerial accountability to structure the delivery of police services and provide safety to communities” (Walsh, 2001). Ratcliffe (2004) identifies Compstat as a “significant application area for crime mapping techniques and conference presentation” (72). Boba (2005) identifies it as a “data and mapping driven police management strategy” (p.24). This policing management strategy was publicized in 1994 by the New York Police Department and it was awarded with an Innovation in Government Award by Harvard University in 1996.

Bratton (1999) enlightens the Compstat role in the police that provides weekly precinct and citywide crime statistics to evaluate active programs. In this frame, semiweekly Compstat meetings are held with top precinct and squad commanders. In these meetings, crime trends, police tactics and resource allocations are reviewed. This enables immediate accountability of applied programs in each six week cycle. Bratton presents the four principles of Compstat that guide patrol and investigative police. These are, “timely, accurate intelligence; rapid deployment; effective tactics; and relentless follow up and assessment” (15). According to Bratton (1999; p.15), “in the 6-week Compstat cycle, the effectiveness of every new tactic or program is rapidly assessed. Failed tactics do not last long, and successful tactics are quickly replicated in other precincts. Gathering field intelligence, adapting tactics to changing field conditions, and closely reviewing field results are now continual, daily processes. The NYPD can make fundamental changes in its tactical approach in a few weeks rather than in a few years”.

Roberts (2006) articulates that: “Compstat is perhaps the best known and most well-documented contemporary example of the power of performance measurement in law enforcement management”. Specifically, Compstat revealed the importance of crime analysis, mapping and its systematic discussion (Mazerolle, Rombouts, McBroom, 2007). Compstat has different dimensions, and use of GIS technology is one of the central impetuses of this integrated system. According to ESRI (2009), “Compstat is a GIS-focused approach to managing a law enforcement organization and relies heavily on effective crime and investigative analysis. ... It’s been nearly a decade since the NYPD adopted Compstat, and crime mapping has grown as a key crime-fighting tool.” Use of Compstat type technology diffused to the other law enforcement agencies across the nation (Masser & Onsrud, 1992; Police Foundation, 2004) and this has become the focus of several researches (Eck & Maguire, 2000; McEwen, 2002; Skogan, 2003; Silverman, 2006; Braga & Weiburd, 2006c; Weisburd, Matrofski, Willis & Greenspan, 2001; Mazerolle, Rombouts, & McBroom, 2007; Unter, 2007; Dabney, 2009).

The efficacy of Compstat was examined on homicide rates in the New York Police Department between 1994 and 1998 by Eck and Maguire (2000). These authors considered Compstat as a “manifestation of focused policing in general and directed patrolling in particular” (235). They also mentioned Compstat as a linchpin strategy “that binds these other changes together” (230), referencing Silverman and O’Connell (1999). Four types of evidence were searched to prove Compstat contribution to homicide changes. First, directed patrolling was accepted as a plausible theory behind Compstat. Decline in homicide rates between 1994 and 1998 following the Compstat implementation was also found. However, the decline of crime three years before the implementation of Compstat was not supported with the causal link between crime decline and Compstat. Thirdly, the authors tested whether acceleration occurred

in the crime decline after Compstat, but this claim was not proven. Finally, surrounding large states such as New Jersey, Connecticut, and Pennsylvania also were examined to understand whether similar crime decline was experienced at the same years or not. The New York crime trend was found to be indistinguishable from these areas that could not support the claim of Compstat on crime decline.

In total, a few determinations on the efficacy of Compstat emerged. First, the decline of homicide rates could not be credited independently only to Compstat. Secondly, other new policing strategies such as zero tolerance policing were implemented almost at the same time. Thirdly, the diffusion of Compstat to U.S. cities was later researched and similar declining rates in other cities were determined. The study also notes that Compstat was not developed for only homicide cases. This implies that Compstat may be effective on some other type of crimes or the overall crime rates of an area. They concluded that “there is little evidence to support assertion that Compstat caused the decline in homicides” (Eck & Maguire, 2000, p.235).

In a study by McEwen<sup>iv</sup> (2002), Compstat was mentioned as a movement in police reforms and management accountability meetings. It was found that use of Compstat was relying on reported crimes and arrest rates reviews as measures of success. The author emphasized the importance of calls for service data consideration since very few calls for data can be included in both reported crimes and arrest data. In summary, the study recommends the consideration of calls for service data for informing Compstat meetings to enable a better complete picture of citizens’ concerns.

Skogan (2003) articulates that “Compstat uses computer technology to identify emerging hot spots, and direct police resources to them quickly. Today, many departments have better

crime analysis and mapping capacity than the NYPD does, but Compstat is most importantly a management process that forces police local commanders to be quick and decisive” (170).

Notably, The National Research Committee indicates inadequacy in making a conclusion based on use of Compstat type systems’ effectiveness in reducing crime (Skogan & Frydl, 2004).

Compstat facets, origins, versions, and strengths were explored by Silverman and colleagues (2006). The pervasiveness of Compstat is emphasized in the Police Foundation’s survey in 1999. This reports 515 large police departments’ involvement in Compstat-like implementations. Complex changes also indicate that Compstat may have the potential to influence. Eterno and Silverman (2006) conclude that “Compstat has provided significant advances in policing and organizational performance.” (281). Furthermore, Eterno and Silverman (2006) questioned whether Compstat is a dream or a nightmare. In their study, the efficacy of Compstat in reducing crime, increasing accountability of key staff members, and better coordination of units in the agency are addressed. As critiques, relations with the community, due process concerns, leadership issues and inadequacy in problem solving are indicated. The simple level analysis of Eterno and Silverman (2006) indicates some probable contributions in CompStat applications; however, this particular study is weak in presenting on certain contributions to crime reductions.

Braga and Weiburd (2006c) examined police innovations and crime prevention of the last 20 years. They present Compstat as a response to the failures of the traditional policing model such as poor organization in the context of crime fighting. The focus of Compstat has revealed more about the police organization and less about specific strategies that the police are using. The empowerment of the command center is also addressed. They (2006c) note that Compstat was implemented in conjunction with other changes, such as broken windows and hot spot

policing. They conclude that “Compstat has yet to be proven as an effective crime control strategy in cities that have adopted the approach” (14).

Compstat was also reviewed by Weisburd, Matrofski, and Willis (2003). On the one hand, Compstat efficacy in crime reduction and improvements in quality of life are expected (Silverman and O’Connell, 1999; Remnick, 1997; Gurwitt, 1998; Bratton, 1999); on the other hand, the gap to grasp its promising nature and current Compstat implementation is argued. Differently, Weisburd and colleagues identify Compstat as an organizational level application of Goldstein’s (1979) problem solving approach. As an innovation, Compstat has been distinguished from community policing because COP is seen as a challenge to the command and control systems of standard model policing. Contrarily, Compstat is described as reinforcement to traditional command and control (Weisburd et al., 2006, p.298). In conclusion, the promising nature of Compstat is articulated; however, full implementation of Compstat type applications are suggested to reach targeted ends. There are also Compstat like versions that can be considered in the same category with Compstat. There might be numerous reasons why full implementation of Compstat is not yet common as it is theorized; however, this topic is not the scope of the study.

Mazerolle, Rombouts and McBroom (2007) evaluated the impact of the Queensland version of Compstat. The interrupted time series analytic technique was used to understand the application across the 29 police districts of Queensland. The Compstat version of Queensland (OPRs) was found to be associated with the significant decrease of reported overall crimes. Strong effect was also found in unreported crimes specifically in the case of unlawful entry into

private dwellings and properties. Finally, OPRs were found to be a cost effective approach in controlling crime.

Unter (2007) tested the Compstat application of the New Orleans Police department for a three year period. Two different examinations were applied by the use of higher ordered and traditional time series analysis. A significant impact on the crime trends was found; however, its effect was found to be short-lived. In the second analysis, policing variables assumed a more major role than sociological variables in explaining overall crime rates.

Dabney (2009) portrays Compstat as a “proactive and outcome-oriented approach to organizing and managing police operations”. This study (2009) provides evidence about line officers and immediate supervisors’ perception. Notably, findings revealed that “most of the rank and file officers interviewed for this project misunderstood or misrepresented the core intent of the Compstat model” (9). Specifically, “(w)ith few exceptions, officers did not articulate a position that captured the mapping and patterning function of data within a Compstat model in general” (11). Dabney concluded that line level and immediate level supervisors were not able to “internalize the core facets of the Compstat model and incorporate these maxims into their daily thinking and behavior” (2). Findings suggest that the Compstat application should consider a two way communication to enable personnel endorsement within an organization. Otherwise, a poor understanding of line level personnel can be prevalent in the case of Compstat type applications.

Although Compstat allows the “rapid conversion of crime data into map ready form enabling a large audience to quickly determine the location of crime hotspots” (Ratcliffe, 2004, p.72), its effect on crime reduction is not certain (Eck & Maguire; 2000; Skogan & Frydl, 2004). Specifically, the need for full implementation of Compstat applications has been suggested to

reach desired ends in policing (Weisburd et al., 2006). There may be also other reasons for explaining the inefficiency of Compstat, such as inadequate training of police managers in crime reduction and interpreting crime intelligence analysis products (crime maps) (Ratcliffe, 2004, p.73), as well as inadequate communication between top and line level personnel (Dabney, 2009). Considering community oriented policing, problem oriented policing, hotspot policing and their convincing effects on fear of crime and crime reduction, this study does not use Compstat policing for controlling crime reduction in police agencies. Additionally, the LEMAS survey does not provide specific data about the use of Compstat type applications in police agencies.

### **3.10.8. Hot Spot Policing**

Hot spot policing is identified as one of the major police innovations of the last three decades (Weisburd & Eck 2004; Skogan & Frydl, 2004; Kappeler & Miller, 2006; Weisburd & Braga, 2006; White, 2007). While the standard model of policing supports the provision of a generalized police service uniformly to urban communities, a new perspective for allocating police resources in a focused way is reported (Skogan & Frydl; 2004, p.236). The focused policing perspective is detailed in four specific areas by the National Research Council (2004): (1) police crackdowns, (2) hot-spots policing, (3) focus on repeat offenders, and (4) mandatory arrest for domestic violence. Hotspot policing has been considered as one of the major innovations, and this section aims to shed light on the understanding of hot spot policing by discussing the concept (Braga, 2001; Ratchfille, 2004; Skogan & Frydl, 2004; Weisburd & Lum, 2005; Braga & Weisburd, 2006; Bayley,2008) and research findings in reducing crime (Sherman, Gartin & Buerger,1989; Sherman & Weisburd,1995; Weisburd & Green, 1995; Braga, 2001; Weisburd & Eck,2004; Skogan & Frydl; 2004; Weisburd & Lum, 2005). Finally, the



importance of crime mapping and GIS utilization in hot spot policing (Weisburd & Green, 1995; Weisburd & Lum, 2005; Skogan & Frydl, 2004), the limitations of police innovation examinations and the current state of policing (Skogan, 2003; Skogan & Frydl, 2004) are addressed below.

The hotspot policing approach focuses on the small places where crime is concentrated (Braga, 2001; Ratchfille, 2004; Skogan & Frydl, 2004; Weisburd & Lum, 2005). In other words, high crime areas, such as specific addresses, street corners, and blocks, cluster of addresses, census tracts, and police boundaries are targeted in this policing approach. Braga (2001) defines hot spot policing as “concentrating police enforcement efforts in high-risk places where crime is concentrated” (105). According to Weisburd and Eck (2004), hot spot policing applies a high focus on the fight against crime, whereas it utilizes low level diversity in regards to the use of different policing tools. This can be interpreted as meaning that the police are applying a standard model of policing tactics on identified and directed hot spots. Braga and Weisburd (2006) consider hot spot policing as a more promising view because it receives more appeal from the police. Similarly, hot spot policing is seen as an internally driven change by Bayley (2008).

Ratcliffe (2004) states that hot spot policing is a growing operational tactic of policing akin to British intelligence led policing. In practice, different policing tactics can be used in hot spot policing based on operational commander and crime prevention practitioners (2004). For example, the police may want to analyze root causes of the crime to intervene or others just may want to directly allocate police resources to identified spots. Additionally, utilization of hot spots policing differs with respect to use of different theoretical explanations and different techniques for detecting crime hot spots.

The criminological nature of the places was questioned by Sherman, Gartin and Buerger (1989). According to Skogan & Frydl (2004; p.238), “the development of desk crime-mapping programs made it practical for police agencies to begin to develop geographic understandings of crime in their cities”. Relying on the routine activities approach (Cohen & Felson, 1979), Sherman et al. (1989) researched the Minneapolis hotspots by using computerized mapping techniques during a one year period (Weisburd & Lum, 2005). They (1989) found that 50% of police calls were made in 3% of the places. Specifically, 3.6% of all places were exposed to rare occurrences of crime; however, the distribution of crime varied significantly by offense type. In particular, concentration of predatory crime was found to be greater in these areas. Noticeably, repeated occurrences took place at 2.2% of the all places. This also shows a high concentration of repeat crimes at the same places. The authors (1989) asked the following question: “If future crime is six times more predictable by the address of the occurrence than by the identity of the offender, why aren't we doing more about it?”(36).

Sherman and Weisburd (1995) examined whether a dosage of uniformed patrol causes any differences on crime rate in the tightly defined geographical areas of Minneapolis. The intent of the study was to correct the flaws of the Kansas City experiment mentioned in the policing section. In one year, 55 of 100 high crime areas, hotspots, were monitored systematically. At the end of the study, 5 to 13% reduction differences were found in total crime rates in observed areas. The study (1995) concluded that more police presence at hotspots can cause modest reductions in crime and it can cause more rate reductions in disorders at high crime locations.

Weisburd and Green (1995) examined drug hot spots in the Jersey City drug market. 56 hot spots were determined by use of computer mapping to experiment and control the activity. Street level narcotics units enforced both unsystematic and oriented enforcements. After a seven

month long observation, a consistent and strong effect on the targeted emergency crime was found. Considering the potential criticisms on displacement, the diffusion of crime control benefits was also found near the targeted hotspots in this study (Wesiburd & Green, 1995).

Braga (2001) examined recent researches to know the effects of hot spots policing on crime. The findings of the study suggests that focused efforts of policing can prevent crime and disorder in hot spots without showing a significant displacement effect. Diffusion of crime benefits were also found to be associated with hot spot policing efforts. It was suggested that hot spot policing promotes appropriate enforcement techniques as a response to misconduct and abuse of force. Wide use of hotspot policing is advised as an alternative to aggressive policing tactics.

The findings of Braga and Weisburd (2006) also confirm the efficacy of the hot spot policing approach. In their study, hot spot policing initiatives are addressed as the most advantageous approach to crime control where diffusion of its benefit is indicated as the highest (342). Weisburd and Eck (2004) also found convincing findings about the effect of the hot spot policing on reducing crime. Notably, “(t)he strongest evidence of police effectiveness in reducing crime and disorder was found in the case of geographically focused police practices as hot-spots policing” (2004, p.42).

The National Research Council (Skogan & Frydl, 2004) concluded with strong empirical support for hot spot policing in their research review as well: “On the basis of a series of randomized experimental studies, we conclude that the practice described as hot-spots policing is effective in reducing crime and disorder and can achieve these reductions without significant displacement of crime control benefits. Indeed, the research evidence suggests that the diffusion

of crime control benefits to areas surrounding treated hot spots is stronger than any displacement outcome (250)".

Weisburd and Lum (2005) examined police agencies in order to understand the diffusion of the innovation of crime mapping between 1982 and 2001. It is underlined in the study that "computerized crime mapping was thus from the outset an essential component of the development of a hot spots approach to policing" (p.426). The study has provided clear links between the police practice of crime mapping and hot spot policing growth. In their survey, police agencies that apply crime mapping described their reasons for doing so by stating that its use is "related to hot spot policing" (427). In fact, 80% of surveyed police agencies reported that they use the crime mapping capability to identify hotspots. Furthermore, two of three police agencies using crime mapping stated that they are using hot spot policing as a tactic. They also found that "the widespread adoption of computerized crime mapping follows research evidence regarding the effectiveness of hot spots policing approaches, and is linked strongly to those approaches in police agencies with computerized crime mapping capabilities" (Weisburd & Lum, 2005).

The main argument of this study is that GIS is a multidimensional technological innovation that assists the police in its fight against crime in several ways. Hot spot policing is one of the subgroup approaches where GIS is centrally utilized (Weisburd & Green, 1995; Radcliffe & Mccullagh, 1998; Weisburd & Lum, 2005; Skogan & Frydl, 2004). There might be major overlaps causing to measurement losses (Weisburd & Eck, 2004; Skogan & Frydl, 2004) while measuring impact of GIS use if we control hotspot policing in this study. By using computer mapping as the explanatory variable, the use of the GIS concept is operationalized and it is supposed to comprise most of the hot spot policing effect in terms of technological software

use. Therefore, hot spot policing is not considered as a separate control variable of crime in the current study.

The utility of GIS is not limited to hot spot policing tactics and use of GIS is in effect in regard to other policing innovations to some extent, such as, problem oriented policing (La Vigne, 1999; Knutsson, 2003), Compstat policing (Ratcliffe, 2004; Boba, 2005; Silverman, 2006; Mazerolle, et al., 2007; ESRI, 2009) and the standard model of policing (Weisburd & Eck, 2004; Braga & Weisburd, 2006; Bayley, 2008). Although the current study does not control the effect of hotspot policing on crime, isolating the entire utility of GIS from other policing strategies is improbable.

While attempting to measure influence of GIS use in police agencies, this study use the police performance concept. Reviewing performance measures in the public services and its application in police agencies can enhance its understanding and reveal the dependent variables of the study.

### **3.11. Performance Measurement in Public Service Delivery**

Performance measurement in public service delivery is common for several reasons in the U.S. local governments. Performance measurement is defined as "the process of quantifying action, where measurement is the process of quantification and action leads to performance" (Neely, Gregory & Platts, 1995p. 80). According to Poister and Streib (1999), measuring workload and worker efficiency started in the early days with the idea of scientific management in mid 1940s. Performance measurement arose for program budgeting in 1960s, and program evaluation in 1970s. In fact, utility of performance measurement have become widespread across the U.S. lately to search for government efficiency (Poister & Streib, 1999). According to

Rivenbark and Pizarella (2002), this general use can be attributed to increasing professionalism of administration, the research of academics and the efforts of sponsorship organizations. Primary intended audiences of performance systems are indicated as “mayors, city managers and other CAOs, department heads, professional staff, and council members rather than citizen groups or state and federal agencies” (Poister & Streib, 1999, p.333). As to Behn (2003) public managers apply performance measures for achieving eight different purposes which are to control, evaluate, budget, celebrate, improve, motivate and promote. Yet, there might be no single performance measure to meet appropriately all these eight purposes. For this reason, Behn (2003) suggests focusing on the ‘purpose’ of performance measuring to find appropriate measure.

Different classifications exist in performance measurement based on different dimensions. Some of the scholars of the California University has listed five classifications of performance measures as, efficiency, effectiveness, quality, timeliness and productivity (Artley, Ellison, Kennedy, 2001). In general, performance measurements can be grouped mainly by relying on subjective and objective approaches (Brown and Coulter, 1983; Parks, 1984; Swindell & Kelly (2000) According to Brown and Coulter (1983), objective measures address effectiveness, efficiency and equity measures such as, inputs, outputs and impacts by use of official archives of public agencies. And, subjective measures value citizen attitudes on provided public service delivery by collecting data from sample of citizens. As to Parks (1984), subjective indicators are constructed mainly from surveyed citizen responses about their evaluations, experiences, and perceptions of provided services. Objective indicators are acquired by use of maintained records by the service agencies. Lack of strong relation between subjective and objective measures emerges as a concern in utility of these measures (Parks, 1984). Likewise,

Swindell and Kelly (2000) consider subjective measures as citizen satisfaction surveys and objective measures as internal performance indicators. They shorten these two approaches into two words as performance and satisfaction and attempt to link them. Although both of these approaches collect the data differently, they can be integrated in presentations to capture a wider picture. In fact, goal of the both measures (subjective and objective) is “to improve service quality” (Swindell and Kelly, 2000; p.47). In this frame, reviewing prior studies of performance measurement in public service delivery and specifically in policing can facilitate to select appropriate measures for the current study.

Prior studies have examined subjective and objective approaches of performance measures (Stipak, 1979; Brown & Coulter, 1983; Parks, 1984; Swindell & Kelly, 2000; Cheurprakobkit and Bartsch, 2001). Stipak (1979) surveys citizen satisfaction by asking evaluation of public services performance. Stipak (1979) concludes that responses to this kind of surveys may not provide the actual picture of the government service delivery. He also notes that this kind of collected data still have some value in policy making, nonetheless, evaluators may encounter with difficult conceptual and statistical problems. Another study (Brown & Coulter, 1983) points out that most research using subjective measures tend to evaluate effectiveness of service delivery. The findings (1983) indicate that satisfaction level and service level performance measures are totally independent issues (57). Similarly, Parks (1984) thinks that these two measures are not conceptually congruent; therefore, they are not supposed to measure the same thing. He (1984) notes that this congruence may be lower if the objective data is used at the aggregate level. Police performance and police priorities were explored while measuring differences between citizen satisfaction and police attributes by Cheurprakobkit and Bartsch (2001). The findings indicate that police attributes were rated more important than police

satisfaction. In specific, crime prevention was found the most improvement attributes of the police. Brown (1996) points out that prior literature is full of with subjective studies which mostly rely on single user perspective. This can be one of the limitations in prior GIS research.

### **3.11.1. Performance Measures in the Police**

Policing is stated as "the most commonly monitored municipal service" by Poister and Streib (1999, p.332). Naturally, "police chiefs and sheriffs, like chief executives of any organization, are measured on results" (Roberts, 2006, p.17). In general, performance measures are used generally to make better decisions, accountability to citizens and elected officials in policing. According to Peed -director of community oriented policing services- using performance measures can increase level of understanding of the officers, supervisors, and executives that can increase effectiveness and efficiency of provided services (Roberts, 2006). In specific, eight facts are aimed within performance measures if they are prepared for policing technology projects (Roberts, 2006). These aim to improve management and delivery of services, improve communication internally and externally, justify program costs, accountability, requirement for federal grant projects, diagnosing problems, evaluating practices, and enhance impact of operations. Simply, performance of a business can be measured, bottom line, as calculating the net revenue (Roberts, 2006, p.56). However, the study of 'basic issues in police performance' indicates inability to standardize performance measures due to complexity of police services (Whitaker, Mastrofski, Ostrom, Parks, Percy 1980). The study (1980) suggests that measurement should be designed to inform what police do and how the police agencies affect their communities.

Measurement in the comparative study of American policing is explored in detail by Maguire and Uchida (2000). Since establishments of most of the urban police departments as the



result of growing disorder and riots concerns in mid and late 1990s, different measures are collected to understand what police organizations do and what police organizations are. As the result of increasing inefficiencies and corruption in local governments, International Chiefs of Police Association (IACP, 2005) and some municipal groups started to collect data on law enforcement and crime statistics. Specifically, urge of IACP and FBI to professionalize the police brought more emphasize on crime fighting rather than other policing services in late 1920s. This point of the history is indicated where the role of police is profoundly characterized as crime fighting that enabled collection of uniform crime reports across the U.S. as to Uchida and Maguire (2000). Additionally, role of the discretion in police decision making is indicated important by Maguire and Uchida (2000) because police discretions can shape overall police organizations' character, image and style. Some of these discretionary decisions are stated as approach to the people, use of force, enforcement preferences, stops search etc. They think that “the discovery of discretion broadened our understanding of what police organizations do” (502).

In addition to focus on ‘what the police do’, specific data has been collected to measure what police organizations are’ (Maguire & Uchida, 2000). Descriptive data on police organizations has been collected intermittently such as by ICMA, PERF, BJS and NIJ grantees since 1930s. In general, these efforts included several topics about police personnel, equipment, practices, and salaries; however, a systematic data collection process did not take place in measuring internal characteristics of police agencies until Law Enforcement Management and Administrative Statistics (LEMAS) survey. Since 1987, LEMAS data is being collected from all large departments and sample of small agencies on more than 500 variables. In this nationwide survey, a law enforcement agency has been considered large if it has more than 100 sworn officers. According to Maguire and Uchida (2000), LEMAS datasets provides good quality of

data which are presented by Bureau of Justice Statistics (BJS, 2009) for practitioners and researchers. LEMAS datasets are also released on internet and used by the scholars for various purposes and analysis (see LEMAS section for further detail).

Because one of the core objectives of measuring performance is to meet stakeholders and customers' expectations of the police agency, these expectations should be appropriately considered within measurements (Roberts, 2006). Parallel to subjective and objective approaches in measuring, there are two main domains described as citizens and organizational capability in performance measurement of U.K. This scale, shown in the figure below, reflects an overarching focus on policing services where priorities are set based on national and local concerns that recognize impact of organizational capability. Current focus is organizational capability because GIS utilization is an organizational phenomenon not an individual trait. In this frame, 'organizational capability' addresses outcomes of the organization as the measure that are affected by resource availability and how these resources are deployed (Roberts, 2006).

In fact, GIS is a more comprehensive policing innovation than it is assumed. Systems such as GIS have much more analytical capability than producing simply crime mapping and hot spot maps, but the scope of the current study is limited to the use of these variables because of available direct data in the LEMAS survey. Respectively, the general capabilities of GIS and its use in policing are elaborated in the upcoming chapter.

This figure, below, was adapted from Creating Performance measures that work (Roberts, 2006, p.54). In this framework, performance measures are divided in to five main categories (Roberts, 2006). These measures are indicated as (1) input, (2) process, (3) output, (4) outcome and (5) impact measures. Identifying shortly, input measures are used to understand human and

capital resources and some of these can be crime incident reports by precincts, calls for service and surveys of residents.

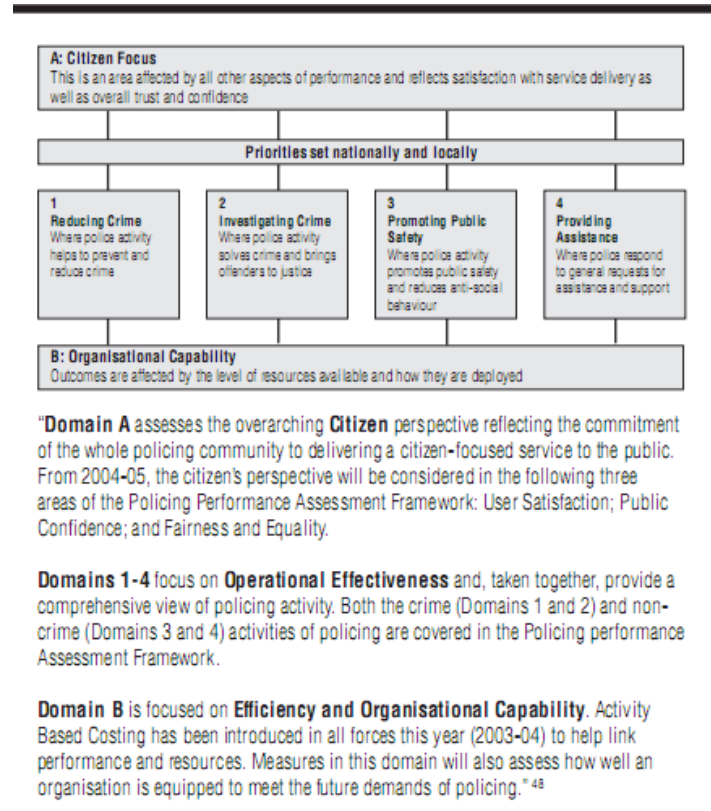


Figure 7: Policing Performance Assessment Framework in U.K.

Process measures are used to examine intermediate steps in providing service and some of these can be neighborhood watch program, distributed laptops, assigned officers to specialized units. Output measures are used to measure product or service of the police agency that are nature of reported crime and arrests, such as geographic distribution, time of the case, etc. Outcome measures are used to measure “expected, desired, or actual results(s) to which outputs of the activities of a service or organization have intended effect” (p.), such as, reduction in crime, decrease in number of calls. Finally, impact measures are used to measure direct and indirect effects of a program. Specifically, impact measures are considered when comparing outcomes of an organization where other organization does not have the same system. Impact

might be measured in four main ways as to Roberts (2006). The first one is “the decreasing volume and rate of reported violent and property crimes (outcomes)” (2006, p.56). Other impact measures are mentioned increase in arrests, enhanced perception of the community, and reduction in call for service. In fact, Maguire and Uchida (2000) think that collecting data only on arrest may not reflect accurate measurement of police organizations across the U.S.

In effect, ‘success’ may not be easily quantified while evaluating public programs’ performance. For this reason, proxy measures are used in order to capture outputs; therefore, success can be appropriately calculated (Swindell & Kelly, 2000). These outputs are assumed to be correlated with actual program outcomes. In this context, these proxies enable employees to maximize their works and also enable managers to be held accountable of managers based on their performance. For example, Swindell and Kelly (2000) examined correlation between citizen satisfaction results and internal performance indicators in 12 cities between 1997 and 1998. Police inputs, efficiency and outcomes were used as the data. Police inputs were listed as police expenditures, and number of fulltime staff while efficiency indicators were number of violent/ property crimes cleared, number of arrests, and number of violation citations. Outcomes were presented as number of violent and property crimes per ‘1,000’ population, average response time to service calls, and percentage of violent crimes cleared by staff. Accordingly, findings suggest that citizens are capable of distinguishing (%85) good and bad public services. Three limitations are addressed by Swindell and Kelly (2000) in this approach. First, this approach provides a correlation not causation. Second, correlation of the proxy and outcome may be weak. Finally, rational information about these proxies may not be entirely known.

Magnifying means and ends performance measures such as outputs, outcomes can help to find the appropriate measure for the focus of the current study. As to Moore and Braga (2003),

outputs of the policing refer concrete police actions as means of the police such as, patrolling, responding to calls for service, investigating and arresting to achieve other desired results. He thinks that police operations can be valued by considering simple policing outputs that may indicate customer satisfaction (Moore and Braga, 2003). “Organizational outputs are the specific things that the police do; desired social outcomes are the valuable results that occur in society as a consequence of what the police do” (Moore and Braga, 2003,p,2). Notable, Moore points out that outputs can be controlled and influenced easily by police agencies. However, the police may have less control on outcomes because outcomes are shaped other factors outside of the police. “The point is that outcomes are always valued as ends in themselves, while outputs are sometimes valued as means to important ends, and sometimes as ends in themselves” (2003,4). In fact, outcomes are shown as ends of the policing and they are considered "ultimate basis for evaluating police performance" (2003, p.3).

Considering mentioned literature above, current study prefers using objective measures of performance and organizational impact analysis. Within the frame work of organizational impact analysis, decrease in crime rate (Part 1 crime) is selected as an outcome performance measure for the study. This is operationalized as the crime rates as the dependent variable (DV) of the current study. Use of this DV is supposed to increase validity of the study because the police do not have so much control on crime by itself. “Although police organizations may have an effect on crime rates, crime is not an organizational property; in the parlance of performance measurement, it is an outcome rather than an output” (Maguire & Uchida, 2000; p.516). This comprehension is also explained below widely via presentation of causes of crime and theoretical explanations of crime. In addition to identifying overall crime rate as DV (1), property crime rate and violent crime rate are also considered as dependent variables.

Magnifying property crime rate (DV 2) and violent crime rate (DV3) dimensions can reveal different effects of computerized mapping on police performance. Specifically, use of GIS can improve policing performance in several ways mentioned above; however, the focus of the study is limited with measuring computerized crime mapping contribution in fight to crime as an organizational capacity.

Capacity and factors effecting capacity of an organization were explored within the study of 'Performance Measures in the U.S Counties'. In the study, capacity is conceptualized as "organizations' ability to achieve their aims" (Berman, E. Wang; 2000, p.210). In specific, receiving support from stakeholders and having adequate technical (infrastructure) abilities are operationalized as key capacities to implement intended reforms. Considering this contextual framework, the study assumes that implementation of a reform can become successful if both of these capacities are ensured in high levels. Although initial implementation efforts of reform did not necessitate high capacity, high capacity was found prerequisite to achieve widespread implementation and institutionalization of performance use in this study. In specific, adequate support was found among performance measurements user counties (39%), whereas, low level of capacity was found in less performance measurements users (9%). According to study of Berman and Wang ( 2000) conclusion, "the capacity requires that jurisdictions are able (1) to relate outputs to operations; (2) to collect timely data; have (3) staff capable of analyzing performance data; (4) adequate information technology; and support from (5) department heads and (6) elected officials" (417).

In fact, GIS is a more comprehensive policing innovation than it is assumed. Systems such as GIS have much more analytical capability than producing simply crime mapping and hot spot maps, but the scope of the current study is limited to the use of these variables because of

available direct data in the LEMAS survey. Respectively, the general capabilities of GIS and its use in policing are elaborated in the upcoming chapter.

*“What do we know about crime control effectiveness? The general principle is that police should be <<intelligence driven>>. By this I mean that they combine careful and systematic analysis of their crime problems with sophisticated management, so that they can respond to what they have learned. Finally, they need an organization that is nimble enough to respond what it knows. But isn't this what the police already do? The (National Resource Council) panel concluded that too often the answer is <<no. >> Instead, police are mostly blindly reactive. They try to respond quickly when they are connected about a crime, and they evaluate their effectiveness by how fast they drive to scene<sup>6</sup>” (Skogan, W.G., 2003; p. 168).*

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<sup>6</sup> Improving police practice through research: Recommendations of the U.S. National Research Council. International Annals of Criminology, 41(1/2), 167-176.

## CHAPTER 4

### Geographic Information Systems

In the literature, the development of land use systems in the United Kingdom and the Canadian geographic information system, managed by Tomlinson, are recognized as the earliest GIS examples (Harries, 1999; Gilfoyle & Thorpe, 2004; Chainey & Ratcliffe; 2005). The role of the military in developing a main digital platform is mentioned as another earlier use of GIS that was aimed at displaying and analyzing the imagery for intelligence gathering (Chainey & Ratcliffe; 2005; p.2). In the 1960s, GIS was used in decision making as a science tool instead of for administrative tasks (Gilfoyle & Thorpe, 2004, p 5). The first known journal of GIS was published in 1987—it was called the “International Journal of Geographic Information Systems” (Masser and Onsrud, 1993). Research in GIS based mapping started with the examination of North American cases in the 1990s (Ratcliffe & McCullah, 2001). Although the GIS phenomenon dates back to the 1960s, the emergence of GIS supportive technology is attributed to after the mid-1980s (Masser & Onsrud, 1993).

Due to high costs in adoption, a handful of police departments were able to start GIS utilization in the late 1980s. True affordability came in the 1990s when personal computers became available (LaVigne & Groff, 2001; Chainey & Ratcliffe, 2005). A number of cities in North American states such as New York, Minnesota, Maryland and some British cities are mentioned as early GIS adopters (Gilfoyle & Thorpe, 2004). In the late 1980s, the National Institute of Justice granted the Drug Market Analysis Program (DMAP) to five sites in the U.S. This enlightened the significance of GIS use in the police’s fight against crime (Rich, 1995). The findings of these studies received great attention from both practitioners and researchers



(McEwen & Taxman, 1995; LaVigne & Groff, 2001). After the accomplishment of DMAP projects, many crime mapping projects were initiated in police agencies. At the same time, the automated mapping function and its high speed are described as the main strengths of GIS technology (Groff & La Vigne, 2002). Over the years, developments in GIS, such as increases in data abilities, user friendly software, and smaller and cheaper computer systems promoted the prevalence of GIS utilization (Gilfoyle & Thorpe, 2004, p.9).

Widespread GIS diffusion started in the 1990s in British local governments. According to LaVigne and Groff (2001), use of GIS technology increased rapidly after the mid-1990s in the U.S. and its main products evolved from descriptive mapping to more analytical efforts. The GIS industry improved and was introduced into several new areas such as planning, health, and policing and crime reduction at this stage (Chainey & Ratcliffe, 2005). Investment in the technological innovation of policing within the context of crime fighting has considerably increased in last decades. According to the U.S. Department of Justice records of 1999, more than \$6 billion were delivered in grant funds to 11,300 police agencies (Brown, 2001). Community Oriented Policing Services Making Officer Redeployment Effective (COPS MORE) enabled most of these funds in order to increase the effectiveness and efficiency of the police. Chainey and Ratcliffe (2005) claimed that innovation in crime mapping was driven by NIJ's Crime Mapping Research (CMRC) program which was established in 1997. The CMRC surveyed police departments to determine how they use analytic mapping. This study enabled development of training to enhance use of maps and geo datasets. The program was renamed as Mapping and Analysis for Public Safety (MAPS) in 2002. Chainey & Ratcliffe (2005) believe that the impact of this program did not remain isolated within the U.S and constituted the foundation for the program's development in other countries.

## 4.1 What is GIS?

Several scholars provide definitions to identify geographic information systems (GIS) (Harries, 1999; Ceccato & Snickars, 2000; Boba, 2005; McDonald & Kemp, 1995) and to explore the functions of GIS (Leipnik & Albert, 2003; Canter, 2000), yet there is no universal GIS definition (Leipnik & Albert, 2003).

Harries (1999) defines GIS as “a computerized mapping system that permits information layering to produce detailed descriptions of conditions and analyses of relationships among variables”. From another perspective, “any system that permits the representation and analysis of geographic information is a geographic information system” (92). According to Harries, GIS refers to computer-based software packages. Pattavina (2005) recognizes MapInfo, ArcView and CrimeStat as the the most frequently used GIS software packages for crime mapping and analysis (Pattavina, 2005). In fact, GIS is not only software, it is also a system that necessitates data, hardware, software, people and procedures (Leipnik et al., 2003).

According to Ceccato and Snickars (2000), GIS is a tool combining databases to visualize attributes of an issue with geographic coordinates. These attributes may be represented as points, lines or areas. According to Boba, (2005), GIS is defined as “a set of computer based tools that allow the user to modify, visualize, query, and analyze geographic and tabular data” (p.37). In fact, GIS is one of the most advanced computerized tools for producing various types of maps. As an output of GIS, maps are presented as essential instruments in order to find emergency routes for reaching specific locations, to determine the patrolling of an area, and for redistricting police sectors (Boba, 2005). Although crime mapping is one of its most used feature, GIS also allows users to see beyond geographic boundaries on maps via manipulation of the data and

statistical functions. According to Ceccato & Snickars (2000), GIS is also used “increasingly as short hand for a great diversity of computer-based applications” (923).

Leipnik and Albert (2003) consider GIS as a powerful tool for spatial analysis. While using GIS, specific features can be represented in separate layers, such as schools, parks, crimes, etc. All of these features can be shown in one base map based on a coordinate system. Then, specific attributes can be inquired on this digital map and database. Additional tables can be related to these maps and the data can be manipulated if something needs to be added, deleted or changed. According to Leipnik and Albert (2003), GIS can be used by crime analysts, computerized crime record management personnel, police executives, shift supervisors, patrol sergeants, and even patrol officers. In fact, deployment of non sworn officers is also very common for specialized services. Mapping abilities, statistical tools, spatial analysis capability, identification of hotspots and interactive availability are some of the most known GIS functions.

According to Canter (2000), all geographic information systems have two common functions: These are to display maps, geographic features and to have a database that stores and relates geographic and other types of data to desired maps. These two main functions are linked on a digital base map; therefore, desired attributes can be related and mapped accordingly. Canter (2000) divides GIS utilization into three groups: forward mapping, backward mapping and interactive mapping. Forward mapping provides descriptive distribution of crime incidences while backward mapping allows hypothesis testing, analytical cluster analysis, and quadrant analysis. Interactive mapping (data modeling) involves prediction and simulation of events, crimes, and tasks. In this mapping, a strategy can be evaluated or assessed once necessary models are developed.

The current study uses the working definition from the international GIS dictionary (McDonald & Kemp, 1995) as did other researchers (Gilfoyle & Thorpe, 2004; Chainey & Ratcliffe, 2005). GIS is here defined as “a computer system for capturing, managing, integrating, manipulating, analyzing, and displaying data which is spatially referenced to the earth” (1995, p.42).

According to Gilfoyle and Thorpe (2004), “there is still disagreement about what exactly constitutes GIS and what functions they should perform. This is partly because they have grown out of a number of technologies—computer assisted mapping and design, remote sensing, digital mapping, database management, image processing—and a variety of applications and people see GIS from their own particular point of view. Above all else, GIS are integrating technologies” (Gilfoyle & Thorpe, 2004, p.6).

The definition of GIS involves several functions and is open to integrations with other technologies mentioned above. It is essential to clarify here which functions of GIS this study focuses on. In this respect, providing a conceptualization of what GIS use means lays the common ground for the study. Before presenting the conceptualization of GIS, some of the major questions in GIS research are answered in different subsections in light of reviewed literature. These questions are: Is GIS an innovation? What are the benefits of GIS use? How is GIS adopted in organizations? What are the failures, barriers, and challenges in GIS adoption? How do police agencies use GIS? What are the differences among GIS, crime mapping and crime analysis? How does GIS contribute to local governments? How does GIS help the police in fighting crime?

## 4.2 Is GIS an innovation?

Identifying innovation can facilitate comprehension of GIS among police innovations. An innovation is defined basically as “ an idea , practice, or object perceived as new by an individual or other units of adoption” (Roger, 1983;1993). King (2000) identifies three type of innovations which are a process (Wilson, 1968), a discrete product or program (Kimberley, 1981), and “a new to policing” (Weiss, 1992). In this framework, diffusion of innovation occurs when four elements, (communication through channels, over time and among the members of social systems) take place (Rogers, 1993). Rogers (1993) defines GIS as “computer based tool for analysis and can be applied by users to an extremely wide range of problems” (21). Everett Rogers identifies GIS as an innovation in his keynote speech in1992 and addressees its diffusion as in the early phase of the S shaped curve (Masser & Onsrud, 1993). In this perspective, scholars examined factors influencing diffusion of GIS innovation (Rogers, 1993), and explanatory theories to understand GIS diffusion (Campell & Masser, 1995).

Rogers (1993) points out three important factors that can influence diffusion of GIS innovation. First, GIS innovations are considered as re-inventible adaptations; therefore, the study of diffusion may encounter several problems in its comprehension. Second, GIS is indicated as an evolving technology that has been changing constantly over time. This also complicates its identification. Third, GIS innovation is acquired by organizations not by the individuals. That means there can be a variety in GIS utilization in organizations. Adoption of GIS innovation is also different from other innovations because of its complexity in use (Gillespie, 2000) and necessary support from capital and human resources. Its data need is

different than classical data because a geographic type of data is required which requires different handling storage and manipulation techniques.

Campbell and Masser (1995) examine three explanatory theories to understand GIS diffusion. Three theories are technological determinism, economic determinism, and social interactionism. Technological determinism emphasizes the advantage of new technology over existing practices. Economic determinism perceives computerization as a necessary means for survival in the public and private sectors. Social interactionism explains technology as a social construct emerging as the result of interactions among cultural, organizational and contextual elements.

Considering the limitations mentioned above (Rogers, 1993), a “need for a more sophisticated treatment” in national longitudinal studies and the ability to search by using new criteria to measure the value of GIS in organizations, institutions and society are suggested. This will break down barriers presented in the current research by Masser and Onsrud (1993, p.4-7). Mazeika (2008) asserts that research on diffusion of innovations is high, but little research is available on the subject of measuring police innovations (Klinger, 2004; Weisburd & Braga, 2006).

### **4.3 What are the Benefits of GIS Use?**

The benefits of GIS use are various and depend at what stage/level the organization happens to be (Sieber, 2000; O’Looney, 2003; McDonald, 2005). Previous research explored GIS benefits in British local governments (Campbell & Masser, 1995; Gilfoyle & Thorpe, 2004), as well as in the U.S. local governments (Budic, 1994; Mamalian & LaVigne, 1999; Greene,

2000; Gillespie, 2000; Tennant, 2001; O'Looney, 2003; Demirci & Suen, 2006; Smith, 2007; Ashby et al., 2007).

British local governments state that the most important benefits of GIS use in the 1990s were improved information processing (61%), better quality decisions (21%), general savings, (11%), and other (7%) miscellaneous benefits (Campbell, & Masser, 1995). According to Gilfoyle and Thorpe (2004), GIS adoption may have effect several issues within the organization. These possible impacts are work practices, information flows, management, and staff and organizational culture.

In terms of operational and decision making effectiveness, Budic (1994) found increased effectiveness in communication of information, accessibility of data, confidence in analysis and identification of conflicts. These mean easier identification in conflicts, increased analytical capability and shorter time to make decisions through the use of GIS.

Mamalian & LaVigne (1999) examined the U.S. local governments in a nationwide survey. According to this study, the benefits of GIS use are established as improving information dissemination, and administration and evaluation of police agencies. The contribution of GIS use in the sphere of decision making also received considerable attention among scholars.

According to Greene (2000), the potential of GIS is limited only by the imagination of users. One of the core strengths of GIS is indicated as linking an unlimited amount of information with a geographic location because maps are facilitator tools to enhance communication that bridges the gap between parts (100). Another important aspect of GIS is stated as visualization power that can influence people. This feature of mapping is very

supportive of the human brain in decision making because much space in the brain is devoted to visual interpretations (Hirschfield & Bowers, 2001, p.6). According to Greene (2000), “the human brain works so the connections are so perfectly obvious.” This can be interpreted as stating that visual representation of crime analysis can facilitate the location of better solutions to tackle crime problems. GIS is considered effective in “disseminating valuable timely graphical information to citizens and officers” (27). Effectiveness of a service delivery can be measurable via GIS (p. 28). Produced maps are also seen as important in confirming, assuring or validating prior estimations or insights which are somewhat already known anecdotally (32). Additionally, increased GIS capacity can allow utilization of interactive features, displaying pictures, charts, aerial photographic images, modeling, video or more details of a targeted event within additional layers. Most of these products can be presented on screens, paper outputs, e-mails, and through online information and webcasts to the interested parties. In a wider context, Greene (2000) articulates that “the digital age has given new value to that commodity known as information. But those who participate in a democratic system have always known that information is its lifeblood. As an information source, GIS is providing a new and powerful paradigm for governing ourselves” (Greene, 2000, p.xii).

Gillespie (2000) applied an empirical approach to estimate GIS benefits. His findings indicate that the complexity of GIS application is the critical factor having influence on the level of benefits. The complexity of GIS consists of input complexity, analysis complexity and output complexity.



As to Tennant (2001) the police benefit from GIS use in augmenting traditional functions, such as crime analysis, and information dissemination; and enhancing problem solving, such as, community and problem-oriented policing and other task forces (As cited by Boba, 2005).

The decision making ability of local organizations is also found to have improved by use of GIS in terms of cost of testing probable models, invested time and effort (O'Looney, 2003). According to O'Looney, there are three ways with which GIS can have effect on decision making. These are making information visual, defining problems from a new perspective (geographic point of view) and misleading the unwary. He also states that, "improvements in services, equity, and the quality of decision making may be the real pay off" (13). Furthermore, problem solving and consensus making are claimed to be on the rise because of GIS use.

According to Suen (2006), GIS facilitates the management of databases in computer based systems which enables visual displays and map production. In addition, GIS allows synchronized visualization of updates based on available data. According to Suen (2006) expansion of GIS will continue depending on technological advances and demand for specialized services (2006).

Smith (2007) discusses competitive advantage of GIS utilization. GIS utilization is considered as continuance in successfully GIS use. In this frame, the study indicates that GIS utilization can provide competitive advantages in security and planning activities in today's market. The discussion mentioned the advantages of GIS use in strategy selection and decision making for both business and governmental authorities. He also notes increasing operational efficiency if digital data processing features are available.

Ashby and colleagues (2007) define GIS as a back bone technology of the local government. Accordingly, GIS is a practical and rational tool to measure local service demand, delivery of services and their performance. Its utilization can facilitate the process of anticipating, properly accommodating, and prioritizing demanded public service delivery. In the study, GIS strength in clear visualization and spatial analysis are underlined; however, using professional GIS software is indicated as largely unnecessary.

#### **4.4 How is GIS Adopted in Organizations?**

Scholars have explored adoption phases of GIS because "simply acquiring a new system doesn't automatically guarantee its successful adoption and diffusion throughout the local government organization" (Budic & Godschalk, 1994; p. 38).

In this context, previous research explored diffusion levels, phases, forms and strategies in GIS adoption (Budic & Godschalk, 1994), expected adaptations in local and regional governmental agencies in the U.S. (Wiggins and Pincus, 1992), GIS adoption facts in British local governments (Gilfoyle & Thorpe, 2004), the use of computerized crime mapping by law enforcement (Mamelian & LaVigne, 1999) and categorization of GIS adoption (Campell & Masser, 1995; O'Looney, 2003).

There are various diffusion levels, phases, forms and strategies in GIS adoption. Budic and Godschalk (1994) examined GIS adoption in local governments. In their study, two levels of GIS diffusion—macro and micro levels—are identified. Macro level diffusion refers to an organizational decision to acquire technology. Micro level diffusion refers to purchase of technology by an agency and its diffusion within the organization. In this study, two phases are

addressed as vital in adopting GIS. These are the initial and implementation phases. The initiation phase aims to gather adequate information about technology to make decision to innovate. This phase evaluates costs and benefits of GIS considering individual and organizational motivations. The implementation phase involves installment of GIS technology, database management, its maintenance and utilization of technology. This phase requires technological and organizational support. The implementation of GIS also differs based on staff and agencies. In this regard, four general forms of diffusion are identified that may develop: top down, bottom up, bidirectional and lateral. Notably, these diffusion forms may or may not follow the hierarchy of organization. Finally, GIS implementation follows five different strategies which are bang-bang, parallel running, phased introduction, trials & dissemination, and incremental evolution. In summary, GIS diffusion occurs through making a decision to innovate, the acquisition of technology, and implementation and adoption up to the end users.

Differences emerge about level, type and intensity of GIS use based on organizational needs (Budic & Godschalk, 1994). Level of GIS use involves mapping, data analysis, synthesis, and management of the system. Intensity refers to frequency of GIS use that may be daily, weekly, monthly, annual, etc. And, the type of utilization refers to a place where GIS service is provided. For example, GIS can be provided directly or indirectly by other agencies or departments. From this perspective, the current study focuses on a level of GIS use which is computer mapping. Budic and Godschalk (1994) also note that "implementation of GIS technology at the organizational level cannot be considered successful without at least minimal staff capability to use the technology for performing organizational tasks".

The implementation success of information technology is indicated as a multidimensional concept (Goodman, 1992; Budic, 1994). Goodman articulates that the “meaning of implementation success is inherently ambiguous” (1992, p.49). Although he presumes that many new GIS initiatives will probably fail, the proliferation of new information technologies are expected. Reviewing research on the categorization of GIS adoption (Campell & Masser, 1995; O’Looney, 2003) and factual success rates of GIS adoption (Wiggins and Pincus, 1992; Mamalian & LaVigne, 1999; Gilfoyle & Thorpe, 2004) can enhance GIS understanding for the study.

The categorization of GIS adoption is presented in several ways by scholars (Campell & Masser, 1995; O’Looney, 2003). GIS implementation is categorized by Campell and Masser (1995) in three ways which are: the classical corporate approach (top-down fashion), the independent approach (single department championing which is an incremental approach to GIS infrastructure), and theoretically and pragmatically, the corporate approach (a mixed-model of GIS). O’Looney (2003) groups GIS implementation in the following phases: beginning, intermediate and advanced phases. At the beginning phase, one person applies GIS with limited ability, training and time. Mostly descriptive mappings are outputs of this phase of GIS implementation. The second phase is called the intermediate term where more standardized data is available with enhanced skilled persons in criminal justice. More productive exploratory maps, most probably analytical mappings, are prepared at this point. At the third phase, GIS is utilized by members of the competent team where they can access essential data sources, and several technologies can be integrated into the main GIS system. A variety of data analysis projects can be executed at the same time and they can be shared with other organizations.

Wiggins and Pincus (1992) used mail surveys to examine opinions of the expected adaptations within two years in local and regional governmental agencies in the U.S. The responses changed from 40% to 90%; whereas, the actual GIS adoption rate was 13% among responding agencies. A similar difference was experienced for the Massachusetts survey where reported expectation was 57% in 1989, whereas, actual rate was only 7%. In 1992, this rate increased to 13% in Massachusetts. After reviewing 11 different surveys, Wiggins and Pincus (1992) conclude that great optimism exists in GIS adaptation; however, actual adaptation can be understood better by setting up longitudinal research.

Gilfoyle and Thorpe (2004) present GIS adoption facts in British local governments. As of 1993, 29% of all local authorities adopted GIS in Great Britain. Planning departments were the pioneers and mostly, single departments were adopting GIS (23). In 1996, most U.K. local authorities were able to adopt at least one GIS within their organizations and local governments were found to be the major GIS users (25). Yet, although the prevalence of GIS in local governments was obvious, most governments had only five or less personnel for the positions and national surveys indicated that only 30% of the geographic information systems were fully operational. As of 2000, 56% of local authorities announced that their GIS utilization was fully operational. To meet the e-government vision of the Great Britain, all local governments were asked by the prime minister to have the capability of electronic delivery on all public dealings by 2005 (2004,11).

Mamelian and LaVigne (1999) examined the use of computerized crime mapping by law enforcement with a nationwide survey (CMRC). Findings showed limited local resource availability, time and training as key considerations in decision making to adopt and maintain

GIS service (Mamelian & LaVigne, 1999). Remarkably, 84% of the crime mapping user departments reported that their leaders were financially supporting mapping projects, and 85% of leaders expressed that “mapping is a valuable tool for the department”. Probably, knowledge and experience based belief of leadership can be one of the main drivers of continuing GIS efforts. One of the potential contributions of the current study is to support this belief (role of form of governments) via analyzing GIS effects on police performance and exploring its general contribution to same (Mamalian & LaVigne, 1999). In addition, non adopting departments noted that having simpler software for crime mapping which requires minimal training would be very useful to adopt.

Some scholars explored the correlates of successful GIS adoption (Onsrud & Pinto,1993), the factors of GIS implementation (Budic, 1994), the factors improving chances of implementation success (Campbell, 1994), the development of the GIS process (Anderson,1996), the proper place for the most successful GIS adoption (Ratcliffe, 1998), the analysis of groups of people using GIS in an organization (Roodzand, 2000), the adoption of GIS in different country cultures (Eric and Toorn, 2002), the establishment of a corporate GIS in British local governments (Gilfoyle & Thorpe, 2004), the adoption of computerized mapping in municipal police (Chamard, 2004), the existence of two separate sets of factors for GIS adoption and use (Skogan & Hartnett, 2005) and diffusion, and the impact and contribution of crime mapping across time and space (Demir, 2009).

Onsrud and Pinto (1993) studied the correlates of GIS adoption and the characteristics of successful GIS users. According to them, adoption success requires acquisition, implementation and use success. This should represent a level between no utilization and high utilization. The

most important factor explaining adoption success was determined to be the utility of GIS. Utility refers to advantageousness, easiness, consistency with organizational goals, and developable uses of the new system. The past history of failure in adopting computerized systems was found to be a second important variable. Having GIS consultants (champion) and cost considerations were established as other important variables. Notably, champions were found to be very influential in acquiring GIS at the outset, but they show less influence later on when fully utilizing the technology in the organization. Onsrud and Pinto (1993) also noted that insisting on case studies inhibited the achievement of generalizable methodologies and findings.

A study by Budic (1994) elicited seven factors in the implementation of GIS. These are political support, staff support, experience with GIS, comprehensiveness of a GIS database, number of GIS applications, type of GIS applications, and system sharing.

Four factors are identified by Campbell (1994) in improving chances of implementation success. These are simple applications, participation of users in implementation, recognition of limits of available resources, and organizational desire to change.

Considering that an organization is a collection of people, Anderson (1996) examined the development of the GIS process. Accordingly, the level of people's participation can determine the success of GIS implementation. Specifically, elected officials, managers, users, and GIS technicians' commitment to implementation is stated as central. Simply, GIS implementation necessitates the purchase of a system (hardware and software), the installation and operation of such system, and database creation. Accordingly, technical, organizational and human support determines the success of GIS utilization. This implementation is stated as a process where "a GIS will continuously evolve" (24). Anderson (1996) concludes that ignorance of participants'

realities will most probably obscure implementation success of GIS. She notes that "to continue applying traditional, linear, solutions, to a multifaceted problem is to court disaster" (124).

Ratcliffe (1998) supports use of a centered approach in GIS use. This is described as ability and a requirement driven approach. He asserts that the most successful GIS adoption can be probable if it is set up in a crime analysis unit, as a user driven and department controlled system by GIS users.

According to Roodzand (2000), three groups of people use GIS in an organization (as cited in Gilfoyle and Thorpe, 2004). These are viewers, users, and doers. Viewers refer to people who view the information whenever they need. Users view and utilize the information for day-to-day, routine activities. And, doers refer to responsible operative people who have strong abilities in GIS utilization and data management.

Sieber (2000) examined GIS implementation in California within a five year case study. The researchers in this study revealed four implementation models in general. These are organizations who want GIS, and those who want maps, a consortium and independence. The organizations who want GIS "reflect an organizational desire to have representational and analytic capability of GIS in house" (19). This necessitates that the agency acquires and maintains essential software, hardware data and paid staff by itself. In this system, agencies can have the greater control on GIS design, time of output delivery and extent of the details. Additionally, GIS utilization predominantly takes place among the organizational users. An organization that wants maps "reflects a desire to possess GIS output (and possibly limited analytic or thematic mapping capacity) but neither the hardware/system nor the technical does have the expertise to maintain a system. The predominant "end-user" of GIS services is within



the organization” (Sieber (2000, p.19). The main difference between these two is the outsourcing. The second type of organization outsources its GIS services. This enables lowering technology staff and maintenance costs but limits the organizational capability because of a restriction to using only core functions of GIS. It can be fairly said that the first type of organization is supposed to have more analytical capability in both managerial and operational issues than other organizations who want maps. Sieber (2000) indicates that maps desiring organizations can be successful in small towns however; more sophisticated data analysis is needed for larger organizations.

Erik Man and Toorn (2002) studied adoption and use of GIS in different country cultures. They established the importance of social conditions in the place of adoption. Specifically, two issues are indicated as important in GIS adoption. One is cultural desirability which refers to dependence on particular cultural conditions in adopting GIS. This relies on the idea that "one cannot simply copy GIS applications and related organizational structure and procedures from elsewhere” (61). This means that a culture can support GIS adoption if the people live in the same or similar cultural topology. The other is feasibility which refers to usability of GIS. Adoption and sustained use of GIS rely on a combination of cultural desirability and feasibility.

Gilfoyle and Thorpe (2004) indicate internal and external drivers of GIS and its management in British local governments. Internal drivers involve businesslike approaches in local government, an integration of corporate information sources, a desire for efficiency in data processing, a commitment to championship efforts on change, a desire for a more comprehensive and effective decision making process, and a desire to share information with the public. External drivers involve rapid growth of internet and digital data, low cost hardware with user

friendly software, emergence of standards in data processes, increasing spatial awareness, public expectation, new momentum in environmental and regional agendas, and increasing need for information sharing on crime, disorder, works, emergencies and the provision of welfare services. The authors (2004) also underline the role of championship in initiating GIS adoption as a politician or officer who has ability to combine knowledge of the organization within a system in an innovative way. It should be noted that building up a corporate GIS with relevant functions of organization may produce many benefits; however, many of these separate operations may need different professionalism and efforts to practice and research (Gilfoyle & Thorpe 2004, p.36). Specifically, standardization of available data, integration of data sources and data sharing issuers are recommended issues to increase capacity of GIS use.

Chamard (2004) examined the adoption of computerized mapping in the municipal police departments of New Jersey. Examination of 347 police departments showed that 13.5% of them adopted computerized mapping. In the study, department size was found to be strongly related with computerized mapping use. In particular, large police agencies that have more than 100 sworn full time officers would more likely adopt computerized mapping than midsize (50-99) (two times more) and smaller agencies (10-0) (six times more). Notably, no evidence was found showing that larger police agencies are the earlier adopters when compared to the smaller agencies. The study concluded by indicating importance of being aware of the barriers that may be encountered by small agencies in adopting mapping.

The study of Skogan and Hartnett (2005) found that "one set of factors is associated with the adoption of innovation and another set is associated with the extent to which it is used" (412). It is criticized by Skogan and Hartnett (2005) that most of the diffusion studies in police

organizations select a dichotomous variable to measure adoption. In fact, the extent of use of innovation changes considerably in different police departments. This is why the extent of the adoption can be measurable best by the system use (411). System use was found to be affected by internal and external factors in the same study. The heaviest innovation users were found to be the resource holder departments that are facing higher crime rates than others. A higher level of innovation utilization was linked to police agency staffing and budget. In other words, factors affecting the use of innovation are stated as resources and experience. The importance of the extent of resources as financial and human capital is also shown in the adoption. In general, non adopter organizations are stated as being poor in resources. The innovation utilization rate was correlated to department expenditures and the number of sworn personnel. Police budgets were heavily correlated with staffing levels (0.74) and strength of department was correlated with crime rate. As cited in the study, Parks and Wilson (2003) argue that the size of the agency can measure the organizational capacity and resources that may support targeted innovation. Funding of COPS was also found to be advancing the adoption. The extent of human resources, such as managers who promote innovation, line personnel who have adequate ability to solve problems, and specialized personnel who are trained enough in use of innovation are also indicated as contributive to innovation (Skogan & Hartnett, 2005). The experience of the police agency was measured by the agency that collects the additional National Incident-Based Reporting System (NIBRS) crime data which facilitates use of innovative technology. Larger departments were found to be intense users. Parks and Wilson also found that the longer the innovation is used the more benefits emerge. The crime rate was not found to be significantly relevant with use of IT in this study. Finally, the authors suggest that adoption can spread rapidly if the philosophy of the new innovation is compatible with the formal and informal organizational cultures. It is apparent

for them that a rapid growth of system use is relevant with three factors: The active role of the hosting department, free access to the system and empowered staff by the use of GIS. It is also noted that utilization of GIS did not challenge the traditional police mission and others who participate in the process. As cited in the study, Grubler (1996) indicates that the span of innovation is between 15-30 years. In this frame, a Compstat-like systems' extension is claimed as one of the most fast diffusing innovations from 1996 to 2006.

In a comprehensive dissertation, Demir (2009) examined the diffusion, impact and contribution of crime mapping across time and space. The findings of the study showed the existence of a spatial dimension in the diffusion of innovations. Specifically, spatial proximity was found to be influential in the diffusion of crime mapping over time that means close police departments are more likely to adopt mapping technology. Additionally, the study found relationships between adopters and non-adopter police agencies in crime rates, people living in urban areas, poverty, population density and total population.

#### **4.4.1 Failures and Barriers in GIS Adoption**

Although successful implementation of GIS emerged as a growing body of research, some scholars shed light on obstacles to successful system implementation (Croswell, 1989), failures in GIS adoption (Ratcliffe, 1998), barriers to implementation (Ramasubramanian, 1999), challenges of crime mapping implementation (Mazerolle et al, 1997), failure of crime mapping integration (Weisburd & McEwen, 1997), barriers in implementation and effectiveness of GIS Kerski (2003), problems between crime analysts and police officers (Cope, 2004), obstacles facing GIS diffusion (Gilfoyle & Thorpe, 2004), and causes for stopping use of mapping (Chamard, 2006).

After evaluating 39 articles, Crosswell (1989) indicates obstacles to successful system implementation as institutional values. In general, these are presented as the vision of the senior management, the talent of mid-level managers, and the dedication of users to operate and develop the system.

Ratcliffe (2002) considers GIS adoption failures. These might stem from organizational resistance, utopist expectations of the system, and technical difficulties. Several technical issues are also mentioned as difficulties in using GIS. The most time and effort consumed in mapping is said to be for preparation of police datasets. Secondly, accurate geocoding is required in order to display the data on a map.

Weisburd and McEwen (1997) articulate the emergence of crime mapping as a major tool in preventing crime, and one that has garnered “an explosion of interest among both scholars and practitioners” (4). Although much attention has risen about the potential of crime mapping, few police departments had been able to integrate it into police operations until 1998. They stated that failure of integration efforts were raised as the result of not using essential theories and academic perspectives with mapping. “Practitioners could count on little help from the academic community” in regard to crime mapping. Prior maps were not much more sophisticated compared to traditionally using handmade pin maps. Produced maps were seen in household products and they were not shared with academicians, the community and other governmental units. In addition to the foregoing, technical inabilities, such as lack of computerization, quality of data, and compatibility of data and systems constituted obstacles to the spread of automated mapping. Finally, Weisburd and McEwen (1997) articulated that “each time that mapping has

emerged as a crime analysis method of crime prevention tool; technological or theoretical barriers have prevented its full-scale development and application” (12-13).

Ramasubramanian (1999) studied GIS implementation in developing countries. In this study, barriers to implementation are referenced to resource constraints, inadequately trained personnel, organizational resistance, and language, cultural, and structural constraints. He suggested understanding, explaining, and critically evaluating the study area to link and communicate with others. The study also (1999) noted that early GIS users prefer the use of mainly mapping while successful organizations have been integrating their technology by day-to-day operations. Adopting crime mapping in police agencies is not a simple, straightforward process.

Mazerolle and colleagues (1997) reviewed the challenges of crime mapping implementation. The first challenge arises when attempting to make a decision as to where to set up the crime mapping tool. These areas can be selected within crime analysis, planning offices or street level problem solving. All these places can change based on what one wants to do in the policing sphere. The second challenge is attributed to technical difficulties such as integrating a personal computer: PC to mainframe computer, archiving, integrity of data, and mapping. The customization need of menus to have a user friendly environment is also shown as another challenge. The authors suggested that the power of mapping can be increased if it is applied in planning for testing pilot projects and solving their logistical problems. In summary, the study concluded by addressing the importance of thinking "who, what, where, when and how the system will be used and then design the system data sources and interfaces accordingly" (1996, 132).

Kerski (2003) examined the implementation and effectiveness of GIS in secondary education. Technological barriers were found to be less important than political, social and educational factors, such as the time required to invest in developing GIS based modules and inadequate training. Findings showed that GIS use affects communication, methods of teaching and learning. This means that the manner of teaching and learning changes when GIS is used in education.

Cope (2004) studied integration of crime analysis in two police forces. The study findings confirmed the importance of the common belief that crime analysis is prepared to guide police activities specifically in targeting crime; however, the efficacy of practice was found to be different from what is expected. First of all, the study indicated that this finding stems from the poor understanding of analysis among police officers and the lack of consensus among the analysts in guiding police operations. This confusion also inhibits cooperation among these parties in extending efforts for analysis and operations. Secondly, police understanding is very different from a crime analyst's understanding. Police understanding is contextual and subjective, whereas, crime analysts' understanding is out of context and mostly objective (Cope, 2004). This might also produce different interactions when a crime analyst comes from a civilian or police background. These facts were claimed to bring more legitimacy or respect to the produced knowledge of crime analysis. Cope's study (2004) concluded by suggesting more training and development to constitute a more productive environment for police officers and crime analysts.

According to an information technology survey of 2000 in planning departments in London, several restraints were reported as being obstacles facing GIS diffusion (Gilfoyle &

Thorpe, 2004). These issues are grouped into five categories, namely, inadequate resources, insufficient awareness of GIS, lack of strategy, inadequate GIS skills-training, and technology and data problems (2004,p. 40). According to Gilfoyle and Thorpe (2004), there seems to be no single blueprint for GIS adoption and three important areas may need more consideration in order to have successful adoptions from prior experiences. These are information management strategy, commitment of individuals at all levels, and coping with change.

As of 1999, 40% of the computerized mapping using agencies stopped using mapping (Chamard, 2006). The Police Foundation (2000) found that police agencies have been experiencing difficulties in finding interested persons to learn the new technology. It was found that larger departments would not stop using it; whereas, 48% of smaller departments stopped using the innovation. Chamard (2006) pointed out that lack of adequate personnel employed in technical support, addition to department size, and disengagement in using mapping for problem oriented policing or crime analysis are the leading factors when it comes to stopping mapping. Discontinuance in use was found to be significantly related to smaller populations in police and the general public. Technical issues, the cost of having a base map and the maintenance of the systems are indicated as other possible reasons for discontinuing service. Rich (1995) also indicated difficulties in having data, in regards to its quality, and compatibility. Chamard (2006) concluded by stating that most of the mapping adopters are able to produce simple maps, whereas, sophisticated mapping is needed to examine underlying factors of crime.

#### **4.5 Challenges in GIS**

Manning (1992) criticizes some technological advances, such as computerization, finger print systems, and DNA investigations in improving policing and questions their potential



contributions. Actually, he assents a parallel analogy about the role of technological innovations such as radio, patrol vehicle, and computers in improving policing in his study, but he argues for the significant positive effects of technologies without underestimating the difficulties.

Considering Manning's views, this section reviews the challenges in GIS use.

Although most of the studies optimistically examined the positive contributions and reasons for GIS use, some scholars also shed light upon the cost of GIS adoption (Brown, 1996; Harries, 1999), the costs of converting data, buying maps, training (O'Looney, 2003; Gilfoyle and Thorpe, 2004; Thorpe, 2004), the role of funds (Police Foundation, 2000), technological, organizational and financial constraints (Manning, 1992; Brown, 1996; Pattavina, 2005), challenges in using GIS (Mazerolle, et al., 1997; Brown, 2001), concerns about the dissemination of maps and their technical and interpreting limits (Wartell & McEwen, 2001; Leipnik & Albert, 2003; O'Looney, 2003), the reasons why more police agencies have not utilized crime mapping (Travis & Hughes, 2002), and the immaturity of GIS (Ratcliffe, 2004).

First of all, understanding the cost of GIS adoption can reveal the potential contribution of the current study, because "one of the most salient computer issues confronting public managers today is whether or not to invest in geographic information system (GIS)" (Brown, 1996; p. 193). While the cost of GIS adoption for a local government is obviously high, it is expected that benefits may be indirect and rarely appreciable. For example, a simple desktop having basic GIS capabilities may require around \$4000 and its expenditure is supposed to be doubled if more sophisticated GIS features are needed (Brown, 1996). Of course, more than one desktop may be needed based on organization size and community needs. The cost of software and hardware may only represent around 20-40% of total costs. Besides, the cost of GIS for a

municipal wide adoption is around \$1 million - 2 million for an organization (Harries, 1999). It is critical to know that the smaller the police organization, the smaller share they can get from COPS funds. This is a very direct obstacle for smaller police organizations in adopting GIS, and a remarkable encouragement for large organizations to invest in technology. To illustrate this situation a COPS Factsheet (2006) is presented below which regulates distribution of funds to police agencies based on ‘serving population’ or ‘budgeted sworn forces’.

**Table 6: Distribution of Funds to Police Agencies by COPS**

<b>Serving Population</b>	<b>Or</b>	<b>Budgeted Sworn Officer</b>	<b>Could apply for a federal share of up to</b>
less than 24,999		01-49	\$25,000
from 25,000 to 49,999		50-99	\$50,000
from 50,000 to 99,999		100-199	\$100,000
from 100,000 to 249,999		200-499	\$250,000
from 250,000 to 499,999		500-999	\$500,000
from 500,000 to 999,999		1,000-1,999	\$1,000,000
more than 1,000,000		Above 2,000	\$3,000,000

There may be other possible costs such as converting data and/or buying compatible maps, having experts and/or training personnel in data manipulation, storage, database management, and interpretations and presentations (O’Looney, 2003). Notably, these costs are stated mainly for start up costs and cost savings can be expected after 4 years (O’Looney, 2003, p.15). In fact, GIS presents a simplified model of the actual world to solve existing and potential problems; however, the main basis for this presentation, the data, necessitates a great deal of

time, money and human resource investment (Gilfoyle and Thorpe, 2004). In particular, “the cost of spatial data capture increasingly dominates and can account for as much as 70% of total GIS costs” (Gilfoyle & Thorpe, 2004; p.53). According to Worboys (2004), a database is the foundation of a GIS. Several issues necessitate further considerations in the data structure of GIS, such as quality, compatibility, accuracy, and completeness; however, the scope of the study limits us when it comes to providing details on the data issue.

The Police Foundation (2000) examined COPS funds to understand the integration of community policing into computer mapping. For this reason, 51 police departments which receive COPS funds in four regions of the U.S. were surveyed; however, the data may not be generalized. Most of the funded departments (42 of 51) were being supported specifically for mapping technology. Findings are suggestive and indicated that most departments used mapping technology for "quite limited purposes" (21). Notably, crime mapping is mainly found to be used for crime analysis and problem solving efforts; nonetheless, there are several different techniques that qualify as mapping use. Although provided funds are enough to buy required instruments for mapping, several difficulties proved frustrating. Achieving a learning curve is one of these underestimated points mentioned in the report. The need for customized mapping is also important but its application seems challenging. Most of the mapping users were crime analysts who learned the utilization of mapping by themselves. The selection of the appropriate software is mentioned as one of the important challenges because of the need of moving back and forth among the use of these systems. A mapping user mostly maps major crime data, calls for service, arrest and traffic accidents. The difficulty of police departments is not the inability to buy more software; rather, it is to know how to better use the system. Overall, the enormous amount of investment in financial and human capital is needed to utilize GIS to a wider extent.

Implementing GIS into an organization and integrating it into police tactics is not a simple and automatic process. Only buying the necessary technology is not adequate to have successful mapping implementation. Specifically, technical support and training are vital basics to integrating computer mapping into policing. This report concluded that "there needs to be a push to successfully implement a GIS plan" (26).

The success of GIS utilization is moderated by technological, organizational and financial constraints (Manning, 1992; Brown, 1996; Pattavina, 2005). According to Pattavina, (2005), the technical aspect of GIS is not easy and needs experts or trained personnel. Eliciting official support is indicated as the most critical factor for achieving a successful GIS utilization (Brown, 1996). Respectively, organizational issues, funding and technological impediments are reported as other inhibiting factors. Manning (1992) points out that several organizational factors mutually shape the technology and line level police officers may consider the technology as loss of autonomy. An organization's commitment and internal support can be seen as crucial elements for successful GIS adoption because GIS innovation comprises an organizational level decision according to Roger (1993). The existing organizational understanding may or may not support adoption of new geographic perspectives on crime. Incorporating new technology into ongoing systems may be over-demanding and integration to essential data sources may consume more time and efforts than it is assumed. Brown (1996) found that local governments have high expectations from GIS technology.

The challenges of using GIS are also presented in a study by Mazerolle, Belluci and Gajewski (1997). One of these is where to build the GIS. The system can be built either for crime analysts, planners of the police department or for the street level problem solving officers. This

might be why measuring overall GIS use is hard to achieve at the organizational level. Although there might be overlaps in these different usages, the police are supposed to make decisions among these options. The second challenge may emerge when the mapping capability of the department is integrated into other computer environments. Building a user friendly menu is considered as the other challenge. The study (1998) concludes that "the power of mapping crime, however, is greatly enhanced when police departments invest resources in planning, pilot testing, and solving logistical problems from the outset" (149).

Brown (2001) points out that the most difficulties in IT implementation emerge when the true extent of required demands is underestimated. In particular, the internal capacity of the organization may remain inadequate when cost overruns, needed expansions, and technical hardships, such as malfunctioning equipment, incompatibilities, implementation delays, expertise shortages, and scope changes are encountered. It is also essential to note that transition from a simple IT implementation to a wider GIS use necessitates "tremendous amount of resources in time, energy and capital" (Brown, 2001, p.363).

Dissemination of information with maps to the public and other organizations can raise tension, as well as ethical and legal concerns (Wartell & McEwen, 2001; Leipnik & Albert, 2003). Sharing information with other organizations and the community can produce several legal and ethical arguments (Wartell & McEwen, 2001) because delivery of information via use of mapping is not yet clear. For example, the economic potential of a community may be affected if crime distribution and frequency maps of this community are publicized on the web or via other means. Specifically, providing crime hotspots in an area may generate criticisms about the safety and land use values. According to Leipnik and Albert (2003), dissemination of GIS

outputs to the public produces big concerns. There might be sensitive data which may also produce privacy claims when it is publicized.

Technical difficulties, inadequate analyses and misinterpretation of mapping can also produce some challenges. “Sometimes it is possible to convey all important features in one display. However, as the number of features grow, the process of integrating them becomes more difficult” (O’Looney, 2003, p.73). Misleading the unwary is a likely negative effect of GIS in decision making. Faulty data or misinterpretation in different level data displays may cause these errors and all of this must be reviewed before making final decisions. As the solution, the data quality must be high and the closest level of data; for instance, individual data should be preferred for GIS analysis. According to O’Looney, (2003) credible answers from the utilization of GIS rely on the integrity and skills of users, the integrity of data, used methods, and the compatibility of the data integrated within the same GIS system (p.38).

According to Travis and Hughes (2002), the question of why more police agencies have not utilized crime mapping has two answers. The first answer indicates that being at the early phase of GIS innovation cycle and its diffusion is supposed to take some time. The second answer is that a computerized crime mapping area is still largely unexplored and this may bring perils to its appliers. This understanding is holding non adopter departments to see the ongoing projects. The study concludes that waiting for more crime mapping adoption examples is suggested.

Ratchliffe (2004) points out that GIS has not yet been fully established in criminal justice, but its potential seems achievable in the long term. The study also insists on the importance of training needs in using GIS that might enable its full capacity. The priority of the

challenge is not to overcome the understanding of law enforcement managers but realizing the training needs of GIS users.

#### **4.6 How Do Police Agencies Use GIS?**

Previous researches have provided substantial details on how police agencies use GIS. Several scholars studied different levels of GIS use (Curtin, et al., 2007; Crossland, et al., 1995; Silverman & O'Connell, 1999; Ratcliffe & Guidetti, 2008; Ghose, 2003; Pinto & Budic, 2000; Jankowski & Timothy, 2001; Comfort & Kapucu, 2006), the adoption of GIS in fighting crime (O'Looney, 2003; Harries, 1999; Craglia, et al., 2000; Murray, et al., 2001; Lodha, 1999), general use of GIS in U.S. policing (Mamelian & LaVigne, 1999), the use of GIS for decision support (Hirschfield, 2001), mapping crime to explore its practices and principles (Harries, 1999), GIS use in the municipal police (Leipnik & Albert, 2003) and law enforcement agencies (LaVigne & Groff, 2001; Chainey, 2001; Leipnik et al., 2003), the use of three GIS applications (hotspot mapping, CompStat and geographical profiling in policing) (Ratcliffe, 2004), and the link between computerized crime mapping and hotspots (Weisburd & Lum, 2005).

In police agencies, the utilization of GIS depends mostly on the ability of crime analysts based on operational and managerial needs. In a wider context, GIS use can take place on the street, managerial, organizational, community, inter-organizational and inter-jurisdictional levels. For example, the utilization of GIS is reported in optimizing patrol beats (Curtin, McCall, Qiu, 2007), supporting spatial decision systems (Crossland, Wynne, Perkins, 1995), organizational change in decision making (Silverman & O'Connell, 1999), changing state police into intelligence led police direction (Ratcliffe & Guidetti, 2008), community participation (Ghose, 2003), information sharing in an interorganizational GIS environment (Pinto & Budic, 2000),

collaborative decision making (Jankowski & Timothy, 2001) and interorganizational coordination in extreme events (Comfort & Kapucu, 2006).

Police departments adopt GIS to enhance crime detection and crime prevention (O’Looney, 2003). For example, distribution of crime patterns (Harries, 1999; Craglia, Haining, & Wiles, 2000), geographical analysis of criminal events (Murray, McGuffog, Western, Mullins, 2001), geographic profiling of criminals (Paulsen, 2006), repeat victimizations (Ratcliffe, 1998) and animation of crime (Lodha, 1999) can be mapped and linked to relevant data by using GIS.

In 1997, a nationwide survey was conducted by the Crime Mapping Research Center (CMRS) of the National Institute of Justice to understand “who uses geographical information systems (GIS) and why other agencies are not using this mapping technology” in the USA (Mamelian & LaVigne, 1999). General use of GIS was identified to understand the spatial relationship of crime and other community characteristics. According to the study (1997), 73% of police departments were using GIS to fulfill UCR requirements and 52% were using it for statistical calculations. Larger police departments (36%) utilize more GIS than smaller departments (3%). Most departments, using crime mapping, reported that GIS was used by crime analysis staff (75%) and a few (9%) reported that patrol officers were using the application. The majority of GIS users (91%) reported this use for geocoding and mapping offense data while 65% of them used calls for service data. Geocoding means "coding the Earth, providing geographic reference information that can be used for computer mapping" (Harries, 1999; p, 97). Most of the adopters utilized GIS on most of the part I crimes, while some of the part II crimes were also explored by GIS users. Traditional automated pin maps (72%) and cluster analysis—the so called hotspot analyses—(77%) were the most used mapping applications. In particular,



mapping was used to inform officers and investigators on crime incident locations (94%), to make decisions on resource allocations (56%), evaluate interventions (49%), inform the community on crime activities (47%), and repeat calls for the service (44%). In general, departments reported that GIS practice improved information delivery, as well as evolutionary and administrative issues.

Harries (1999) studied mapping crime to explore its practices and principles. He indicates that a map may not be enough to carry simply all parties' messages at once. For example, police officers may want to see the street level character of crime on a map, whereas, police managers may want to see allocation of resources toward police areas and accountability. In a larger context, political leadership and local administrators may want to use maps to carry their messages in a presentation while community members may want to see something else on maps. This means that several maps are needed to be produced in different designs to meet diverse purposes. According to Harries (1999), additional information resources are needed to comprehend crime in addition to UCR data. These involve community and governmental data, such as land use, tax assessments, playgrounds, alley lighting, etc. Demographic data is also needed to consider a change in society by reviewing ethnic variety, socio economic conditions, age, etc. Finally, Harries (1999) also characterizes GIS use in policing as three types of mapping including the descriptive, analytic, and interactive types in parallel to McEwen and Taxman's views (1995).

According to Hirschfield (2001), GIS is utilized mainly for decision support in crime prevention. Hirschfield (2001) categorizes eight groups where GIS can be utilized in decision support. These are (1) identifying strategic priorities and making operational decisions, (2)

producing audits and strategies in order to prevent crime and disorder in an area, (3) setting up coordinators and project managers to develop partnerships for sustainable crime reductions, (4) studying causes and prevention of crime, (5) tracking changes of crime in neighborhoods, (6) monitoring conditions in business operation areas, (7) predicting safer places to live and invest in. Specifically, the main use of GIS with crime data analysis is addressed as mapping the distribution of incidents, putting contextual information on to the map, identifying clusters from points, identifying hotspot demographics and land use, calculating, mapping crime rates, conducting specific site and radial analysis, identifying buffer zones, identifying comparison areas, and tracking displacement (249-250). A decision making support system, mentioned above, requires access to sources of quality data, software and further competences in a few key areas. Two types of data, recorded crime information and calls for service records, are the most widely used sources for this reason. While recorded crime data represent crime distribution of the area, calls for services are used to understand public anxiety about crime and antisocial behaviors in that area (Hirschfield, 2001). Other key areas are listed as awareness of spatial dimension of incidents, data processing capabilities, familiarity and competence in GIS utilization, skills in data and map design, ability to interpret, and report of the analyzed data.

Leipnik and Albert (2003) stated that GIS utilization is concentrated in the municipal police service delivery and Sheriff's offices are also implementing GIS. They think that Sheriff may benefit more because they have larger areas for service delivery than the police. As to LaVigne and Groff (2001), law enforcement agencies generally utilize GIS in operations, command and control decisions, investigations, community, cross jurisdictional analysis, interagency partnerships, collaboration with courts and corrections. Research on GIS applications has also extended use of GIS into new levels of analytic mapping. In particular,

three areas are found “to identify causal factors relating to crime patterns, to develop more rigorous hot spot identification methods and analysis tools, and to predict the likely location of crime hot spots before they emerge” (LaVigne and Groff, 2001; p.214). The current study intends to examine the first two dimensions of these three areas. In addition, more information can be found about the prediction of the crime dimension in more recent studies (Groff & LaVigne, 2002; McLaughlin et al., 2004; Chainey, Tompson, Uhlig, 2008).

Chainey (2001) emphasizes the role of GIS use in connecting policing with relevant parties in information sharing that facilitates fighting crime and disorders. Specifically, the use of GIS is addressed to support operational policing, crime-disorder monitoring and prevention initiatives (96).

*Chainey (2001) concludes that “at the heart of many of these solutions has been the use of GIS to map incidents of crime and disorder and analyze spatial and temporal patterns. The use of GIS has played an important role in integrating data from their many disparate sources across the partnerships, presenting information in a way that can better involve the local community, provide outputs that assist strategic decision-making and the monitoring of targeted reduction initiatives, plus help build the case and support bids for investment. ... The use of GIS continues to be the core of many of these processes, providing the link between presenting the information collected and directing efforts that sustain the targeted reductions in crime and disorder (117,118)”.*

According to Leipnik and his colleagues (2003), geographic information technology can visualize spatial and temporal patterns of crime and police activities to better respond to calls and follow other policing activities. Besides, the police can predict potential crime areas by using GIS and allocating its resources accordingly. Notably, the GIS practice range differs from department to department, from simple maps to sophisticated analytic maps. Basically, GIS supports four spatial police functions which are points (crime locations), lines (streets), and areas (boundary of precincts or targeted areas). These geographic features can be explained better by use of separate thematic layers such as political boundaries, parks, zonings, traffic flows, etc.

These layers enable visibility of targeted areas within the same reference system. Analysis and manipulations can be executed on this digital ground by use of attribute data. This visualization can be enhanced by using appropriate vector or raster formats. Additional data coming from different sources, such as aerial photos, remote sensing and GPS can be stored and associated when they are needed.

Ratcliffe (2004) explored the use of three GIS applications which are hotspot mapping, CompStat and geographical profiling in policing. The study indicated that providing specialized training to police managers about how to use crime mapping in policing for crime prevention and crime reduction is as important as investing on technical abilities of crime analysts. The study concludes by enlightening a hidden challenge. This states that less worrying on education and more blaming for police management in using GIS is problematic.

According to Weisburd and Lum (2005), computerized crime mapping and the hotspots approach are linked (427). They applied a pilot study by collecting data from 125 police agencies in 2001. They found that 62% of agencies adopted computerized crime mapping as of 2001. A larger number of the policing agencies (48%) stated that they are using computerized crime mapping "to facilitate hot spot policing" (428). In parallel to this finding, they found that 80% of computerized crime mapping users conducts hot spot analysis. Specifically, rapid adoption of crime mapping was found in larger police departments. They also found that diffusion of computerized crime mapping in large departments has not reached its saturation point. Considering the trends, they expect that increase in adoption of mapping will steadily increase for a few years. They also suggest that crime analysts are more open to innovation, whereas the police organizations are resistant to change.

#### 4.7. What are the Differences among GIS, Crime Mapping and Crime Analysis?

There might be confusion in understanding GIS, crime mapping and crime analysis concepts. GIS, crime mapping and crime analysis are interconnected constructs. Crime mapping is defined as "the ability to map and analyze crime in a spatial context is now a reality." In other words, "crime mapping relies on the accurate geocoding of incident locations that are then mapped within a GIS" (1995, p.315). Crime analysis is defined as the "systematic study of crime and disorder problems as well as other police – related issues – including socio-demographic, spatial, and temporal factors – to assist the police in criminal apprehension, crime and disorder reduction, crime prevention, and evaluation (Boba, 2005; p.17)".

According to Harries (1999), "crime mapping has long been an integral part of the process known today as crime analysis" (1) and GIS use is "mainly restricted to crime analysis" in police agencies (LeBeau 2001; p.139). LeBeau (2001) presents roles of these interconnected constructs within a reasonable frame. "Geographic information systems, automated mapping, and spatial analysis are becoming valuable tools for policing. These tools have been mainly employed in crime analysis and they are functionally linked with police computer aided dispatch and record management systems" (139). These three constructs tend to be understood easier in a bundle rather than being separate tools. Although GIS is an inclusive digital infrastructure providing the several benefits mentioned above, the acronym, GIS, has been used very similarly to crime mapping and crime analysis in prior studies about police agencies (Mamalian & LaVigne, 1999; Boba, 2005; Pattavina, 2005; Demir, 2009).

Crime mapping and analysis are used interchangeably in studies (Boba, 2005; Ratcliffe, 1999; Mamalian & LaVigne, 1999; Foster, 2004; Pattavina, 2005). Crime mapping is the

smallest concept among these three and takes place at the core of crime analysis (See Figure 6 below). According to Ratcliffe (1999), use of mapping in crime analysis is portrayed as "a considerable effort with little worthwhile return" (314). On the contrary, Mamalian and LaVigne (1999) use a larger terminology as 'computerized crime mapping technology' that "enables law enforcement agencies to analyze and correlate data sources to create a detailed snapshot of crime incidents and related factors within a community or other geographical area" (1). This identification fairly combines most features of GIS, crime mapping and crime analysis as one term. Although findings reveal the impact of GIS on different levels, some questions arise such as, Can crime mapping, by use of GIS, produce solutions for organized crime? According to Pattavina (2005), "crime mapping today is considered to be part of a group of computer applications that belong to GIS technology. Because many discipline use GIS and hardware and software capabilities are constantly evolving, an exact list of all GIS components and capabilities is difficult to explicate" (147). Briefly, crime mapping is regarded as a base feature and used in crime analysis in police agencies (Bobe, p.39).

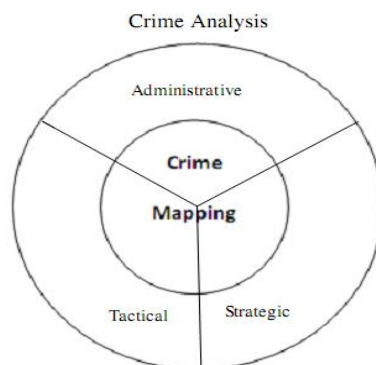


Figure: Relationship of Crime Mapping to Crime Analysis  
The figure was adapted from Rachel Boba (2005,p.38), Crime Mapping and Analysis

### Figure 8: Relationship of Crime Mapping to Crime Analysis

Crime mapping and analysis are also used as contiguous terms in some studies (Foster, 2004; Demir, 2009). For example, "crime mapping and analysis can provide information into

why crime occurs” (Foster, 2004; p.262). Foster (2004) also states that: “The art of crime mapping and analysis is continuing to grow and become more sophisticated” (262). Foster (2004) points out that contemporary crime analysis necessitates mapping, crime analysts, training, and data sources; however, the importance of automated mapping may be underestimated in crime analysis. McDonald (2005) also defines crime analysis and mapping as if they are almost the same concepts. The field of crime analysis/mapping is considered as “developed independent of automated ability to rapidly collect, synthesize, and analyze data” (126). McDonald (2005) thinks that “a considerable amount of time would pass until true capacity of IT was recognized and applied in law enforcement” (126). Foster (2004 ) summarizes the interconnectedness of these terms in a sentence: “Although mapping is not the only thing crime analysis does, you cannot conduct modern crime analysis without mapping capabilities, and you cannot conduct geographic and statistical analysis without minimal hardware and software” (p.248).

Although crime mapping and analysis can be considered as specialized areas of policing, GIS practice is not peculiar to the police and emerges as a wider concept (Foster, 2004). To be more specific, crime analysis is a larger construct than crime mapping (Boba, 2005); however, its abilities are not as far-reaching as the GIS role within the police organization. GIS use is not limited only to crime analysis; most policing services like administrative, operational, and interorganizational tasks are also supported by use of GIS. All of these views mentioned above can be summarized by saying that crime analysis and crime mapping are the main scopes of GIS applications within the police (Mamalian & LaVigne; 1999; LeBeau 2001; Pattavina, 2005), and they can contribute to crime reduction.

Introducing crime mapping and crime analysis concepts in a wider context can advance general understanding of this interconnectedness and the relevance of current research. These subsections also contribute to the understanding of some of the proposed independent variables (crime mapping, crime analysis) of the study.

#### **4.7.1 Crime Mapping**

It is a prerequisite to know that crime mapping is an older application than computer invention. The first known crime mapping application was prepared in the 1825 and 1827 years in Europe (Weisburd & McEwen, 1997). In the U.S., it was the 1920s when the first known map based crime research was conducted that linked delinquency to relevant factors by urban sociologists in Chicago. The concentric zone model emerged with the use of crime mapping (Burgess, 1925) while explaining urban social structures (Boba, 2005, p.49). The proposition was that some areas might be more prone to crime than others. It was found that the concentration of gangs occurred where social disorganization was high and social bounds were weak (Weisburd & McEwen, 1997). The social disorganization theory which examined juvenile delinquency in urban areas of Chicago extended this understanding (Shaw & McKay, 1942). This line of research reemerged in the second term of the 20<sup>th</sup> century and a separate section presenting causes of crime was included in the current study to show further research in this area. The comprehension of crime mapping concept can be strengthened by reviewing its history of and previous research in this area.

Chamard (2006) studied the history of crime mapping and its use in U.S. police departments. Before computerized crime mapping, a few police departments were using pin maps which were attached to walls. However, their capacity was limited in presenting simple



distributions of crime and required large spaces with intensive labor. When computerized mapping was introduced, most police departments were not able to afford it until cheaper personal computers became available in the 1990s (Chamard, 2006). Increasingly cheaper technology allowed several police agencies to benefit from the fruits of crime mapping in different areas (Gilfoyle & Thorpe, 2004). Notably, the advent of personal computers enabled data access and its analysis, but the needs of police promoted crime mapping development (McDonald, 2005). In addition to decreasing computerization cost, the availability of sufficient data on crimes, arrests, accidents, and calls for service by the advent of electronic management systems such as computer aided systems and record management systems (RMS) facilitated the use of crime mapping (Boba, 2005; p.51).

Initially, the National Institute of Justice funded projects (a problem oriented policing study in New Jersey, community involvement addressing crime in Connecticut, drug incidents by area overtime in Pennsylvania, and innovative narcotic enforcement strategy in Missouri) used the crime mapping tool for their analysis (Groff & LaVigne, 2002). Boba (2005) asserts that “these projects led the way crime mapping... and demonstrated how communities could use GIS tools as a central part of crime control initiatives” (p.50). In the mid-1990s, CompStat policing known as “data and mapping driven police management strategy” publicized and popularized the importance of crime analysis, mapping and its systematic discussion (Boba, p.24; Mazerolle, Rombouts, McBroom, 2007). Furthermore, Rich (1995) found from its interviews that “computerized mapping is a valuable tool whose potential is just beginning to be tapped”.

In 1994, The Violent *Crime* Control and Law Enforcement Act provided general foundation funding for mapping and crime analysis technologies across the U.S. (Bowers &

Hirschfield, 2001). Following this, the federal government funded the Office of Community Oriented Policing Services (COPS) which provided more than \$53million direct grants between 1995 and 2003 such as MORE (Making Officer Redeployment) for crime mapping (Boba, 2005, p. 52). The establishment of COPS considerably promoted crime analysis and relevant technological use in the police.

Dr Scheider, social science analyst in COPS, articulated importance of this use by saying that *“some of the funds provided by MORE grants have been used to purchase crime mapping and GIS hardware and software. The COPS office recognizes the important role that crime mapping plays in the in-depth analysis of community problems. This increased analytic capability improves capacity of law enforcement to work with community to develop more effective solutions to crime and social disorder problems.* (Boba, 2005; p.51)

This emphasizes that the statement, *“increased analytic capability improves capacity of law enforcement to work with community to develop more effective solutions to crime and social disorder problem”* is one of the main foundations of current research.

Scholarly discussions about crime mapping were started in the mid-1990s. “Crime Analysis through Computer Mapping” was one of the first initiatives held in Chicago in 1993 (Block & Dabdoub, 1995). The Crime Mapping Research Center, MAPS (currently, mapping and analysis for public safety) program and CMAP (Crime Mapping & Analysis Program) were founded by the Department of Justice Institute in these years. Because of these kinds of establishments, workshops, annual conferences, grants, training, and relevant publications became widespread in following years. Visiting some of the literature about the identification of crime mapping below can deepen our grasp of this topic.

Crime mapping is conceptualized as the mapping and analysis of crime by Bowers and Hirschfield, (2001). Accordingly, *crime mapping is described as “the manipulation and processing of spatially referenced crime data in order for it to be displayed visually in an output that is informative to the particular users” (p.1)*. According to Boba (2005), crime mapping focuses on the geographic nature of events as a complimentary feature of crime analysis that is used by almost all types of analysis (p.39). As seen in Figure 8 above, crime mapping takes place at the core of crime analysis and is considered a subset of crime analysis (Boba, 2005).

There are also some other issues, such as software packages and data requirements which need to be addressed to clarify the crime mapping concept. First, crime mapping is one of the primary outputs of GIS as mentioned earlier; nonetheless, there might be other software packages that provide crime mapping such as STAC and CrimeStat. All of these packages need GIS in different degrees to display their outputs (Bowers & Hirschfield, 2001). Second, the quality of the data is central in using effective crime mapping because some techniques such as geocoding require a certain type of data. In other words, the availability of local, state and federal level geographically referenced crime data may have a very substantial positive effect on development, diffusion and utilization of crime mapping. Finally, crime mapping practice in police agencies can be a very supportive tool for crime prevention and solution initiatives if its outputs can be interpreted based on criminological theories (Eck, 1997).

As an obstacle to its development, there is little general understanding about crime mapping among researchers and practitioners. According to McDonald (2005), researchers have explained the crime mapping concept with abstract jargon as a statistical tool, whereas, practitioners have considered crime mapping as a simplistic process to lead effective tactics

(138). McDonald states that this technical language of researchers has constituted an obstacle for practitioners in understanding research. He suggests that “crime mapping researchers need to find a way in which to simplify communications if they have any hope that practitioners will heed their findings and use them to improve crime mapping” (138). This conflict might stem from researchers and practitioners having different goals. This is due to the fact that researchers are generally engaged in the search for causes of crime, whereas, the police are concerned with finding solutions to crime, removing criminals from the streets from problematic areas.

Crime mapping can be used for several tasks in police agencies and this is difficult to categorize. According to Bowers and Hirschfield (2001), crime mapping is used to inform target audiences about operations and investigations. It is also used to improve crime prevention, monitor crime changes and evaluate effectiveness of crime prevention initiatives. According to Chainey and Ratcliffe (2005), crime mapping takes place in command and control for managerial analysis, operational analysis, monitoring crime, problem solving, geographic profiling, program evaluation, performance reviews, and dissemination of information. Specifically, they (2005) state that “crime mapping can play an important role in the policing and crime reduction process, from the first stage of data collection through to the monitoring and evaluation of any targeted response. It can also act as an important mechanism in a more preliminary stage, that of preventing crime by helping in the design of initiatives that are successful in tackling a crime problem (4, 5)”. According to Boba (2005), the effects of crime mapping are evident at three points: crime mapping facilitates visualization and statistical analysis of spatial nature of events and crime; allows users to link other data sources based on geographic relationships; and produces maps to communicate analysis results (p. 38).

#### 4.7.2 Crime Analysis

Most likely, earlier crime analyses were conducted based on experiences and observations while the current state of analysis relies on computer based analytical techniques. The London police force is known as the first organization using crime analysis after it was established with the Metropolitan Act in 1842 (Boba, 2005). Crime analysis practice slowly grew up in the early- to mid-1990's in the U.S. Furthermore, systematic crime analysis started between 1950 and 1960 in the U.S. (Boba, 2005). During the second half of the 20th century, new perspectives appeared in the fight against crime and some scholars emphasized the importance of location and its geographical analysis (further relevant research can be seen in the causes of crime section).

Crime analysis (CA) is defined similarly by scholars (Emig & Heck & Kravitz; 1980; Gottlieb, Arenbberg & Singh, 1994; Boba 2005; Santos, 2012). According to Emig and colleagues (1980), crime analysis is a “set of systematic, analytical process that provides timely, pertinent information about crime patterns and crime trend correlations” (as cited by Boba, 2005). Gottlieb, Arenbberg and Singh (1994) emphasize that crime analysis is a “set of systematic, analytical process ... directed at providing timely and pertinent information relative to crime patterns and trend correlations...” Although several definitions exist, the current research defines crime analysis as a “systematic study of crime and disorder problems as well as other police-related issues – including socio-demographic, spatial, and temporal factors – to assist the police in criminal apprehension, crime and disorder reduction, crime prevention, and evaluation”. (Boba 2005; p.17)

Crime analysis relies greatly on the computer technology of crime mapping (Boba, 2005; p.108). Four basic software programs are used for crime analysis purposes. These are spreadsheets, database management, statistics, and GIS (103-105). Other specialized crime analysis software programs are also available – these are easier to operate and have simpler functions than those of other existing software (106). ATAC, Crime-Stat, and Crime-View are examples of this specialized crime analysis software and some agencies also produce their own specialized software.

To understand the crime analysis process, understanding its audiences, focus and theoretical basis is also important. The process of crime analysis includes the collection, collation analysis dissemination and feedback phases (Boba, 2005, p.9). The audience of crime analysis consists of “(1) administrators, (2) command staff, (3) city government officials, news media and (4) citizens (2005, p.18). According to Tennant (2001) crime analysis provides community-level analyses which provide a focus for contextual-level analysis (as cited by Boba, 2005). According to Boba (2005), there are three focus areas that are aimed at increasing efforts toward the fight against crime. These are tactical, strategic and administrative crime analyses as presented in figure 6. Identifying immediate patterns of crime analysis is called tactical crime analysis. Strategic crime analysis aims for long term characteristics, such as analyzing the relationship of disorder and crime, examining crime patterns, and incorporating crime data with relevant quantitative and qualitative geographic information. Administrative crime analysis conveys all acquired knowledge mainly to the public and relevant parties. There is also a theoretical basis for crime analysis efforts such as the crime triangle, rational choice, crime pattern, routine activities, situational crime prevention, repeated victimization and displacement (Boba, 2005; p59-69).

Reviewing essential human and nonhuman resources of crime analysis can also extend the grasp of GIS concept. Employment of at least one employee is essential to operate, coordinate and/or manage crime analysis based on the size of the unit. A crime analyst can either be a civilian or a sworn police officer who is supposed to have same capabilities for crime analysis (Foster, 2004). A crime analyst is expected to have computer skills, analytical skills and understanding of police work. Considering the larger police agencies, crime analysis can be executed via individuals or within specialized units consisting of specialized personnel (McDonald, 2005). General knowledge about a served community and investigative skills are expected from the analyst. Additionally, training might be considered to strengthen his/her professional abilities; therefore, the function of crime analysis can be effectively maintained at the agency. Geographic and crime data resources are also essential for crime analysis similarly to crime mapping in order to process information. Crime analysis can be fully effective if information sources are adequately integrated. Computer aided dispatch systems (CAD) and record management systems (RMS) are some of these desired supportive systems. Otherwise, crime analysts can be overwhelmed by having to enter needed data into the system.

The evolution of crime analysis in an organization is described by five stages (McDonald, 2005).

**Stage 1:** The first stage is recognized by the primitive IT applications. At this stage, one or two persons in the planning office (instead of having a crime analysis unit) are assigned to collect and report crime data annually to the top level administration for supervisory and budgetary reasons.

**Stage 2:** Cumulative reports are collected and distributed to a broader audience more periodically. Serious crime type categories are monitored, displayed and compared with former years. An official crime analyst may be assigned from selected personnel.

**Stage 3:** Analyzed data is used within community policing programs and distributed frequently to the beat areas and police officers to introduce hotspots and changing crime

patterns. This data also can be shared with collaborating community groups and/or be directly made available for the residents.

**Stage 4:** Appropriate policing operations are managed based on the “sound, accessible, and accurate data”, instead of convenience, intuition and/or direction of the political leadership. In fact, a scientific approach in policing may be institutionalized at this phase. A central crime analysis unit serves at the organizational level in addition to crime analysts serving in the police district level. Hotspots and crime patterns are distributed to district levels and responsible parties are held accountable for their progress in changing crime patterns.

**Stage 5:** This stage is described as the final phase that a police organization can currently reach. At this phase, daily crime distribution is traced routinely. Operations and management are expected to be integrated like Compstat type applications. Managers and subordinators are supposed to meet and review analyzed data on a regular basis. Additionally, street level policing staffs who serve for beats and other ground level service deliveries are held responsible. A broad range of data functions can be used at this phase which may process the data continuously or automatically. When a change occurs in hotspots and crime patterns, the police are alarmed and their car or hand systems allow inquiries for potential crime and terrorist attacks. Stage 5 police departments are supposed to have interorganizational and regional bounds with the relevant safety organizations. They are supposed to trace and apply regional crime control tactics.

In fact, McDonald (2005) does not suggest a guideline to present progress from one stage to other stages. This conceptualization allows the study of police agencies in the context of crime analysis progress. According to McDonald (2005), “Compstat and POP could not have occurred, or might not even have been conceptualized without needed advances in IT and crime analysis theory and application” (136).

The determinants of crime analysis in large police agencies across the U.S. were explored by O’Shea & Nicholls (2003). Researchers found that the size of the department is a weak predictor, and crime rate is not a predictor of crime analysis. Devoted resources were found to be significant in terms of hardware and software inventory; however, no effect was reported on crime analysis. Quality of crime analysis was found relevant to the sophistication of managers’ demand and crime analysis outputs. The effect of overall crime analysis was found to be superior to the crime analysts’ position. According to Boba (2005), direct expected benefits of crime



analysis to police are (1) apprehension, (2) crime and disorder reduction (3) crime prevention and (4) evaluation (See figure 2.1 p.6-9).

In a different way, Eck (1987) thinks that crime analysis can produce a marginal influence on crime. Spelman Eck indicates that some of the limitations of crime analysis units are provided. He thinks that crime analysis should be used in advance to understanding crime, instead of being applied to police responses. The management of police forces should be well informed by using crime analysis. Finally, a systematic attempt should be designed for existing police tactics to tailor operations.

Based on the reviewed literature, (Groff & LaVigne, 2002; Boba, 2005; Mazerolle, et al., 2007; Rich, 1995; Bowers & Hirschfield, 2001; Chainey & Ratcliffe, 2005), it is obvious that crime mapping, crime analysis and GIS are interconnected constructs. In this respect, the crime analysis capacity of a police agency gradually progresses based on available technical capabilities and human resource abilities. This progress can result in a crime analysis unit (McDonald, 2005) reaching the third stage of its development. In addition, management and subordination of the unit can be more widespread in advanced phases. As found by O'Shea and Nicholls (2003), the sophistication of crime analysis unit management and its outputs are significant indicators of quality in crime analysis. Furthermore, this unit should have more personnel and time to understand the root causes of crime (Eck, 1987) when available supportive criminal theories are considered (Boba, 2005).

Considering these (Boba, 2005; Foster, 2004; O'Shea & Nicholls, 2003; McDonald, 2005) and others findings (Leipnik et al., 2003), the current study uses the existence of a crime analysis unit as the evidence of GIS use and its institutionalization in the police. Respectively,

the number of working people in these units can be considered as the indicator of crime analysis size. Therefore, having a crime analysis unit is used as an independent variable to explain and /or control the use of GIS in police organizations.

#### **4.8 How Does GIS Contribute to Local Governments?**

Although an optimistic debate on the usefulness of GIS is common, evidence on the performance of GIS use is scarce (Budic, 1994; Nedovic-Budic, 1998, 1999; Goelman, 2005). This constitutes discrepancy between theoretical and practical expectations. Nedovic-Budic (1999; p. 284) questions whether it is “necessary to devote special efforts to look at the effects and consequences of GIS use. The answer is a qualified yes”. In this context, reviewing empirical evidence of previous studies is essential to understand the impact of GIS use in local governments.

In order to understand the contribution of GIS on local governments, scholars examined the effects of GIS use in North American planning (Harries & Elmes, 1993), in Southeastern states (Budic (1994), in British local governments (Campbell, 1994), within empirical findings and basic frameworks (Nedovic-Budic, 1998), in the social services (Queralt & Witte, 1998), in student learning (West, 2003), and in emergency response operations (Johansson et al., 2007).

Harries and Elmes (1993) examined the use of GIS in North American urban and regional planning. They identified GIS as an innovation and teased out its complexity. Although a variety of GIS use is noted, the field of GIS is indicated as sufficient for examinations of trends, directions, and evaluations. The study indicates that political support and funding are perceived

as significant for GIS adoption. The study concludes that “GIS is revolutionizing the traditional methods of handling spatial data in planning” (18).

Budic (1994) explored how GIS affects planning and expectations of the planning agencies at four southeastern states. GIS improvements are found in better communication of information, data accessibility and accuracy, amount of current data, and level of confidence in analysis when GIS is performed. In particular, experience with GIS utilization was found as the most contributive factor to operational benefits. Notably, the use of GIS for analytical tasks was found to be positively effective in improving decision making.

Campbell (1994) examines twelve case studies in British local governments to understand how effective GIS use is in practice. There are two parts in this examination. In the first part, the study found little contribution after two years experience in local organizations. The second part aimed to identify inhibiting factors of effective implementation. Findings indicate that consideration of four factors can enhance chances of increasing GIS success. These are the use of simple, user friendly applications, the use of all relevant participants, awareness about available resources, and having the ability to cope with organizational change. Overall, Campbell’s evaluation (1994) indicates that effective GIS implementation necessitates organizational level consideration.

Remarkably, Nedovic-Budic (1998) has examined the impact of GIS technology within empirical findings and basic frameworks, but GIS contribution was found to be sporadic, unsystematic and inconclusive. According to Budic (1998b), GIS users are affected by tangible personal benefits, whereas, administrators are affected primarily by organizational benefits. The

author suggests performing comprehensive, multidimensional, context and process-based research to contribute to the development of GIS technology.

Queralt and Witte (1998) examine the role of GIS in the social services in Florida. With the use of mapping, GIS identified areas of service delivery, potential service gaps and a spatial mismatch between home and jobs. This shows the efficacy of GIS use in problem solving for social services.

Another study (West, 2003) indicates that GIS use positively affects student attitudes. This is attributed to the effect of GIS in enhancing intrinsic motivation of participants. The study found enhanced student learning when they use GIS.

Johansson, Graunland and Trnka (2007) examined the effect of GIS in emergency response operations by an experimental study. 132 persons forming 22 teams were tested and the results indicated that teams employed with GIS achieved their jobs significantly better than traditional ones. In particular, the communication volume was found to be falling.

#### **4.9 How Does GIS Help the Police in Fighting Crime?**

Although several researchers describe the current use of computerized crime mapping across the U.S., little evidence exists about whether this utilization increases overall performance of the police organization or not (Nedovic-Budic, 1998, 1999; Goelman, 2005). To quantify the success of police performance, proxy measures are used, such as inputs, outputs and outcomes (Swindell & Kelly, 2000; Moore, 2003; Roberts, 2006). Input measures are used to understand human and capital resources (Roberts, 2006) and some of the police inputs are indicated as police expenditures and number of fulltime staff (Swindell & Kelly, 2000). Output measures are

used to express product or service of the police agency (Roberts, 2006). Outputs of policing refer to concrete police actions such as patrolling, responding, investigating and arresting to accomplish desired results (Moore, 2003). While outputs refer to means and ends of policing interchangeably, outcomes refer to the ends of policing all the time (Moore, 2003; p.4). Specifically, outputs are controlled and influenced easily by police agencies. Nonetheless, the police have less control on outcomes because outcomes are shaped by many social factors outside of the police. According to Moore (2003), social outcomes are “the valuable results that occur in society as a consequence of what the police do” (p.2).

Several scholars benefited from input and output measures to examine the contribution of GIS use by the police. In this respect, prior studies explored the contribution of GIS to crime control and prevention (Rich, 1995; Weisburd & McEwen, 1997), the existence of a geoarchive for community policing strategy (Block, 1998), identifying repeated victimizations (Ratcliffe & McCullagh, 1998), the digital representation of crime (LaVigne, 1998), analyses of crime (Canter, 2000), regional analysis and decision making (Greenwald, 2000), combining a technology and a technique (Manning, 2001), democratic policing (Markovic, 2002), law enforcement (Leipnik & Albert, 2003), communication with personnel (Gonzales et al., 2005), the use of hotspot mapping, CompStat and geographical profiling (Ratcliffe, 2004), the effects of crime mapping use in terms of perception of crime patterns and patrol activities (Paulsen, 2004) enhancing the community policing strategy (Zehner, 2005), traffic safety (Smith, 2007), increasing visualization (Chen et al, 2005), recognizing and assessing crime trends (Levine, 2006), optimizing police travel to citizen calls (Li et al., 2008) and changing the way the police and the public view public policy problems (LaVigne et al., 2008).

Rich (1995) examined the use of computerized mapping in crime control and prevention programs. Two primary goals were found in regard to using mapping software. The first is to better understand the nature and the extent of problems in addition to possible contributing factors. Secondly, allocation of resources was facilitated by use of mapping software. Most widely, mapping was found to be used for crime analysis in medium and large police agencies. The target audience of mapping was indicated as policy makers, community leaders, the police, and state and local government agencies. Rich concluded that "decreasing costs of personal computers, decreasing costs and increasing sophistication of mapping software, increasing availability of geographic and demographic data, and the need to improve performance while controlling costs" (10) increased the use of computerized mapping. Obstacles to this increase were indicated as user expertise, data quality, costs of hardware - software, and data acquisition.

Block (1998) explores the role of geoarchiving as a main foundation of GIS in community policing. She points out pin maps as an old police approach while identifying computer aided crime mapping as a new phenomenon. Besides, she articulates that "the potential effects of this innovation are so fundamental to the nature of local decision making and problem solving that it deserves to be called a "technological revolution".(28). In fact, she indicates that the current crime mapping is useful if geographic data is made meaningful by use of an analysis tool. At the earlier phase, mapping capability was housed centrally outside of the police departments. Access of the police to mapping was indirect. PC based software availability and decreases in costs enabled the use of computerized mapping on local levels. The need for more than pretty maps is highlighted and the importance of theory application in explaining crime patterns and linkages is indicated. Block (1998) points out that "a good descriptive map may be enough for communicating information, but for effective decision making spatial analysis tools

are also needed (64)". A map is called a thematic map if it provides analysis of differences across areas. In summary, Block (1998) defines the role of a geoarchive as an information foundation for the community policing strategy.

As a central tool to ecological crime research, GIS's role is examined in identification of repeated victimization as well (Radcliffe & Mccullagh, 1998). This research (1998) provided the opportunity to examine applicability of GIS for larger datasets which have implications for proactive crime prevention methods. The quality of victimization identification process was found to be dramatically improved (as far as detection is concerned) by the use of GIS. Specifically, accuracy and speed of the data analysis were considerably increased.

According to LaVigne (1998), GIS enabled digital illustration of crime in descriptive and analytical maps. She believes that GIS can be used to support traditional policing goals, such as allocating resources to identified areas. Besides, more can be acquired when GIS is used to support, identify and analyze crime and to find better ways to intervene and measure these tactics. Accordingly, this type of utilization can be attributed to problem oriented policing.

Canter (2000) discusses GIS use in crime analysis. He indicates two broad functions of crime analysis as tactical and strategic. Strategic crime analysis refers to a focus on understanding long term crime trends. Tactical crime analysis refers to identification of crime patterns, linkage analysis, and target profiling and offender activity patterns. Tactical crime analysis uses data for several days, whereas, strategic crime analysis uses at least year long data. Canter (2000) points out the importance of descriptive and analytic mapping in both of these crime analysis functions.

Even multijurisdictional GIS applications are in use and researched for conforming software and databases to enhance regional analysis and decision making (Greenwald, 2000); however, the scope of the study is limited to utilization of GIS within local governments.

Manning (2001) examined the role of IT technology applications in police organizations. The study suggests that information technology utilization varies in policing. The study concludes that "the potential of crime analysis and crime mapping as means, combining a technology and a technique, is greater than any other innovations in policing in recent times" (101).

Markovic (2002) examines the importance of crime mapping in contribution to democratic policing. He asserts that "crime mapping can make democratic policing not only possible, but practical" (1). Four ways are indicated to show its probable contribution. First, crime maps can increase internal accountability that is supposed to improve the provided quality of police services. Second, when crime maps can be shared with other governmental officials and the community, it can help to construct a common understanding of the crime problem. Third, when crime mapping can be shared with only the public, non-governmental organizations (NGO) and neighborhood associations can make partnerships with police. Finally, when crime mapping technology can be shared with academic researchers, a body of knowledge can emerge to inform and guide public policy. Markovoc (2002) closes by saying that the use of simple and cheap crime mapping applications can enable all of the four abovementioned goals.

Leipnik and Albert (2003) study how GIS can be used for law enforcement agencies. Accordingly, GIS aids crime analysis, improves decision making at the command level, and assists patrols and community outreach activities. Respectively, Leipnik and his colleagues



(2003) studied “how law enforcement agencies can make geographic information technologies work for them.” According to the study, GIS technology can be usable by police departments when they have enough resources to invest in its adoption and to assign at least one person (a crime analyst, information specialist, or a staff member reasonably competent in the use of computers) for a portion of time in the agency (Leipnik et al., 2003).

Gonzales and colleagues (2005) point out that maps can bring strong messages to people who may not have enough knowledge to interpret it. This is important because different causes constitute different hotspots that might necessitate different police tactics (Gonzales et al., 2005). The message may be transmitted via several symbols such as, points, line areas. These depicted symbols may need theories to connect the cases with reasonable logic. These explanations are expected to link the maps to police actions. Consequently, recognition and application of these linkages can advance the making of better crime mapping.

Paulsen (2004) assessed the effects of crime mapping use in policing in terms of perception of crime patterns and patrol activities. The assumption of the study was to encourage utilization of crime analysis in the form of crime maps to understand crime patterns that would affect adjusting patrol beats accordingly. The study found that delivery of crime mapping simply would not have a significant effect in improving officers’ perception with respect to understanding crime patterns. The study suggests that investing in an Information Technology (IT) infrastructure to enable full capabilities of crime mapping use and training personnel can lead to real impact on the police activities. The study concluded by suggesting the examination of larger samples over longer time periods to achieve better results.

The study of Zehner (2005) examined GIS and crime analysis use in Este town. The study shows evidence that GIS can be used for visualizing crime, analyzing previous incidents, and predicting probable future events. This suggests that utilization of GIS facilitates the exchange of information. The study also proved that these findings can be presented by using GIS for operational, administrative, and executive levels. Overall, the study indicates that the community policing strategy can be enhanced and the crime rate can be reduced by using GIS. As a limitation, the inability to exchange information inside and the outside of the organization is addressed.

Smith (2007) used a simple analysis to explore the effect of using GIS in traffic safety in Alabama. The author found a positive impact in traffic safety. Use of GIS was found to be significantly contributive toward solving specific traffic crimes, such as decreasing invested time of law enforcement in the ticketing process.

Visualization in law enforcement was discussed and tested to shed light on the effect of two GIS based applications (Chen et al., 2005). These applications are spatial temporal visualization (STV) and the criminal activities network (CAN). Applications were designed mainly to help identification of crime patterns and criminal relationships. Increase in speed and effectiveness for detecting emerging crime patterns and managing police resources was found when STV is in use. The CAN system could not have been tested adequately but the study reported that CAN was able to assist in investigations in a few cases. The study concludes that automatic visualization techniques and tools can greatly increase the benefits of the law enforcement community.

Levine (2006) examined the role of the CrimeStat program, which is described as a statistics tool for spatial analysis, in crime analysis. The original version of the CrimeStat program was set up in 1996 and was updated by three versions until 2006. The program mainly provides outputs for the police. Seven routines are attributed to the CrimeStat program in producing hotspots. Hotspots are produced by the use of a complex paradigm that identifies a closer collection of points. CrimeStat outputs are displayable in GIS and their explanations rely on human capital and their interpretations. Its emergence facilitated the summarizing and assessing of the crime trend as a statistical and analysis tool.

A GIS software component, MapObject enables the display of 110 alarm points. It can also calculate, show the shortest path, and select the appropriate police around for these potential crimes (Li, Mo & Zhou, 2008). This new feature of GIS has been tested in a few places, such as Lhasa and Tibet, and preliminary findings are positive.

The role of crime mapping in public safety is indicated mainly to identify crime concentrations and allocate police resources based on changing crime (LaVigne, Elderbroom, Brazzell, 2008). The authors think that utilization of crime mapping became a centerpiece of the “strategic, data driven approach, to crime prevention and control” (2). Accordingly, the utility of mapping has enabled the tracking of crime trends over time that has helped the police rearrange its tactics. In addition to these, the underlying causes of crime can be understood by the use of GIS that facilitates a better investigation of cases. It is expected that mapping can be increasingly beneficial in policy making, policy research, organization management and service delivery. The study (2008;p.6) concluded by stating that “mapping is most powerful as part of broader, innovative strategies that change the way we view public policy problems and the way we seek

to solve those problems. When employed collaboratively, justice mapping has the potential to improve policy outcomes and positively shape the decisions that have a meaningful and substantial impact on public safety and our nation's most vulnerable communities”.

#### **4.10 Contribution of GIS Use to Policing Outcomes**

Remarkably, there is a recent rising line of research examining the contribution of GIS use on policing performance as outcomes (the ends of policing). Measuring outcomes is targeted at explaining organizational capability that is also affected by available resources and the way that these resources are deployed (Roberts, 2006). Outcomes can be represented as the rate of (violent and property) crimes, response time to service calls, and cleared crimes (Moore, 2003). Within the framework of organizational impact analysis, a decrease in crime rate is used as an outcome performance measure for the current study. Prior studies indicate the emergence of a new line of research examining the contribution of GIS in outcomes of police organizations. In this regard, scholars examined the role of using GIS in finding places for better street lighting (Pain et al., 2006), police effectiveness with GIS and the reason why findings might be puzzling (Garicano & Heaton, 2006), the impact of information technologies on the outcome of criminal investigations (Hekim, 2009), diffusion, the impact and contribution of crime mapping (Demir, 2009), the extent of the crime analysis influence in police decision making (Gul, 2009), and information technology, organization, and productivity in the police (Garicano & Heaton, 2010; Garicano, 2010).

The current study extends this line of research that measures the impact of GIS in outcomes of police organizations. In addition to this, the current study aims to contribute to the research on police innovations, IT implementation, and police effectiveness in reducing crime by

measuring the impact of GIS use in police performance. The literature is reviewed below to enhance overall comprehension of the study.

The study of Pain and colleagues (2006) provides evidence on the contribution of GIS in reducing fear of crime. The study assumed that when use of GIS identifies better places for street lighting this can lead to reduction in crime and fear of crime rates. Findings (2006) indicate that using GIS can reduce fear of crime parallel to the proposed assumption. This means that GIS has the potential to promote having more inclusive knowledge for effective decision making in policing.

Garican and Heaton (2006) measured the effectiveness of IT use in policing between 1987 and 2003. Their study concludes with two major findings. First, IT can increase police effectiveness in reducing crime; however, its effectiveness can be shadowed by increasing recorded crimes. Second, organizational use of IT is influential when it is used in conjunction with new available data. Garican and Heaton (2006) also explained why findings might be puzzling if proposed effectiveness of GIS did not show up in the same study. They think that this might mainly stem from two reasons. These are: increase in crime measurement due to technological advances and the need for complementariness. First, they found that crime reporting increased by 10% when computers were in use effectively to record crimes. This means that improvement in reporting can increase crime rates while dropping clearance rates. Second, complementariness refers to institutionalized use of an IT system, such as CompStat. In other words, the contribution of IT may be minimal when its use is negligible in an organization and its impact may be substantial when its use is combined effectively within the organizational and human resource context. This assumption was tested by using available data in 1997 for

CompStat and results confirm the impact of combined use of IT in an organization. In particular, a positive relationship was found between IT implementation and clearance rates and a negative association was established with crime rates. Additionally, the quoted study notes that IT implementation decreased the cost of communication but more resources are needed to educate staff for use of the technology. New data and different forms of organizational changes also may be essential when IT is applied within an organization. Despite their wide and detailed statistical employment, the study could not, surprisingly, find a link between decreasing crime rates and increase in clearance rates. The authors tested whether the delayed effect is the case for adoptions, however, findings did not show a significant value to interpret in this way. This unexpected finding might stem from their methodological deficiencies. Because the study attempts to measure the impact of IT in police organizations, there seems to be no control on the demographic variables of the population. This control with respect to the strategies of police actions should be considered essential because the police operate within boundaries of an area where there is a population interacting with the police.

Recently, Hekim (2009) examined the impact of information technologies on the outcome of criminal investigations in the police in his dissertation. The study could not find a consistent relationship between utilization of information technology in police departments and clearance rates. In particular, only 8.5% of the models showed significant results in using information technology to decrease clearance rates. Hekim (2009) thinks that using unbalanced data caused these unintended results. He also questions that “the clearance rate variable may not be the correct outcome variable for measuring Net Benefit in the law enforcement context” (121). Hekim’s (2009) study is very recent and contributory in exploring the role of IT in criminal investigations. The study findings reveal that a consistent relationship between the use

of IT in police departments and clearance rates is not apparent. This finding cannot prove that there is no relationship between IT and clearance rates for a few reasons. First, this study (2009) attempted to measure IT impact by using the De Lone and McLean model (1992) in only one of the categories (IT use), whereas impact might be captured clearly if one of the other success categories might be employed. Second, the entire findings of the study may be arguable because none of the major known contributors—department size, poverty, median income and percentage of Whites—were found to be significantly linked with clearance rates. Finally, the cross sectional nature of the study might be the reason for the mixed results.

Demir (2009) examined the contribution of crime mapping in police managers' decision making. Decision making was evaluated in the context of resource allocation and redistricting decisions. Demir (2009) believes that “contemporary criminal justice organizations are more and more dependent on the rapid and accurate collection, analysis, and dissemination of information in order to make decisions effectively and allocate resources efficiently” (p.65) . He claims that “the potential of crime analysis and crime mapping, combining a technology and a technique, is greater than any other improvement in policing in recent years”. The assumption of his study is that combined use of crime analysis and crime mapping can enable “the police to proactively react to problematic areas” that is” potentially (to) create a deterrent effect” (100). Findings indicate that police departments will use crime mapping to make decisions on resource allocation and districting unless the provided number of crime mapping processes, their frequency and their representation in different crime types provide too much information. In addition, another result shows that crime maps will be more likely utilized for strategic mapping by police if their production is reasonable in cost. Finally, the study showed partial evidence that the use of crime mapping and crime analysis have increased police effectiveness in increasing clearance rates by

arrests. Demir's (2009) research can be one of the guiding studies to new researches because three examinations on crime mapping (its diffusion, impact in decision making and contribution to clearance rates) have been provided in one firm research study.

Gul (2009) examined the extent of the crime analysis influence in police decision making at the command, detective and patrol levels. Gul (2009) thinks that a change may occur in policing due to external and internal factors to cover the flaws of the existing policing model. In his study, crime analysis types such as statistical analysis, intelligent analysis survey analysis, etc., were merged as a latent (independent) variable. Internal and external variables were used as control variables. In particular, the crime analysis unit, agency size, unions, organizational hierarchy, and total operating budget have been considered as internal (organizational) independent variables, and the crime rate has been considered as the environmental (external) independent control variable. Notably, Gul (2009) used crime rates to control the environmental effect on decision making instead of clearance rates because crime rates are indicated as more reliable and valid records. Findings indicate that when the crime level is higher than the average level (0.59) using more crime analysis is desired by the command level for decision making. Specifically, the high use of crime analysis was perceived when the mean of the crime rate increase was 0.66. No significant change was found for detective and patrol levels' decision making usage depending on crime rate increases. Agency size was also found to be significantly linked with the higher use of crime analysis at only command level decision making. Additionally, the operation budget was found to be significantly related with higher use of crime analysis for only command level decision making in bivariate analysis. The study found that "crime analysis is significantly associated with all of the decision-making variables" (91). Overall, the study found that "having a crime analysis unit in the agency matters at all levels of



organizational decision-making” (106); however, the study was not able to provide evidence to indicate which level of police service would be more effective to establish a crime analysis unit. Notably, the study did not find a significant relation between budget and crime analysis in decision making in the multivariate model. This may come from an inappropriate operationalization of the budget variable because the researcher considered only the local budget to cover the costs of the crime analysis deployment. In fact, existing literature has indicated that federal funding, specifically COPS funding, has made a big contribution to adoption of technology for law enforcement agencies (Mastrofski, Parks, Wilson, 2003).

Garicano and Heaton (2010) studied information technology, organization, and productivity in the public sector (the police). In the study, the period of adoption, such as early adopter cities which grows and nongrows were examined in addition to their former (2009) study. Findings indicate that an extension in the size of the agency and skillful personnel and increasing complexity within the organization. IT and worker skills are identified as complementary in police agencies. IT adoption is indicated as influential for increasing the need for college level educated personnel and internal training. Bureaucratization is also shown to be increased with the use of IT, but with little or no increase in productivity. This means the study could not find a significant association with increasing police productivity measured by clearance and crime rates. Additionally, resource availability as measured expenditure of the organization was found to be insignificant in relation to IT adoption. This finding is also different than what the literature notes. Remarkably, the researcher suggests that contribution of IT adoption can be effective when IT adoption is executed as an entire package of organizational change, such as CompStat policing. The study concludes that “police departments, like firms, are likely to enjoy the benefits of computerization only when they identify the specific ways the new

information and data availabilities interact with existing organizational practices and make adjustments accordingly” (2010,25).

This new proposition, complementarities, was reexamined in a smaller study (Garicano, 2010). Complementarities is defined a “range of organizational choices that are supposed to put in effect together while adopting a particular technological advance to improve efficiency” (355). Otherwise, the absence of a complementary organizational change or small adjustments may negate expected effects of IT in police agencies. In the study, complementarities’ success is referred to as being not a "matter of small adjustments, made independently at each of several margins, but rather involve[s] substantial and closely coordinated changes in a whole range of the firm's activities” (Milgrom and Roberts, 1990).

**Table 7: Findings of the Recent Studies Examining Policing Outcomes**

Studies in Reducing :	Crime	Fear of Crime	Clearance	Effectiveness
Zehner, 2005	Reduced			Increased
Pain et al, 2006	No Change	Reduced		Increased
Garicano & Heaton,2006	Mixed			Increased
Hekim, 2009			Mixed	
Demir, 2009			Partially Reduced	Increased
Gul, 2009				Increased
Garicano & Heaton, 2010	No Change		No Change	Lower
Garicano, 2010				Negligible

In summary of the above mentioned recent line of research, studies have shown mixed results about the contribution of GIS use in outcomes of policing. This can be interpreted as stating that the contribution of GIS to police performance in terms of reducing crime rates, fear of crime, clearance and effectiveness are not clear as their effects are illustrated in the table 7.

#### 4.11 Conceptualization of Geographic Information Systems

When a phenomenon is not understood commonly in similar ways, exploratory studies examine the issue to increase its general comprehension. From this point of view, the current study can be identified as an exploratory research because the contribution of GIS use to police performance is not yet empirically clear (Nedovic-Budic, 1998, Garicano, Heaton, 2006; Mazeika, 2008; Hekim, 2009; Demir, 2009; Garicano, Heaton, 2010). This situation is articulated by Demir (2009) who says that "there is a gap in the literature about the impact of technology use on police overall effectiveness in terms of decreasing crime rates and increasing clearances" (108).

Before starting to explore GIS and attempting to measure its contribution to policing performance, there are some essential dimensions of the GIS concept that must first be comprehended. It is important to point out that the use of GIS in police departments is identified as an organizational phenomenon (ideally) and not as an individual trait (Rogers, 1993) since law enforcement agencies inherently have strong geographic ties at all levels of the organization (Ratcliffe, 2004). In practice, GIS use varies depending on several internal and external factors in police departments. For example, the location where GIS is employed may alter the GIS practice. It can be employed in a police department or in another department of local government such as the planning department. Second, the GIS adoption means that a police agency has just started to implement GIS. However, the adoption of GIS does not assure successful use of GIS.

Further clarification is also necessary as to why GIS and its use have not been uniformly comprehended in both practice and research. First of all, the GIS abbreviation is understood differently among practitioners and researchers. Some scholars use GIS as the abbreviation of

‘geographic information system(s)’, while others interpret the acronym as ‘geographic information science’ as indicated earlier. Secondly, GIS is still accepted as an evolving innovation in its early phase, according to Roger (cited in Masser and Onsrud, 1993). This may be why its conceptualization and operationalization vary in the literature. Thirdly, GIS has strong functionalities and some of these are very dominant, such as mapping and statistical analysis. Most of these functions have the potential to constitute a new line of research. For example, when the current literature is reviewed, GIS utilization bifurcates mainly in two branches: crime mapping and crime analysis. In other words, although several main properties of these branches overlap, both crime mapping and crime analysis are perceived as separate specialized research areas. This bifurcation also hinders the grasp of the GIS concept. More perspectives and examples can be presented in support of why the comprehension of the GIS concept is not easy; however, the scope of this study is limited by time and available resources. In summary, the ongoing dynamic development process of GIS impedes the establishment of common ground to identify GIS and its measures.

Similarly, King (2000) warns researchers about the examination of innovations by saying that “police innovation is multidimensional, and should be treated thus in future studies” (314). King (2000) also asserts that innovation research can produce different correlates because each policing innovation can be unique. As a solution to the existence of varying perspectives in GIS understanding, using a shared conceptualization of computer mapping can be a common ground for these lines of research.

Having a unified conceptualization of computer mapping can also enable better measurement of the use of GIS in police departments. Several scholars identified computer

mapping as an innovation (Harries, 1999, Chamard, 2004; Weisburd & Lum, 2005; Mazeika, 2008; Demir, 2009) and the current study uses conceptualization of computer mapping in three forms: descriptive, analytic and interactive, as presented below (McEwen and Taxman, 1995).

#### **4.12 Computer Mapping**

GIS is an evolving innovation and it has several major and minor functions.

Computerized mapping is one of these dominant functions. Computer mapping is identified by McEwen and Taxman (1995) as a rapidly developing technique that provides numerous ways to assist police departments. According to these authors, early computerized mapping applications took place for visualizing representations of crime and “automated mapping systems offer potential for having major impacts on the strategies and tactics of police departments” (1995, 280). In an earlier study, Pauly and Finch (1967) explored the utility of computerized mapping that showed efficiency in the allocation of police manpower. According to (McEwen & Taxman, 1995; p. 281), the numerous features of computerized mapping are “critical to empowering the police to work on crime problems”. In particular, automated mapping enables examination of issues with existing information, provides mechanisms to train staff in the use of information to expand efficacy of the police response, considers the spatial aspect of the crime, supports ongoing policing strategies such as community and problem oriented policing (Harries, 1999), constitutes an institutional memory of the department, strengthens police response to crime problems, conveys selected key information to police officers and the community, facilitates developing proactive strategies, provides consistent and accurate information to guide police actions, allows one to focus on serious issues, and supports institutional change within police departments. Although GIS provides advanced technologies to display such as animations and

three dimensional modeling, these may not be common in localities since “most local governments with GIS are currently using only the simplest applications and display capabilities” (O’Looney, 2003; p.83). In summary, McEwen and Taxman (1995) suggest that “mapping, like other forms of technology, will be critical in advancing police organizations to make them more effective and efficient in the coming years” (282).

The conceptualization of computer mapping was provided in the study of ‘applications of computer mapping to police operations’ by McEwen and Taxman (1995). In this study, the utilization of the computer mapping technique is divided into three subareas: descriptive, analytical and interactive computer mapping. Descriptive refers to basic types of mapping showing distribution of events such as traffic accidents, calls for service, etc. in a pin map or similar formats. Analytical mapping refers to analyzing data and displaying its analytic result on a map. Hot spot identification is indicated as one of the primary examples of this application. Statistical techniques and their use for spatial distribution on maps are other examples of analytical mappings. Interactive mapping refers to a more complicated cycle of system allowing one to make queries to produce maps based on analysis and regular decision making on these outputs. Interactive mapping can be extended to making assessments and evaluations of used systems. The current study uses computer mapping variables as the main explanatory variable which is considered operationalization of GIS use. Specifically, two subareas of computer mapping are considered in this study because only descriptive and analytic computer mapping data was systematically collected in police agencies between 1997 and 2007 by the LEMAS survey. Further details about these subareas of computer mapping are provided below.

#### 4.12.1 Descriptive Computer Mapping

Descriptive maps are the simplest maps which are easy to produce, use and understand. To the managers, descriptive mapping enables understanding of the representation of targeted areas. To the patrol officers, descriptive maps provide a better representation of the crime in beats compared to written reports. In LEMAS data, there is a crime mapping variable representing this construct, therefore, descriptive mapping is operationalized as crime mapping in the current study. Maps can be zoomed to represent the entire jurisdiction or smaller areas such as block groups or a block based on requirements. Different types of events can be also represented such as drug markets, robberies, etc. in these descriptive maps. These or other targeted events can be published on departments' bulletins; therefore, an officer can understand the crime patterns of the area within a few minutes by looking at these maps. According to McEwen and Taxman (1995), descriptive maps can also be used to examine the displacement effects of applied police strategies. Specifically, a before and after map review enable evaluation of the effect of applied strategies on the area. Three problems of descriptive mapping are stated to keep the accuracy of the maps (1995, 267). First, descriptive mapping provides a clearer presentation of all events in a shorter time, but it may not be easy to discern pattern of crimes when many events take place by looking at pin maps. Second, recognition of an address or a location may produce large problems when these areas are an apartment or mobile home type places. Finally, boundary problems may occur in shaded descriptive maps when geographies such as census tracts precincts and reporting areas intersect. This confluence may lead to misleading results in borders because patterns of crime may be lost.

#### 4.12.2 Analytical Computer Mapping

While descriptive mapping presents available individual data points, analytical mapping displays the results of analyzed data. Analytical mapping is an inferential process. In this process, additional software that implements specifically designed algorithms to identify targeted crime patterns is used for producing analytical mapping. For example, hotspots are identified by use of cluster analysis (Ratcliffe, 2000). Different analytical mapping software can be used such as Space and Temporal Analysis of Crime (STAC) in police agencies to perform special cluster analyses. STAC is a statistical tool and is defined as "not a mapping package in itself but an analytical package to be used in conjunction with mapping software (Craigla et al., 2000; p.712). According to the study by Craigla, Haining and Wiles (2000), STAC is widely used in North American police and it is useful for operational policing that requires reply to crime whenever it occurs. Notably, this software tool was not found proper for strategic analyses of crime.

GIS is also used for forecasting space and time of the crime by using analytical mapping. For example, using artificial networks can be one of these types of techniques (Olligschlaeger, 1997). In this technique, two simple algorithms are used to forecast drug hotspots areas. Highly significant results were found by the use of spatial data by Olligschlaeger (1997). They (1997; p.344) state that "forecasting is only one of countless ways in which GIS can be used for modeling. Exploring and improving the ways in which neural networks can be applied to GIS promise to be an exciting field in the years to come". According to Eck (1998), supporting interpretations of descriptive and analytical mapping is essential by using criminological theories. Otherwise, a crime analyst can indicate the hot spots as a descriptive feature by relying only on analytical tools, but may not explain why crime is concentrated in this area.



Ratcliffe (2002) also indicates the importance of identification of crime hotspots in order to improve communication of law enforcement agencies. According to Ratcliffe, geographic profiling of serial killers and mapping a high volume of crime are the two most popular analytical applications of GIS. This technique is indicated as being very contributive if there is a discord in perceptions of police officers and the actual number of incidents of crime (Ratcliffe & McGullah, 2001). This issue may also be helpful to the police if several private websites provide varying crime distribution information about the areas.

Overall, analytical mapping expands the utilization of spatial data by developing exploratory models for geographic trends and testing hypotheses to capture underlying reasons for the crime rate. This enables the police to identify crime patterns, predict probable events, and support decision making for proactive policing strategies. In the current study, analytical mapping is operationalized by using the hot spot identification variable because only this variable is available to represent the analytical mapping technique in the LEMAS dataset.

#### **4.12.3 Interactive Computer Mapping and Beyond**

Interactive mapping comprises both descriptive and analytical mapping features in a system that is open to all users. This system allows one to ask “what if” questions and then, to find results (answers to the questions) instantaneously. Without waiting for periods or days or specialized tasks, a user can set up any type of investigation and display a case geographically on the interactive screen map. On this screen map, the user can advance an inquiry and use all associated information, such as points, crime types, demographics or other connected information resources. In summary, this mechanism provides enhancements on both management and operation levels of policing.

Systematic U.S. wide data collection for internal characteristics of law enforcement agencies has been executed via LEMAS survey since 1987. LEMAS survey is collecting data about specifically designed use of descriptive and analytic mapping variables since 1997. Accordingly, both of these mapping types are frequently used in large police agencies. However, there is not a specifically designed variable referring use of interactive mapping for current police practices. In other words, available data do not provide a separate variable for identifying interactive mapping. This may be because operationalization of the interactive mapping use is still ambiguous in GIS research. In particular, interactive mapping is a larger and more complex concept than former ones which needs a separate focus of a study. In brief, collecting data and providing clearer conceptualization and operationalization of interactive mapping can facilitate further research in this area.

In addition to three common ways of computerized mapping use, McEwen and Taxman (1995) suggest that “the mapping applications should not, however, be stand alone systems.” Instead, they need to be included in the department’s overall records management or information system. Mapping should be another tool in the arsenal, just as management information systems draw on a variety of data reports. Finally, integrating other data files with the mapping systems opens up many new opportunities for developing more insightful maps. Calls for service, arrests, citizen hot line complaints, and many other types of data can be integrated to show a complete picture of police need in an area (279-280). All of these mean that the effectiveness of GIS may be more enhanced if the surrounding local and regional entities can be incorporated in a shared system based on time and invested efforts (Budic and Pinto, 1999). Since the scope of the study is to evaluate performance of the individual police departments within the local environment, the

examination of the integrated or shared inter local and regional systems are not included in this study. This examination can be suggested as a contributive focus for future studies.

McEwen and Taxaman (1995) articulate the importance of computer mapping conceptualization:

*“With the advances in mapping technologies, and the coordination of researchers and police officers working together to understand crime, police departments are moving into a new horizons of problem solving. The three types of mapping are premised on some analytical and statistical principles that researcher use “(1995, 281).*

#### **4.13 How to Measure GIS?**

Drivers of the GIS implementation success can be explored in various ways. Goodman (1992) defines implementation as “a process undertaken to translate a tool, technique, method, or other object into some form of utilization; bounded by adaptation decision and institutionalization”. Implementation success is a multi dimensional concept identified by several constitutions (Goodman, 1992). According to Masser & Onsrud (1992); GIS implementation success is mainly studied by two dominant approaches which are content and process models. In brief, content model identifies key determinants of innovation in acceptance and use that focuses on set of variables such as technological features, availability of resources, reward systems etc (Masser & Onsrud, 1992; Obermeyer and Pinto, 2008). The second approach so called process model aims to determine key phases in adoption of innovation that focuses on “complicated set of rational, social and political activities” in the process. The idea of process approach is mainly to understand “how these processes function with different technologies and different context” (Masser and Onsrud, 1992, p 48). Considering only one of these models may not be enough to study a broad or complex problem because geographic information systems are multipurpose tools providing advantageous to different group of users (Onsrud & Pinto, 1993). Recent studies have been encouraging use of combination of techniques to cover weakness of used methods in

this kind of problems. Onsrud and Pinto (1993; p.19) says that "while each method is useful, neither offers a complete picture. A through approach should identify both the key decision factors in adopting geographic information technologies and the process by which the diffusion occurs". Ramasubramanian (1999) suggests a new comprehensive research method in addition to content and process frameworks. New method is called context that attempts to link both of these methods. He also notes that GIS use also differs based on unique conditions of countries.

There are also other measures to be mentioned for studying use of GIS. In a different view, three measures are presented by Budic and Godschalk (1994): user satisfaction, system usage and system performance. System performance is relevant with the current study context. Assessment of benefits is a way of measuring system performance which refers to organizational efficiency and effectiveness. According to Aldosary and Zahaer, (1996) assessing benefits of GIS can be used as "an indirect measure of the success of implementing GIS system performance." Accordingly, system performance which is operationalized as improvement of organizational efficiency and effectiveness is suggested to examine value of information systems.

Several methods and variables are currently in use in the literature<sup>7</sup> to measure success of information systems. In our methodology analysis, the general way in measuring information systems success is on a six point scale (Delone & McLeane, 1992; Pinto and Slevin, 1988). These focus points are: system quality, information quality, use, user satisfaction, individual impact, and organizational impact. This six point scale is the place where a researcher must start

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<sup>7</sup> [This study](#), "Information Systems Success: The quest for the dependent variable" reviewed and categorized relevant 186 articles.

to narrow the study and arrange the appropriate dependent measure (Figure 9). This study means ‘GIS’ when information technology is addressed.



**Figure 9: Assessment of System Success over Time**

Source: Obermeyer and Pinto; 2008; Delone and McLeane, 1992; Pinto and Slevin 1988

Call for more research on organizational impact analysis of information systems is bold (Delone and McLeane, 1992; Keen 1981). It is natural logic that there are both internal and external variables effecting implementation of GIS. Tomlinson, known as the father of GIS, says 1986 that “the success and failure of GIS rarely depends on technical factors, almost always on the human and managerial ones” (Gilfoyle and Thorpe, 2004). For example, use of GIS success in police agencies is mostly relevant with the environment: higher administrative authorities and policy makers. Evidence is available demonstrating both positive and negative influences of the political structures and form of governments on success of the GIS adoption (Kim, 2004; Petch and Reeve, 1999; Gilfoyle and Thorpe, 2004; Keen 1981).

Orlikowski and Baroudi (1991) studied 155 different information systems research and indicated inadequate longitudinal research in this area. Cross sectional study is one of the most common methods used in measuring success of GIS for years; however; its findings are limited compare to longitudinal study. Orlikowski and Baroudi suggest as the conclusion of their study

that “much can be gained if a plurality of research perspectives is effectively employed to investigate information systems phenomena” (1991). Therefore, this research employs longitudinal design which enables to approximate the before and after condition of the social organization.

**Table 8: Articles Classified by Time Period of Study**

<b>Time Period of Study</b>	<b>Frequency</b>	<b>Percent</b>
<b>Cross Sectional: single snapshot</b>	140	90.3
<b>Longitudinal</b>	7	4.5
<b>Cross-sectional: Multiple snapshots</b>	6	3.9
<b>Process Traces</b>	2	1.3

Source: Orlikowski and Baroudi, 1991

The longitudinal study comprises 2000 and 2007 years as a term to measure impact of GIS on crime rates and change over time. Several factors indicate below that this timeframe can be a fruitful term for the examination (Chester, 2006; Boba, 2005; Masser and Onsrud, 1992). According to US Bureau of Justice Statistics of 1999, use of GIS in US police departments started to be nationwide in late 1990s. At that time; “more than 50% of GIS users were using technology for either crime analysis or crime mapping” (Boba, 2005). Another example is emergence of the CompStat policing which was first applied in 1994 by New York Police Department. Although Compstat has been identified differently in various resources, a GIS application - crime mapping was central impetus of the integrated system (ESRI, 2009). Since then, use of CompStat type technology diffused to the other law enforcement agencies in the U.S. where it and its parallel type use have become focus of researches (Masser & Onsrud, 1992; Police Foundation, 2004).

In these years, United States Department of Justice and National Institute of Justice funded studies remarkably on computer mapping and its underlying reasons. The ‘Use of Computerized Crime mapping by Law Enforcement in the United States, 1997-1998’ was implemented by (Inter-University Consortium for Political and Social Research) ICPSR, 2003. Although it could be a suitable, rich dataset for a cross sectional study; it was imperfect as the result of huge missing values. Another considerable dataset collected by ICPSR is “Developing a Comprehensive Empirical Model of Policing in the United States, 1996-1999”. This resource is also a well constructed database consist of 3005 cases and 87 variables. Although this time period seems early for examination of the phenomena, it can be beneficial to integrate some of its relevant variables to the main dataset if it is essential.

Encouragement on longitudinal study is evident on GIS implementation by scholars (Masser and Onsrud, 1992; Orlikowski and Baroudi, 1991). Although LEMAS have been collecting data since 1987, GIS related variables such as use of crime mapping and hot spot identification have been collected only since 1997. In fact, the data was available for only crime mapping feature of the GIS use until 2000. The data on hotspot identification became available for 2000 and successive years. These considerations indicate that a longitudinal study including 2000 - 2007 term may provide a very comparative period for acquiring statistical snapshot of the GIS development in U.S. Police agencies. Similar comparative studies exist using 1998, 2000, and 2001 LEMAS datasets to examine crime overtime, such as ‘Analyzing change over time in property crime victimization’ (Chester, 2006).

## **CHAPTER 5**

### **Methodology**

#### **5.1. Introduction**

A scientific methodology constitutes the basis for conducting research to evaluate claims for knowledge. In other words, a scientific discussion is held to derive logical conclusions based on ‘premises known true or evidences gathered’ (Nachmias and Nachmias, 2000). The major purpose of methodology is said to help scientists to “see” or communicate with each other to share a common experience. In this context, the essential leveraging tool is regarded as ‘logic’ to reach empirical objectivity: truth. The validation of the truth must be within scientifically accepted and appropriate techniques. As the result; others are supposed to better understand, explain and predict the unexplained event. Therefore; the following chapter aims to share a common experience on use of Geographic Information Systems in police agencies to communicate with others and find the truth by using scientifically appropriate techniques, evidences and logic. In this respect, this chapter follows the fundamental elements of the research (Nachmias and Nachmias, 2000), by providing a discussion on research question, hypotheses, unit of analysis, research design, dependent, independent and control variables. Respectively, data analysis, reliability, validity and limitation issues are addressed in the study.

#### **5.2. Purpose of the Study**

In general, the purpose of the current study is to explore use of GIS by law enforcement agencies and examine its impact on police performance in cities and counties of the U.S. The performance of the police agencies is measured by crime rate that is explained in detail within the policing chapter.



### 5.3. Research Question

In this respect, the research question for the current study is: Does use of GIS (operationalized as computer mapping) have positive impact on police performance in city and county police agencies of the United States?

### 5.4. Hypotheses

Hypothesis is defined as “a tentative answer to a research problem, expressed in the form of a clearly stated relation between independent and dependent variables”. Hypotheses are supposed to be, ‘clear’, ‘specific’, testable, and value-free (2000, p.56-58). In current study, seven hypotheses are proposed and their null hypotheses are tested to better understand the use of GIS phenomenon within the police performance context. Definitions and how these variables are measured are told within the dependend variables and independent variables sections. These hypotheses are:

H1: The crime rate decreases within GIS user local police departments as the locality has a professional form of government.

H2: The crime rate decreases within GIS user local police departments as the police have crime analysis unit.

H3: The crime rate decreases within GIS user local police departments as the locality has stronger police strength.

H4: The crime rate decreases within GIS user local police departments as the police personnel has higher training hours.

H5: Use of computer mapping in police agencies decreases crime rates. Computer mapping consists of crime mapping and hot spot identification at the same time.

H6: Use of crime mapping (a subset of computer mapping) in police agencies decreases the crime rates.

H7: Use of hot spot identification (another subset of computer mapping) in police agencies decreases the crime rates.

After presenting hypotheses, providing proposed analytical techniques for testing them can enhance general understanding of the study. At the first phase, H1, H2, H3, H4, are tested within the simple statistics context. Correlation analysis and independent sample t test are applied to explore the relationships between police performance and professionalized form of government; police performance and having full time specialized crime analysis personnel; police performance and having stronger police strength; police performance and having better education.

In these hypotheses, GIS user local police departments refer to organizations which use crime mapping and / or hot spot identification. Some of the police departments may not have any of these GIS functions; therefore, they are coded with zero (0). Some police departments may use only crime mapping technique and they are coded as one (1) and considered as the first order GIS user police departments. And some of the other police departments may use both crime mapping and hot spot identification that are considered as the computer mapping user police agencies. This examination with its interpretation is supposed to show the relation of the each variable on DV in different level GIS user police organizations. Notably, results of these tests

may be misleading, if the other variables are interrelated (Tabachnick and Fidell, 2007). This interrelation is considered and multivariate analysis is suggested at the next phase to have more reliable results.

At the next phase, multiple regression analysis is used to test hypothesis 5 because there are many variables to be considered in the model. This analysis is supposed to show effects of the each independent variable on DV but not causality. This model necessitates consideration of all proposed independent variables (both explanatory and control variables) to explore effect of use of GIS on police performance. Although this study has defined variables, the study doesn't have control on IVs. Nonetheless, a composite variable (crime mapping + hotspot identification = computer mapping) in the model is formed to represent use of GIS (computer mapping) and it is analyzed by use of multiple regression as well.

Successively, subset variables of computer mapping (crime mapping and hot spot identification) are separately analyzed with multiple regressions to distinguish effect of each subset variables. This model also requires consideration of all proposed independent variables to explore effects. Specifically, H6 and H7 are explained at this time. Respectively, findings are interpreted based on suggested theories and literature review.

In general, GIS influence can be traced at the organizational and interorganizational levels. When an organization adopts a GIS (based on LEMAS records), this study considers this use as an organizational use. The term, organizational GIS use, has been interchangeably used as GIS utilization and use of GIS within the study. Contribution of GIS in policing is operationalized as use of computer mapping for policing (McEwen and Taxman, 1995). Specifically, use of GIS is categorized in three levels based on its mapping types. These levels

are enclosed within computer mapping conceptualization which includes descriptive, analytic, and interactive mapping (McEwen, & Taxman, 1995). In fact, only two of the mapping types – descriptive and analytic- are considered to be measured within this study. In the literature, crime mapping takes place within descriptive mapping, and hotspot identification takes places within analytical mapping frameworks. Therefore, descriptive mapping is operationalized as crime mapping and analytic mapping is operationalized as hotspot identification within the study. In this context, non adopting police organizations are represented with 0 coding.

This research explores use of GIS in two forms of computer mapping in relation to thirteen factors that theory and previous researches suggest. In the light of information technology capacity theory; form of government, number of crime analysis personnel, and number of sworn officers are used explanatory variables. Control variables are race, median income, family disruption, poverty, gender, age, population density, community policing and problem oriented policing strategies within the U.S. regions. All of these variables have been identified based on relevant literature and theories.

The main assumption of the research is: use of GIS in police agencies as different forms such as; crime mapping and hot spot identification have positive impact on police performance. In other words, the more GIS based applications are in use in police agency, the large GIS specialty and analytical capability the organization is supposed to have. The large GIS specialty and analytical capability police agency has; the police performance is supposed to increase. Therefore, having increased police performance, the police agencies are assumed to have more impact on crime rates while controlling other relevant variables.

Specifically, the focus of the study is not to examine ‘how’ GIS based applications impact on crime rates; instead, it targets to explore ‘what’ GIS applications do on crime rates. Examining, primarily, what police do or deliver as services in terms of GIS use can provide more meaningful findings considering existing police agencies. Without understanding the current application ground, focusing on how police use the GIS in an organization may produce little contribution to the field. Finally, LEMAS dataset was set by the ICRS for general purposes that mean we, as researchers, don’t have a methodological control on the collected dataset; instead, we have a statistical control on the variables to measure aimed direction.

### **5.5. The Unit of Analysis**

The unit of analysis for this study is police agencies of the United States. Specifically, the research is narrowed as cities and counties which have large police agencies. In this study, police agencies having more than 100 officers are considered as large based on LEMAS survey. Similar categorization also has been used by police foundation researches (Weisburd et al., 2004). At this phase, reviewing LEMAS survey can facilitate understanding of primarily used dataset.

### **5.6. Law Enforcement Management and Administrative Statistics Survey**

Law Enforcement Management and Administrative Statistics (LEMAS) is a national survey which is conducted every three or four years by Bureau of Justice Statistics to collect data from state and local law enforcement agencies. Inter-university Consortium for Political and Social Research (ICPSR) publishes and distributes the LEMAS datasets. Specifically, the survey is sent to all of the large agencies employing more than 100 sworn officers. Additionally, sample of the small state and local police agencies which have less than 100 sworn officers represent the

national small agencies for each collection period (LEMAS Coodebook, 2003). Large police agencies are called as self representing (SR) agencies while small agencies are called nonself-representing (NSR) agencies in the LEMAS.

Data collection process is described in detail in the LEMAS codebook (2003). The data collection is held by sending of a survey to the police and sheriff's organizations. Collected agency level data is published with the name of Law Enforcement Management and Administrative Statistics (LEMAS). Around 500 descriptive variables are provided within LEMAS dataset depending on the years about "agency responsibilities, operating expenditures, job functions of sworn and civilian employees, officer salaries and special pay, demographic characteristics of officers, weapons and armor policies, education and training requirements, computers and information systems, vehicles, special units, and community policing activities" (BJS,2009) . To date, LEMAS datasets were collected for 1987, 1990, 1993, 1997, 1999, 2000, 2003 years. Data collection for 2007 year was funded, and; results have been recently published.

In fact, LEMAS is a reliable governmental data source which is frequently used on policing research for dissertations (Gtierrez, 2002; Kaminski, 2002; Lemmer, 2005) and journal articles (MacDonalds, 2002; Hassell, Shin, Zhao & Maguire, 2003; Chappell, MacDonald, John & Manz, 2006; King, 2009). Lack of systematic data on police agencies and police behavior is criticized (Alpert & McDonald, 2001). In fact, LEMAS has evolved and produced as a systematic and convenient data since 1987. Wells and Falcone (2005,p. 7) indicate "LEMAS surveys as a primary source of national information and data on the police in the U.S. both for providing an accurate and current picture of the state of policing in the nation as well as for providing an ongoing, publicly available national data source for high quality policing research".

Limitations of the LEMAS survey must be considered while using the dataset in research. All large agencies (SR) are presented in the dataset based on their responses; however, only selected sample of small agencies (NSR) represent the all small agencies in the dataset (Lemas Codebook 2003). This requires considering sampling errors for the small agencies' results (2003, Codebook; Eitle, 2005). Additionally, LEMAS is a self reporting survey that may result validity concerns based on individual respondents. According to Wells and Falcone (2005), how accurate their responses are uncertain and constituting additional quality control procedures, agencies to follow-up, and validate interviews may be contributive to LEMAS (5-7). Response rates are high in LEMAS for example, 90.6% of the agencies responded for 2003 LEMAS surveys. However, some participating agencies may not respond the questionnaire fully. As solution to these missing data, hot deck imputation, median value imputation or ratio imputation techniques have been used. These techniques are also subject to error while interpreting the data for none reporting agencies. According to the codebook of 2003 (p.5); "hot deck imputation uses the value reported by a randomly selected agency from the same sample cell. Median value imputation uses the median value of an item reported by agencies in the same sample cell. Ratio imputation uses the median value of a ratio reported by agencies in the same sample cell".

Constituting additional quality control procedures, agencies to follow-up, and validate interviews of a randomly selected sample of responding agencies may help to enhance the reliability and validity of the LEMAS datasets. At this phase, LEMAS 2003 dataset is explored in detail to as a representative to other collected years.

In 2003, 3,154 mails were sent to state and local law enforcement agencies as LEMAS survey questionnaire. Dataset collection was conducted between December 2003 and December

2004. Data is presented on general purpose law enforcement agencies as state, local and sheriff departments in LEMAS survey. Special jurisdiction agencies and Texas constables are allowed for exclusion in the LEMAS. In fact, there were 3179 elected agencies to be surveyed; but 25 of them defined as out of scope because these agencies either closed their services or outsourced on part time basis. Therefore, 955 self reporting (SR) agencies out of the 3,154 sample state and local law enforcement agencies take place in the LEMAS dataset. As self reporting agencies (SR), 574 local police departments, 332 sheriffs' offices and 49 primary state law enforcement agencies were surveyed in the dataset. 2,199 nonself representing (NSR) agencies which have less than 100 sworn personnel were also selected by use of stratified random sample by the LEMAS. The focus of the study is large police agencies and small police agencies are not considered in the scope of the study. Overall, response rate of the LEMAS 2003 survey is 100% for the state law enforcement agencies, 92.1% for local police departments and 87.0% for sheriffs' offices.

According to LEMAS 2003 dataset codebook: the "(d)ata include agency personnel, expenditures and pay, operations, community policing initiatives, equipment, computers and information systems, and written policies" (4) Specifically, 461 variables are provided within 11 variable groups. These variable groups are named as Identification Items, Descriptive Information, Personnel, Operation, Specialized Units, Community Policing, Emergency Preparedness, Equipment, Policies and Procedures, Flag Variables, Weight. An appendix LEMAS questionnaire which was used as the primary tool for data collection is provided.

Introducing available number of variables and used variables in datasets can enhance understanding of the selected datasets. According to LEMAS survey codebooks, 1997 LEMAS



dataset consists of 3412 cases with 706 variables; 1999 LEMAS includes 3246 cases with 339 variables. Similarly; 2000 LEMAS consists of 2985 cases with 438 variables. The study will use 8 variables from LEMAS datasets that will be operationalized as seven variables in the current study. The coded numbers of variables in LEMAS survey are population, 69, 97, 125, 126, 177, 175 and 197. The first selected variable is the population (1) variable which provides number of people living in the community. Variable number 177 represents existence of crime analysis unit (2) and deployment of full time personnel in a police agency. Variable number 69 is named as Education Requirement for Recruits which shows degree of the required education (3) in police agencies. Variable number 97 is named total hours of training (4) which combines both field and in class trainings at one variable. Variables numbered as 125 and 126 aims to show number of total males and total females (5) who work in the police organization. Variable number 176 is named as Community Policing Unit which shows existence of a specialized unit and specialized full time personnel (6) for community policing. Variable number 197 is named Encouraged SARA Type Projects that represents existence of problem oriented policing application (7). Details of these variables are provided in methodology chapter.

Cost of implementing GIS is believed very costly for local authorities with population of 50,000 (McGill, 2005). Although some of the high costs are funded for large police agencies to some degree by federal organizations such as COPS, small size police agencies still get the least benefits based on their serving populations. With parallelism, Mapping and Analysis for Public Safety (MAPS) organization conducted a national survey in 1997 and found out that “36% of larger departments (those with more than 100 officers) reported using computerized crime mapping, whereas only 3% of smaller departments (those with fewer than 100 officers) did so; this variation in the adaptation of GIS technology by agency size” (Boba, 2005). Examination of

closer data context can provide more meaningful results if it is a homogeneous in nature. For this reason, this study mainly focuses on large size police agencies having more than 100 officers in 2000, 2003 and 2007 to measure crime change over time.

### **5.7. Research Design**

This study uses a macro level perspective to explore crime rates in localities of the U.S. between 2000 and 2007. These years have been purposively selected for a few reasons. First, use of GIS became widespread after mid 1990s in the police agencies. Second, systematic data collection on use of GIS at the local law enforcement agencies is available only after 1997. Law Enforcement Management and Administrative Statistics survey (LEMAS) is the only systematic national reliable source providing this data across the U.S. Finally, available literature review indicates that LEMAS data have been frequently used to examine nationwide trends. There are also other explanatory variables derived from the Uniform Crime Report program (UCR) and the U.S. Bureau of Census. Current study is a quantitative research which uses secondary data analysis on a combined dataset.

According to our methodology review, the general followed pattern in measuring information systems success relies on a six point scale where call for more research on organizational impact analysis of information systems is bold (Keen 1981; Delone & McLeane, 1992; Pinto and Slevin, 1988). Evidence exists in the literature, indicating both positive and negative effects of the political authorities and type of governments on success of the GIS implementation as well (Kim, 2004; Petch and Reeve, 1999; Gilfoyle and Thorpe, 2004; Keen 1981). In this sense, embracing more variables within organizational impact analysis which

includes both content and process variables in a combined manner can provide more explanatory variable for the study.

Therefore, this study utilizes a combined approach benefiting primarily from process approach with some from content approach (Masser and Onsrud, 1992; Obermeyer and Pinto, 2008). To constitute this composed structure, both environmental variables and some content variables such as technological features are represented in the organizational impact model. This combined model can be better presented within information technology capacity (Kim & Bretschneider, 2004) model which is provided in detail in following sections.

In addition to these, to involve several types of GIS based applications over time across the nation can be more fruitfull. Specifically, longitudinal study design which is defined as “extended overtime to allow researchers to examine changes in the dependent variable” is considered as a comprehensive solution to the research (Nachmias and Nachmias, 2000). Consequently, this study is designed as a quantitative, longitudinal research covering 2000 and 2007 years.

## **5.8. Variables**

In this research structure, two sets of factors are examined to explore the contribution of GIS use to police performance. Derived from the mentioned research (Neely et al, 1995; Behn, 2003) within the policing chapter, performance measure is defined as increase and decrease of crime rate of an area as outcome of a police agency (Roberts, 2006). In the current study, success of police performance is quantified by using crime rate as an outcome proxy, as the dependent variable (Swindell & Kelly, 2000; Moore and Baraga, 2003; Roberts, 2006). All variables of the

study are described as the data dictionary table below for a quick review. Variables' names, their descriptions, values/categories and measurement levels are clearly briefed based on LEMAS 2003 dataset.

**Table 9: Data Dictionary of the Study**

Variable Names	Measurement	Measurement Level	Data Source
Crime Rate (Overall)	Number of crimes per 100,000 people	Ratio	The UCR
Violent Crime Rate	Number of violent crimes per 100,000 people	Ratio	The UCR
Property Crime Rate	Number of violent crimes per 100,000 people	Ratio	The UCR
Crime mapping	Existence or absence of crime mapping	Dichotomous	LEMAS
Hotspot Identification	Existence or absence of Hotspot Identification	Dichotomous	LEMAS
Professional Form of Government	1 Manager and council, 2 Other forms	Dichotomous	Open Source
Managerial Capability Of IT, Crime Analysis	1=Specialized Full 2 No	Dichotomous	LEMAS
Police Expenditure/ Strength	The number of police employees in a police agency / population	Ratio	LEMAS
Education	Total hours of in service training	Ratio	LEMAS
Age	Percentage of youth between 15-24	Ratio	The Census Bureau
Gender	the number of males per 100 females between the ages of 15 and 59	Ratio	The Census Bureau
Urban Size	Population	Ratio	The Census Bureau
Regions	1= West, 2= South, 3= Midwest, 4=North East	Nominal	The Census Bureau
Family Disruption	Number of Single headed families	Ratio	The Census Bureau
Ethnic Heterogeneity	Percent of nonwhite population	Ratio	The Census Bureau
Poverty	Poverty Line	Ratio	The Census Bureau
Problem Oriented Policing	0=absence 1=exists	Dichotomous	LEMAS
Community Policing Unit	0=absence 1=exists	Dichotomous	LEMAS

Respectively, the first set of factors is presented in the light of the information technology capacity theory (Kim & Bretschneider, 2004). This includes presentation of three main factors: administrative authority, the managerial capability of the IT manager, and financial support to examine an IT application. Additionally, education is presented as a control variable of GIS use.

Correlates of crime rate are presented as the second set of factors to control their effects on crime. As demographic variables, age, sex, population (urban size) and regions are presented. As the social and economic variables, ethnic heterogeneity, family disruption and poverty variables are presented based on social disorganization and collective efficacy views. Finally, community policing and problem oriented policing strategies which have been found influential in reducing crime rates, are presented as control variables to determine contribution of GIS use on police performance. At this point, introducing and applying local government information technology capacity theory (Kim & Bretschneider, 2004) can help to link the hypotheses to the general conceptual model as an explanatory ground to study GIS utilization.

### **5.8.1. Local Government Information Technology Capacity Theory**

Information technology capacity (ITC) theory is a comprehensive approach which explores an organizational information technology capacity (Kim & Bretschneider, 2004). This theory requires encompassing both human and nonhuman capital aspects of studied phenomena without excluding environment to measure the overall capacity. Majority of the GIS research are divided into two main focuses as GIS adoption and GIS use (Skogan and Hartnett, 2005). Distinctively, ITC theory combines both of these measurement areas (adoption and use of IT) into one newly defined construct Information Technology Capacity (ITC). Specifically, information technology capacity theory attempts to knit together organizational, environmental

and managerial factors affecting level of IT capacity. This is why ITC is defined as "the ability of the local government to effectively apply IT to achieve desired ends". Figure of the determinants of IT capacity clarifies the casual mechanism among the interacting variables. This theory identifies three factors and all of these three factors are accepted essential. Specifically, local government information technology capacity theory urges considering three main explanatory as administrative authority, managerial capability of IT manager, and financial support. While stating administrative support, the study means people who can invest resources because innovation requires large amount of investment for a long time (Kim; Bretschneider, 2004; p.3). It must be noted that administration will be taking risk of failure or delay in appropriately allocating other sources. This variable can be represented by considering top administrators' knowledge in IT support of council and support of state in financially supporting innovation process.

Secondly, managerial capability of IT manager is defined "as the ability to identify problems of the current information system, and to develop and evaluate alternatives to improve the IT capacity of the organization". This can be operationalized as the existence of a crime analysis unit in a police organization within the current study because this unit is supposed to have the expertise personal and managerial staff having mentioned ability. Manager of the crime analysis unit is expected to have enough knowledge and expertise in using analysis tools such as GIS and computer mapping is the central utility of crime analysis unit (Boba, 2005),

Thirdly, financial support is indicated one of the strongest predictors of innovation in the organization within the ITC theory (Kim & Bretschneider, 2004). To consider this dimension, overall expenditures or IT portion of the total budget can be used as applicable variable. Current

study is already using police expenditure variable which can substitute this need. Using another similar variable like budget may produce multicollinearity problem. Therefore, the study does not use an additional financial support variable instead considers police expenditure variable, which represents police expenditures and organizational size at once, in this context. In the data analysis phase, this issue can be reviewed again and adjusted according to study findings.

There are also control variables advised as, IT literacy, organizational size, and type of government. General IT literacy is also suggested as a control variable because if the more people use IT the more IT service can be expected. Respectively, organizational size is addressed to be considered as control variables. Size of the organization is indicated positively related with the innovation. In other words, large organizational size was found facilitator of innovation. In short, the ITC theory assumes that managerial capability of IT can have an effect in improving the organizational capacity if adequate resources, as political support and budgetary support are provided. This also means that provided financial support may not improve the IT capacity of the organization by itself unless adequate IT managerial capability and administrative support exists. These three variables are interdependent.

In their study (Kim & Bretschneider, 2004), level of used IT technology is also shown important because influence of government was found positively or negatively depending on this. They listed level of technologies as the first order, second order and third order technology capacity. This can be applied within current study as nonuser police agencies (0), and GIS user agencies (2). In specific, three common GIS utilization in police agencies as the first order (descriptive) GIS utilization (1), second order (analytic) GIS utilization (2) and third order (interactive) GIS utilization (3) are categorized in order to increase precision of the study.

## **Application of Information Technology Capacity Model**

At this point, illustrating the proposed theoretical model can provide a clear ground for better communication (Moon, 2002). In other words, this illustration links the proposed variables to the general conceptual model. The Information Technology Capacity (ITC) theory is one of the approaches exploring influences of interrelated factors on IT success. According to this theory, while measuring success of the information technology, human capital and non human capital factors; managerial and administrative capability support are specific considerations. In brief, ITC theory encompasses organizational and environmental variables as a comprehensive approach. Based on ITC theory, proposed variables are applied below as dependent, independent variables and control variables.

Part I involves dependent variables which are crime rates (overall, property and violent). Primary IVs are presented as use of GIS factors as Part II. This includes computer mapping and ITC theory variables which are the authority, the managerial capability of the IT manager, financial support and education. Part III stands for demographic, socio economic and policing variables of crime which are age, sex, urban size, regions, ethnic heterogeneity, family disruption, poverty, And finally, policing variables as: community policing and problem oriented policing strategies.

### **5.8.2. Dependent Variable: Crime Rates**

Crime rate has been selected as the dependent variable of the current study which aims to measure performance of the police in cities and counties of the U.S. In particular, crime rate of an area is generally used as the proxy to measure overall performance of a police agency in crime fight. In other words: it is assumed that if the crime rate decreases in the jurisdiction of



that police organization, then the police performance is high. The UCR program calculates crime rates as number of crime per 100,000 persons. Periodically, each year, the FBI calculates rates of the crimes reported to the police. Eight types of serious offenses take place and tracked in this crime index. The FBI crime index is constituted by composition of criminal homicide, forcible rape, and robbery, aggravated assault, burglary, larceny motor vehicle theft and arson. The FBI also counts other crimes as part II offenses if they are arrested. Newly adapted crime data collection mechanism, NIBRS, provides a wider range and detailed incident reporting as datasets.

Distinguishing dependent variable as overall (DV1), property (DV2) and violent (DV3) crime rates can facilitate to capture effects of GIS use on police performance because majority of crimes falls in these main categories (Murray, McGuffog, Western, and Mullins, 2001). UCR defines the violent crime as “those offenses which involve force or threat of force”. Accordingly, violent crime consists of murder and nonnegligent manslaughter, forcible rape, robbery, and aggravated assault (FBI, 2007). Property crimes do not comprise force or threat of force against the victims. UCR identifies the offenses of burglary, larceny-theft, motor vehicle theft, and arson as property crimes (FBI, 2007). The UCR data, as its strengths, weaknesses, superiority to other measures of crime and limitations, is widely discussed in chapter II.

### **5.9. Independent Variables**

Several variables take place in explanation of crime. On the one hand, while testing a problem, it is better to have as much as potential explanatory variables in the system (Moon, 2002). On the other hand, relevant factors are expected to be narrowed based on the research focus, while measuring crime. Since focus of the study is to measure impact of GIS use on police performance, use of GIS variables are indicated one of the boxes. There is body of literature on

use of GIS effect in improving visualization, communication, comprehension, speed, and accuracy of the provided service delivery (Boba, 2005, p.38; Greene, 2000; O’Looney, 2003; Chainey and Ratcliffe, 2005). Crime mapping is one of the leading tools of the GIS utilized by police agencies (Shea and Nicholls, 2002). “According to COPS grant examinations in 2002, “(c)rime mapping and spreadsheet are the most commonly used software of the choices offered. Nearly 6 out of 10 (65% and 60%, respectively) departments that responded use that type of software” (COPS, 2002). When PC, laptop and GIS become widespread as the result of lower costs at the outset of 1990s; GIS usage increased considerably. Dramatic increase in use of crime mapping occurred in mid 1990s when CompStat’s impact was felt at police agencies across the United States (Boba, 2005; Weisburd and at all, 2001; Eck and Maguire, 2000).

Use of GIS variables represents different forms of GIS mapping applications. This research considers all type of GIS mapping as the use of GIS based on LEMAS dataset. Within the LEMAS dataset, two variables are presented which are crime mapping and hotspot identification. Both of these variables are used as IVs within the study and these variables are described for large size police agencies in the U.S localities.

### **Application of the Variables**

For several reasons, crime mapping is the most used function of the GIS. According to the research on “Crime Analysis in America”, 6 out of 10 departments have been (60%) using crime mapping (Shea & Nicholls, 2002). Therefore this study considers use of crime mapping as an indicator of GIS use in that police agency, however this doesn’t mean that this utilization is successful or not. This level of mapping also shows that some of the police “departments are not engaging in more sophisticated statistical-based methods of analysis” (Shea & Nicholls, 2002).

In other words, use of crime mapping represents the first order GIS technology (Kim & Bretschneider, 2004).

Hotspot is simply defined as an area of high crime concentration (Cahiney & Ratcliffe, 2005). Hotspot identification represents the superior utilization of GIS because the application needs more expertise and sometimes supplementary software for deployment. It is also used instead of analytical mapping applications. Researchers (Gonzales et al., 2005) state that “identifying hot spots requires multiple techniques; no single method is sufficient to analyze all types of crime.” Therefore, use of hotspot identification at a police agency indicates having a higher analytical capability that refers the second order GIS use (Kim & Bretschneider, 2004).

**Table 10: Use of GIS**

<b>LEMAS DATA COLLECTION YEARS</b>	<b>1997</b>	<b>1999</b>	<b>2000</b>	<b>2003</b>
V2 CRIMEMAPPING	V233	V126	V208	V403
V3 HOTSPOT IDENTIFICATION	V267	V119	-----	V407

Additionally, integration of information based systems such as computer aided dispatch, record management systems, and vehicle mounted laptop computers into GIS infrastructure can increase contribution of the GIS on police performance (McEwen & Taxman, 1995). This understanding also refers to use of interactive mapping as the third order technology of a police agency. In this study, the third order GIS use is not considered because the study of integrated systems necessitates several dimensions to be considered. Therefore, this examination need is addressed as a future study topic.

### **5.9.1. Crime Mapping**

Crime mapping is defined as “the process of using a geographic information system to conduct spatial analysis of crime problems and other police- related issues” by Boba (2005).

According to LEMAS (2003) dataset, 2858 valid cases exists and 1 case missing in total. 67.6 %

of the agencies are not using crime mapping. Level of measurement is dichotomous consists of 1 and 0. 1 refers to existence of crime mapping. When we focus on the large size police agencies (See appendix 1), it is seen that 57.8 % of them are reporting while 42.2% of them are not reporting use of crime mapping. This means 505 agencies out of 873 cases have been using crime mapping which represents the first order GIS use in these police agencies.

**Table 11: Crime Mapping Use in Police Agencies**

Existence	Frequency	Percent
No	1934	67.6
Yes	923	32.3
DK	1	0
Total	2858	100

Source: 2003 LEMAS Survey

### 5.9.2. Hotspot Identification:

In this study, hotspot is defined as “a specific location or small area that suffers a large amount of crime” (Boba, 2005). This variable is dichotomous variable with only one missing case. 599 police agencies which mean 21% of the agencies are using hotspot identification technique.. 40.3% of police organizations use hot spot while 59.7% of them are not using (Appendix 1).

**Table 12: Hotspot Identification Use in Police Agencies**

Existence	Frequency	Percent
No	2258	79
Yes	599	21
DK	1	0
Total	2858	100

### 5.9.3. ITC Theory based Variables: Form of Government

Cities of the U.S states are governed independent of the states. Cities may differ in size and may be even bigger than states. For example New York City is bigger than 41 of the 50 states

by population. Because of this huge power on existence continuing service delivery, forms of city governments also must be examined in terms of their impact on going services. Previous studies indicate effects of the political authority on crime and used technologies (Mamalian & LaVigne, 1999; Kim & Bretschneider, 2004). According to 1996, 2001 and 2009 International City / County Management Association (ICMA, 2010) surveys, mainly four forms are used nationwide. These are Mayor-Council, Manager-Council, the Commission and Town/ Representative Town Meetings. Similarly, Wikstrom and Stephens, (1998) analyzes main types of city governments in different studies and emphasizes on their different impacts (Friesema, 1971; Wikstrom and Stephens, 2000; Wikstrom, 2003). Specifically, forms of governments are considered as two main forms. One is called reformed or professional form of governments which is governed mostly by a council and county manager. Second group of governments are called unreformed governments which refers to major council form of governments. The professional form of government is a type of city government where the city is governed by a council and a county manager; conversely, a nonprofessional form of government refers to the mayor, council and other forms of government (Wilson, 1968; Wilson and Boland, 1977; Langworthy, 1985; Slovak, 1986). Inclusion of the form of city governments can be contributive to the research; however, the aimed data was not collected with the LEMAS dataset. Therefore, form of city governments are found out via visiting governmental sources manually on web. In summary, administrative authority is considered as form of government with the ITC theory. And its operationalization addresses professionalized and non professionalized form of governments.

**Table 13: Form of Government**

LEMAS DATA COLLECTION YEARS	1997	1999	2000	2003
V4 FORM OF GOVERNMENT	*	*	*	*

#### 5.9.4. Crime Analysis Unit

Policing information is systematically processed mainly by either crime analysis personnel or crime analysis units to study of crime in U.S Police agencies (Santos, 2012). As a policing tool, GIS is generally used by crime analysts and deployed within these units. Use of GIS is mainly sustainable within crime analysis units (CAU). In general, crime analysis represented –if it exists-, in most police agencies by either specialized personnel or crime analysis unit. Considering this qualification of the full time employed specialized personal, current study uses existence of crime analysis and availability of the specialized personal as the representation of the managerial capability of the IT in a police agency.

**Table 14: Crime Analysis Unit**

LEMAS DATA COLLECTION YEARS	1997	1999	2000	2003
V5 CRIME ANALYSIS UNIT	V396	V125	V338	V177

A police agency unit can be institutionalized for conducting crime analysis (Boba, 2005). In the 2003 LEMAS survey dataset, the level of measurement for CAU is discrete. There are 902 valid cases out of 2859 as the 31.5% of the cases. Since this variable is narrow and has large number of missing value, it is not considered as dependent variable. 507 out of 873 large police organizations (57.7%) prefer having crime analysis unit, where others assign personnel (not unit), or sometimes address the issue but don't provide personnel.

**Table 15: Crime Analysis Unit in Police Agencies**

Description	Frequency	Percent
Agency has specialized unit w f/t personal to address problem	517	18.1
Agency has dedicated personnel to address this problem	133	4.7
Agency addresses this problem, but doesn't have dedicated personal	164	5.7
Agency does not address this problem	88	3.1
Total	902	31.5
Missing	1957	68.5
Total	2859	100

Source: 2003 LEMAS

### 5.9.5. Education

Education is indicated as a control variable explaining use of information systems in organizations (Mamelian & LaVigne, 1999; Ramasubramanian, 1999; Gilfoyle & Thorpe, 2004; Police Foundation, 2000; Kerski, 2003; Pattavina, 2005; O’Looney, 2003; Foster, 2004; Ratchliffe, 2004; Garicano & Heaton, 2010; Cope, 2004; Paulsen, 2004; Skogan & Hartnett, 2005). Education is also one of the suggested aspects of the information technology capacity as and this is why it is considered as one of the variables. Education is defined as the in service training which is measured as the total training hours based on the LEMAS survey records.

Specifically, current study uses a variable to control role of education and training on GIS use which is operationalized as formal and professional education. Both formal education and professional education are considered within the variable as a unified variable. Because using a unified one variable can better measure level of the education provided to human resources of a police agency (Mazeika (2008). Specifically, LEMAS provides a variable which represents total hours of training that combines both field and in class trainings at one variable. Therefore, this variable is worded as training hours within the hypothesis testing process.

**Table 16: Education**

LEMAS DATA COLLECTION YEARS	1997	1999	2000	2003
V6 TOTAL HOURS OF TRAINING	***	***	***	***

### 5.9.6. Number of Total Police

Although some studies indicate that police presence is not a statistically significant variable (Eck and Macguire, 2000); organization of the police which relies on the number of available police has impact on reducing crime (Bluemstein & Wallman, 2000). In fact, police size and police expenditures constructs are used interchangeably (Snipes, 1993), and police strength can be operationalized by number of total police (Maguire, 2001).

**Table 17: Number of Total Police**

LEMAS DATA COLLECTION YEARS	1997	1999	2000	2003
V7 TOTAL LAW ENFORCEMENT OFFICERS	V280	FTE	V14	TOT_P

Current study operationalizes number of total police divided by the population as an independent variable to control effect of the police strength (organizational size and expenditure) on crime. Measurement of the number of police variable is ratio and the range is between 0 to 35973 police. The mean of the police number in LEMAS 2003 data set is 166.057.

**Table 18: Number of Police in U.S Localities**

	N	Minimum	Maximum	Mean
Total Police	2859	0	35973	166.057

Source: 2003 LEMAS

### **5.9.7. Demographic, Social and Economic Variables of Crime**

Age, sex, urban size, and regions are considered related factors with criminality in the literature (Flowers, 1989). Findings of a study on examination of crime rates in cities and counties of the U.S can be arguable if it doesn't consider adequate demographic variables (Fox, 2000). Therefore, age (V8), sex (V9), urban size (V10) and regions (V11) are considered within the study. And these variables are gathered from the Bureaus of census sources for the study. U.S. Bureau of Census provides the data for 1990 and 2000 years relevant to this study. Since this research magnifies 1997, 1999, 2000, 2003 and 2007 years, their populations are adjusted accordingly with the use of appropriate statistical techniques. Specifically, age is operationalized as percentage of youth who are between 15 and 24. Gender refers to sex where sex ratio is used to measure gender variable. Sex ratio is operationalized by considering the number of males per 100 females between the ages of 15 and 59.



**Table 19: Part III, Descriptive, Environment and Administrative Variables**

LEMAS DATA COLLECTION YEARS	1997	1999	2000	2003
V8 Age, V9 Sex, V10 Population, V11 Regions	*	*	*	*

### 5.9.8. Population

Population, urban size, is one of the key variables of the most researches to identify addressed people. The population data is already available in LEMAS datasets and the range is between 62 at Mentone city of Texas to 35,484,453 California, Sacramento.

**Table 20: Population**

LEMAS DATA COLLECTION YEARS	1997	1999	2000	2003
V10 POPULATION	V14	VV11	V11	POP

Level of measurement is ratio and mean of the population in 2859 localities is 208476.42. Specifically, urban size can be operational either raw population numbers or using population density. This requires dividing the place to the population.

**Table 21: Population in U.S Localities**

2003	N	Minimum	Maximum	Mean
Population	2859	62	35484453	208476.4

Source: 2003 LEMAS

### 5.9.9. Region

Several studies address importance of regions in distribution of crime across the U.S. (Land, et all, 1991; Winsberg, 1993; Grattet et al., 1998; Glaeser & Sacerdote, 1999; Quesey, 2000; Levitt, 2004) this is because implementation of a technology can be influenced by both the immediate environment and regional context (Mazeika, 2008). Therefore, regions of the US are considered within the current study as a control variable. Level of measurement is discrete that represents West, South, Midwest, North East regions of the U.S.

#### **5.9.10. V12 Racial Heterogeneity**

Several studies indicate importance of considering economic and racial heterogeneity variety in crime explanations in cities and counties (Shaw & MacKay, 1942; Liska & Champlin 1984; Miethe, et al., 1991; Pratt & Cullen, 2005). This composition can be measured as racial heterogeneity which refers to the percentage of nonwhites and the percentage of Blacks. In the current study, racial heterogeneity is measured as the percentage of nonwhites (Pratt & Cullen, 2005) to cover all subgroup races in the explanation.

#### **5.9.11. Family Disruption**

Previous studies indicate effect of family disruption in explaining crime phenomena in cities and counties of the U.S. Specifically, social and economic characteristics have been studied in this context (Liska & Champlin, 1984; Sampson, 1987; Sampson & Groves, 1989; Glaeser, Sacerdote & Scheinkman, 1996; Stucky, 2005). Specifically, family disruption has been operationalized as single headed families and percentage of divorced people (Sampson, 1987; Sampson & Groves, 1989; Miethe, et al, 1991; Pratt & Cullen, 2005). In study, the single headed family is used as the operationalization of family disruption (Messner & Sampson, 1991).

#### **5.9.12. Poverty**

Poverty is considered one of the important explanatory of crime and scholars have explored the effect of poverty on crime (Flango & Sherbenou, 1976; Hsieh & Pugh, 1993; Pratt & Cullen, 2005; Stucky, 2006). Its unequal distribution in a community can result in high crime rates and areas depending on several other factors. Absolute and relative poverty are used to quantify poverty. Absolute poverty means a number of people or households living below the income threshold. Relative poverty means to set up a poverty line. A recent study indicates that

the effects of absolute and relative poverty on violent crime and burglary are clear (Patterson, 1991). Specifically, poverty is addressed to be more strongly associated with crime rates than relative poverty. Therefore, poverty is measured by absolute poverty in this study.

### 5.9.13. Policing Variables

There can be policing variables having impact on crime rate because use of GIS is not the only tool to have impact on police performance. Previous studies shows that community policing and problem oriented policing strategies are influential on crime change. Considering these two policing strategies with the current research as control variables can increase explanatory power of the proposed research model. These variables are identified based on relevant literature and theories. These variables are detailed in policing chapter.

**Table 22: Policing Variables**

LEMAS DATA COLLECTION YEARS	1997	1999	2000	2003
V15 COMMUNITY POLICING UNIT	V395	V189	V337	V176
V16ENCOURAGED SARA-TYPE PROJECTS	V481	V214	-----	V197

#### **Encouraged SARA-Type Projects: Scanning, Analysis, Response and Assessment**

SARA type of policing represent problem oriented policing. Specifically, SARA is “spotting problems using knowledge, basic data and electronic maps, using hunches and information technology to dig deeper into problems’ characteristics and underlying causes, devising a solution, working with the community, wherever possible, and looking back to see if the solution worked and what lessons can be learned (Anonymous , (2009). The level of measurement is dichotomous and only one case is missing. 959 agencies are reporting ‘yes’ that means 33.5 % of the agencies benefiting from it. In large police agencies, 51.3% use SARA type projects that mean 448 organizations out of 872 are using them (See appendix for table).

**Table 23: Encouraged SARA Type Projects in Police Agencies**

<b>Existence</b>	<b>Frequency</b>	<b>Percent</b>
No	1893	66.2
Yes	959	33.5
Missing	1	0
DK	5	0.2
Total	2858	100

Source: 2003 LEMAS

And essential variables are derived from LEMAS survey. Some variables are derived from other sources such as the UCR program, and Census Bureau. A few other variables are collected by examining relevant localities website in order to have a better data set to analyze.

#### **5.10. Data Collection**

The context of a research topic can be better understood by analyzing data which is collected in different times on similar issues (Nachmias and Nachmias, 2000). Secondary data analysis is used to gather the relevant data for this study because the secondary data is also the only available systematic data to study longitudinal nature of the GIS use in police agencies. As the one method, panel study can be used to measure the same sample at periodic times that is supposed to provide both net and gross changes (Anonymous, 2009b; Nachmias and Nachmias, 2000). As an alternative method, the trend study can be preferred for a study. The trend study is a subset of longitudinal study that takes periodic samples from different groups in the same population. Trend studies are important to measure net changes at the aggregate level. The LEMAS survey has been collecting data from the large police agencies as entire population; therefore, the study will use panel study approach instead of the trend approach.

There is a need to comprise several factors to understand and explain the true extent of the proposed research question. For this reason, several variables presented below are derived from three major data sources that are combined as a new dataset to measure use of GIS impact

on police performance. The proposed data are retrieved from the LEMAS survey, the Uniform Crime Reports (UCR), the Bureau of the Census and open resources. All variables of the study are described within the data dictionary table below for a brief review. Names of variables, their values/categories, measurement levels, and data sources are clearly presented.

It is essential to use some of the demographic variables to measure crime rates in places; therefore, necessary social, economic and demographic variables are gathered from official sources. Demographic data is collected periodically by Bureau of U.S Census and there is a necessity to use 1990 and 2000 census data sources for the study. Since the study aims to use 2000, 2003, and 2007 datasets; relevant demographic datasets are pooled accordingly. Social, economic and demographic variables are derived from this reliable governmental source.

### **5.11. Data Analysis**

The analysis used in this study is a macro level data for crime examination. A study can focus on individuals and examine their characteristics as a micro level study (Sampson, 1991). If the study targets groups, neighborhoods and their characteristics, it is called as mid level analysis. And if the study analysis focuses on overall values of the community by use of overall data rather than individuals or groups data, it is called macro level analysis. These types of analyses are utilized with different names in other sources as well. Boba (2005) classifies these analyses in different names but within the similar logic. His work of “Crime Analysis and Crime Mapping” calls them as individual, local and societal level of analysis.

Criminology theories also have these perspectives and support this level of analysis via different ideas. For example, rational choice theory (Boba, 2005), provides ground for individual analysis, crime pattern theory (Boba, 2005) provides standpoint for local level analysis, and routine activities and social disorganization theory and information technology capacity theory

(Kim, 2004) suggest foundation for societal analysis. Some studies show the negligence of community characteristics at the macro level as a reality within “Linking the Micro- and Macrolevel Dimensions of Community Social Organization” (Sampson, 1991). This shows the need for more research on societal perspectives; hence this study is set as a macro level analysis.

### **5.11.1. Descriptive Statistics**

In this study, the screening the data is completed to clean the data based on relevant techniques, assumptions, and prior to analysis. Descriptive statistics are used in order to explore the LEMAS dataset. This enables to know data and find reliable differences and/or relationships (Tabachnick and Fidell, 2007).

### **5.11.2. Hypotheses Testing**

At the first step, hypotheses are tested to find out significant and non-significant relationships. Mainly, correlation analysis is used to test the hypotheses since variables are continues, and their findings are interpreted accordingly. Additionally, Independent Sample t Test is also applied for dichotomious variables to explore the relationships.

### **5.11.3. Multivariate Analysis: Multiple Regressions**

Secondly, a comparative approach is applied between GIS user police agencies and nonusers to capture differences. For this phase, police agencies using GIS based applications are coded a new dichotomous variable consists of 1 and 0. Use of crime mapping and hotspot identifications are used separately as determinant variables and codified as 1 at this step. The others, nonusers, are coded as 0. Finally, an explanatory model based on information technology capacity approach is applied. For the modal, multiple regression is applied since the DV are continues. All findings are interpreted according to their techniques.

## 5.12. Reliability and Validity

When applying a measurement, it is almost impossible to calculate the true score independently from all the error. However, there must be a common ground to provide reliability to the reader. Reliability is defined as “ to the extent which a measuring instrument contains variable errors, that is , error that appear inconsistently between observations either during any one measurement procedure or each time a given variable is measured by the same instrument” (Nachmias and Nachmias, 2000; P.155). The main focus of the study: large police agencies are divided in two categories as GIS users and nonuser. This increased strength of the research. Finally, longitudinal nature of the study comprising 3 datasets for 7 years is supposed to provide a very bright snapshot of the GIS use and its contribution to crime rates change over time.

Validity is originated from the concern to understand whether a researcher is intended I am measuring what I am intended to or not. This questioning is natural because most of the measurement in social sciences are indirect (Nachmias and Nachmias, 2000; P.148). Although researcher may not be certain about the situation, he/she can provide adequate evidences from former literature, researches and successfully used similar examinations to prove the applied instruments. Logic and common sense also must be supporting these referenced ideas and examples presented in the study. Finally, presenting a used theoretical framework can make more contribution on understanding the conducted study.

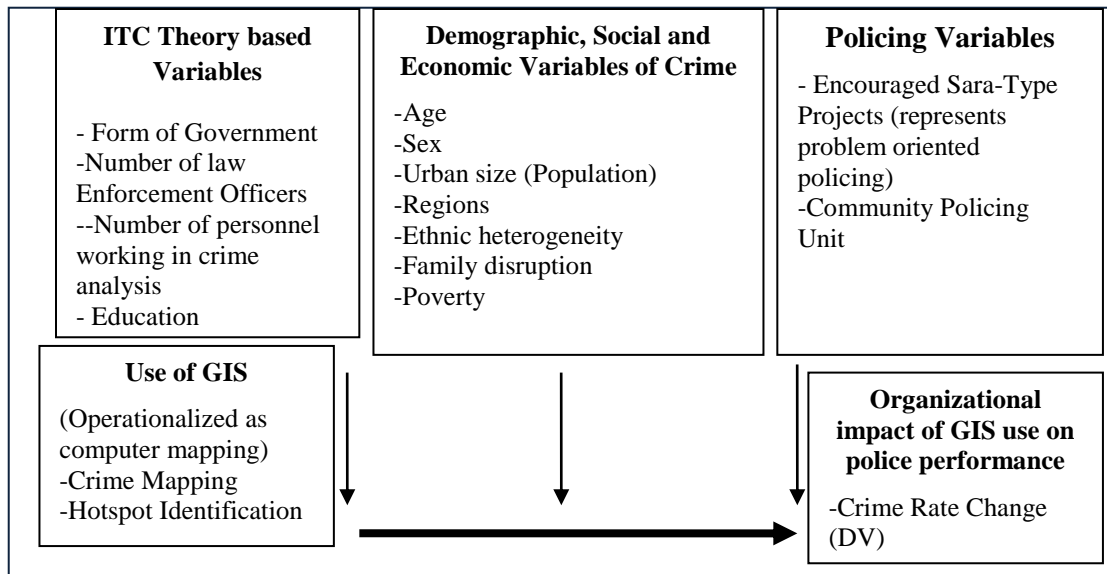
In general, content validity, face validity, empirical validity and predictive validity requirements should be met to some degree in order to have a more valid research. According to Nachmias and Nachmias, (2000) Content validity refers to the variables of the concept that must be adequately covered in the design in order to explain enough. This study combines both content and process approaches' variables in the modal which provides a very comprehensive

ground. Face validity refers to meet subjective evaluation of the researchers including the sampling. In fact, GIS use is majority by use of crime mapping techniques in police agencies (Boba, 2005, p.24; ESRI, 2009). This study utilizes crime mapping and hotspot identification variables as the center of the research considering other environmental factors. Additionally, randomly structured nationwide sampling is provided by a governmental agency, *ICPSR*, with very high responsive rates (Lemas, 2003). This signifies generalizability of the study. Finally, research question and hypotheses are presented adequately clear, specific and coherent.

### **5.13. Limitation of the Study**

Each study brings its advantageous and disadvantageous within. Time resource, availability of the data, methodological and statistical constraints are general limitation sources of the studies. Since collection of nationwide data on cutting edge policing technologies, such as GIS utilization, the study primarily relies on LEMAS dataset. Although LEMAS dataset has a lot of strengths, the researcher doesn't have any methodological control on it. This is one of the limitations of the study however; this limitation is tolerated by use of several statistical control techniques on the data. Additionally, Geographic information technology and policing are both dynamic disciplines to be hardly examined comprehensively. As a result, both disciplines require expertise since the research is attempting to measure cutting edge technologies. Although this study examines overall organizational impact of GIS utilization in police agencies at societal level, it is hard to capture roots of the GIS phenomena at the same time at the user end levels. Here is the analysis plan based on the Information Technology Capacity Model presented below to outline entire picture at the one frame.





**Figure 10: Application of the Proposed Model**

The model was adapted from: Kim, H.J. (2004, October). Local Government Information Technology Capacity:

## CHAPTER 6

### Data Analysis and Results

#### 6.1. Introduction

This chapter provides analysis of a compiled dataset in three main steps. The first step focuses on the exploration of descriptive statistics of each variable. The second step concentrates on the exploration of relationships between the dependent variable and independent variables. Finally, multiple regression analysis is used in order to understand correlations of variables within the proposed information technology capacity model (Kim and Bretschneider, 2004). At the first step, independent sample t test and correlation analysis are used as hypotheses testing tools. These analysis phases previously required screening data and meeting regression assumptions, such as checking the ratio of cases, detecting outliers, removing some extreme cases, exploring missing cases, removing insignificant variables and transforming some variables into new values to increase the validity of the study. These phases are followed by the interpretation and discussion of findings based on recent similar study results, and all of these analyses are applied by using SPSS 20.

#### 6.2. Descriptive Statistics

This section presents descriptive statistics of dependent and independent variables. Descriptive statistics results include number of cases, mean, median, range, standard deviations kurtosis and skewness values of variables. Detailed tables of values are presented at the appendix part and essential summary descriptions are shown within this section to display values of used variables.

### 6.2.1. Dependent Variables

There are three dependent variables suggested by the study. These are overall crime rates, violent crime rates and property crime rates of cities and counties of the U.S. Crime values are derived from the Uniform Crime Report (UCR) sources and rates are calculated per 100,000 residents. Crime rate calculation is an essential process to measure all units of analysis within the same format because crime rate is used as a proxy to measure police performance in these areas in the study (Albanese, 2005; Roberts, 2006; FBI, 2007). As asserted earlier within the methodology part, police organizations which employ 100 and more than 100 full time personnel are studied as subjects of the study. The scope of the study is limited to the years 2000, 2003 and 2007, respectively. The main data for Use of GIS, which is retrieved from the Law Enforcement and Management Statistics (LEMAS), is available for those years. Some of the earlier LEMAS data are also available for the years 1997 and 1999; however, the value of hotspot analysis category, which is a secondary use of GIS, is missing in those earlier years. In particular, there is no specific data category designed to collect the value for measuring hotspot analysis. Based on descriptive statistics (Table 24), there are 2,078 cases representing the years 2000, 2003, and 2007. In detail, there are 687 cases for 2000, 702 cases for 2003, and 689 cases for 2007.

**Table 24: Data Details Based on Years**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	2000	687	33.1	33.1	33.1
	2003	702	33.8	33.8	66.8
	2007	689	33.2	33.2	100
	Total	2,078	100	100	

Descriptive statistics of three dependent variables (overall crime, violent and property crime rates) are presented in Table 25 below. Based on overall crime rates, minimum value is

0.04 and maximum value is 272.65 with a mean value of 10.79. Standard deviation of crime rate is 20.29. Minimum value of property crime rate is 0.1 and maximum value is 198.57. Mean value of property crime is 7.41 with 14.07 standard deviation. Minimum value of violent crime rate is 0.002 and maximum value is 79.01. The mean value is 3.38 and its standard deviation is 6.53. This range is wide and several aspects may cause this large variation. In fact, the main factors of crime deriving from literature are considered within the study to better explain the phenomena.

**Table 25: Descriptive Statistics of Crime Rate (Overall, Violent and Property)**

	N	Minimum	Maximum	Mean	Std. Deviation
Overall Crime Rate Per 100,000 citizens	2078	0.04	272.65	Eki.79	20.29
Violent Crime Rate Per 100,000 citizens	2078	0.002	79.01	Mar.38	Haz.53
Property Crime Rate Per 100,000 citizens	2078	0.01	198.57	Tem.41	14.Tem

A distribution is accepted as normal when the values of skewness and kurtosis are close to zero (Tabachnick and Fidell, 2007; p.79). Moreover, “standard normal distribution has kurtosis of +3 irrespective of the mean or standard deviation of distribution” (Singh, 2007; p.140-141). Field (2009) also verifies that values below the threshold of 3.29 are acceptable in large samples. When the dependent variables of overall crime, violent and property crime rates are screened, skewness and kurtosis values are found above the limits of normality (Table 26). Due to the fact that the values of overall crime rate (Skewness 5.93 and Kurtosis 47.8), violent crime rate (Skewness 5.89 and Kurtosis 46.13), and property crime rate (Skewness 6.18 and Kurtosis 53.24) variables are above these limits, these variables are transformed into natural logarithmic (Ln) values. According to Weisberg (2005), the transformation of variables is a key

tool in improving the usefulness of the models. New logarithmic values are used to reach more valid and meaningful results in the following steps.

**Table 26: Skewness and Kurtosis Values of Crime Rates**

	Skewness		Kurtosis	
	Statistic	Std. Error	Statistic	Std. Error
Overall Crime Rate Per 100,000 citizens	5.93	0.054	47.8	0.107
Violent Crime Rate Per 100,000 citizens	5.89	0.054	46.13	0.107
Property Crime Rate Per 100,000 citizens	6.18	0.054	53.24	0.107

### 6.2.2. Descriptive Statistics for LEMAS Variables

In the section, the use of GIS (crime mapping, hotspot analysis and computer mapping), the form of government, the crime analysis unit, education and the police strength are analyzed.

This subsection includes crime mapping and hotspot identification variables based on LEMAS. In addition to these, a composite variable, called Computer Mapping, is formed to comprise the “Use of GIS”. This composite variable includes both computer mapping and hotspot identification values as one (Crime mapping + Hotspot). The use of GIS variables is analyzed in detail because one of the main foci of the study is to discern the use of GIS by law enforcement agencies in the U.S. In particular, statistics include description, frequency, cross tabulation and bar chart results of the use of GIS to better explain the phenomenon.

As shown in Table 27, crime mapping values are mostly provided by police agencies; however, fewer organizations provide a value for hotspot analysis. These missing values in a row influence the development of the third variable, Computer Mapping, which is a composite variable as explained above. In total, there are 2,078 cases reporting whether the police

organization has or does not have a crime mapping application. In fact, use of second level computer mapping, the so called hotspot analysis variable, is less reported in the dataset. Yet, the LEMAS 2000 dataset does not have a specific or similar value for the hotspot technique. Specifically, 1,146 out of 2,078 police agencies provided data for 2003 and 2007. This means the data has 932 missing values of Hotspot and Computer Mapping variables. This level of missing cases can be reviewed in later steps of the study to assess its effect on the results.

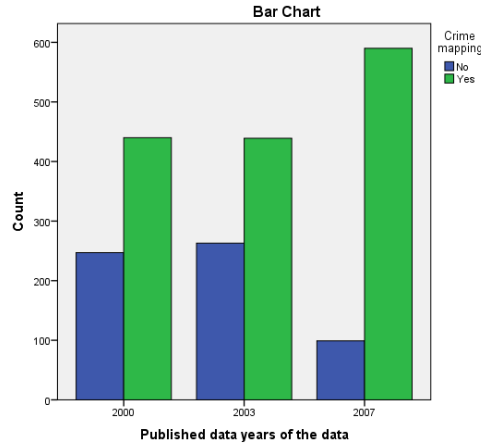
**Table 27: Descriptive Statistics of GIS Use Variables**

	N	Range	Minimum	Maximum	Mean	Std. Deviation
Crime Mapping	2078	1	0	1	0.71	0.455
Hotspot Identification	1146	1	0	1	0.53	0.499
Use of GIS	1146	2	0	2	1.29	0.731

Because GIS use and its sub variables are important factors of the study, a closer look based on the years can reveal such use among police agencies in cities of the U.S. This analysis provides information about the use of GIS by law enforcement agencies between 2000 and 2007. As shown in Table 28 below, 440 police organizations used the crime mapping feature of GIS out of 687 in 2000. 439 police agencies out of 702 used crime mapping in 2003 and 590 out of 689 used crime mapping in 2007. Based on Figure 11, a gradual increase is obvious in the deployment of crime mapping among the police in successive years.

**Table 28: Years of data: Crime Mapping Cross Tabulation**

		Crime mapping		Total
		No	Yes	
Published data years	2000	247	440	687
	2003	263	439	702
	2007	99	590	689
Total		609	1,469	2,078

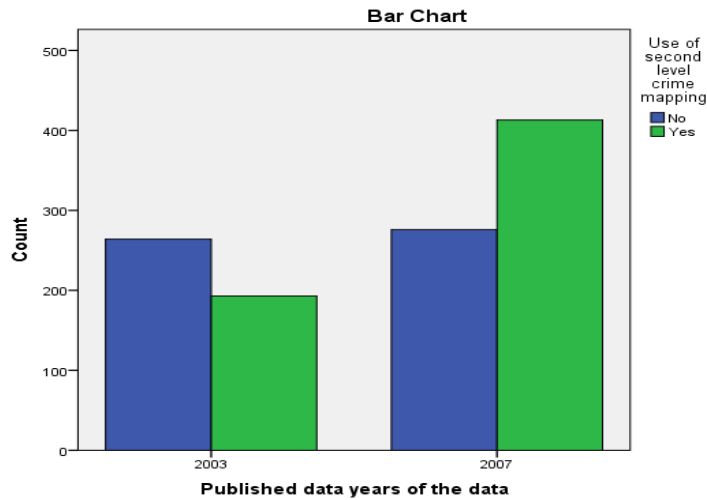


**Figure 11: Use of Geographic Information Systems by Law Enforcement Agencies between 2000 and 2007**

Use of secondary level of computer mapping, the so called hotspot mapping analysis, was possible and made available in 193 police organizations out of 457 in 2003. 413 police agencies out of 689 used secondary level computer mapping in 2007. The rising use of hotspot mapping by police is also obvious in Figure 12.

**Table 29: Years of data: Use of Hotspot, Cross Tabulation**

		Use of Hotspot Mapping		Total
		No	Yes	
Published data years	2003	264	193	457
	2007	276	413	689
Total		540	606	1,146

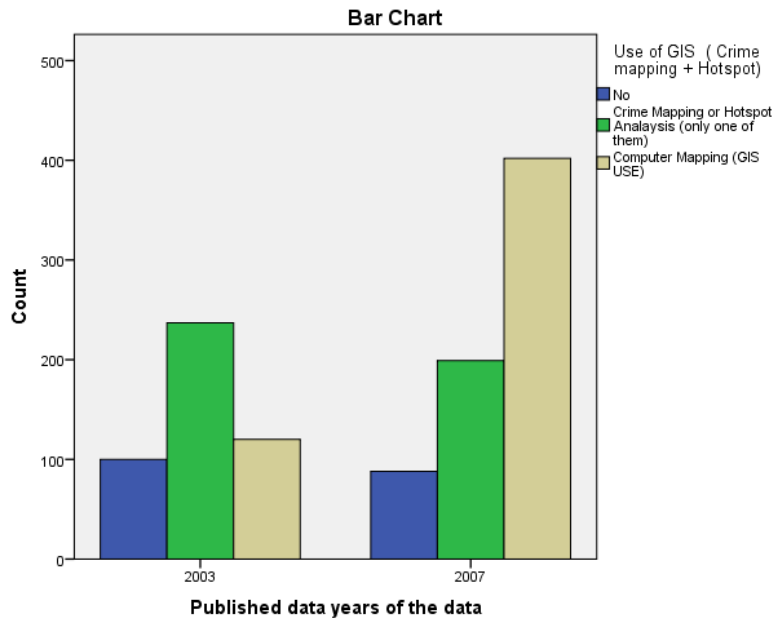


**Figure 12: Use of Hotspot Mapping By Law Enforcement Agencies from 2003 to 2007**

Use of GIS, so called computer mapping, was measurable within police agencies in 2003 and the trend of using GIS rapidly increased in 2007. Specifically, use of GIS rated at 120 out of 457 in 2003, and considerably higher at 402 out of 689 in 2007. This shows the increased use of GIS in police agencies in later years. This increase is demonstrated in the bar chart (Figure 13).

**Table 30: Years of data: Use of GIS (Crime mapping + Hotspot) Crosstabulation**

		Use of GIS ( Crime mapping + Hotspot)			Total
		No None	Crime Mapping or Hotspot Analysis	Yes, Computer Mapping (GIS Use) Crime Mapping and Hotspot Analysis	
Published data years	2003	100	237	120	457
	2007	88	199	402	689
Total		188	436	522	1146



**Figure 13: Use of GIS by Law Enforcement Agencies between 2003 and 2007**

One of the strengths of this study comes from the consideration of the form of government variable. It is very rare to encompass the form of government perspective in GIS use studies and crime studies. In fact, this variable was coded manually by using either city / county or police organizations' websites, or by querying from online web encyclopedias. In the data collection phase, the form of government variable was coded as: Professional form of government (1), Nonprofessional form of government (2), and Other forms of government (0). In



order to comply with regression analysis assumptions, a new discrete variable was computed that dichotomizes the following: Professionalized Form of government (1) and others (0). The category of “others” includes both the nonprofessional and other forms of governments.

Considering the years 2000, 2003 and 2007, 37.6 percent of cities and counties (782) have a professional form of government, 40.8 percent of cities and counties (847) have a nonprofessional form of government and 21.6 percent of cities and counties have other forms of government. These results represent the three years. Moreover, these results may differ slightly if the data were collected for each three different years. Descriptive results show that the nonprofessional form of government is the most prevalent form, and the professional form is the secondary widespread form of government among the cities and counties at present.

**Table 31: Form of Government**

	Frequency	Percent	Valid Percent	Cumulative Percent
Other form of governments	449	21.6	21.6	21.6
Professional form government	782	37.6	37.6	59.2
Nonprofessional government	847	40.8	40.8	100

As seen in Table 32, the majority of the police (71.1 percent) employed crime analysis units and a minority (28.9 percent) did not have crime analysis units between the years 2000 and 2007.

**Table 32: Crime Analysis Unit**

		Frequency	Percent	Valid Percent	Cumulative Percent
<b>Valid</b>	<b>No</b>	594	28.6	28.9	28.9
	<b>Yes</b>	1463	70.4	71.1	100
	<b>Total</b>	2057	99	100	
<b>Missing</b>	<b>System</b>	21	1		
<b>Total</b>		2,078	100		

Education is an independent variable of LEMAS that was retrieved as total hours of training. Specifically, the education variable is a unified variable that was suggested by Mazeika (2008) to better measure the level of education provided to the human resources of a police agency. The data, total hours of training, comes from the LEMAS survey that consists of both field and in class training as one variable. 2,078 police organizations provided the data. The minimum value of the education variable is 0 while the maximum value is 240 hours. The range is 240 and this large variation indicates the existence of big differences in training at large police agencies. The mean of education is 37.53, where standard deviation is 25.32. Skewness and kurtosis values are above expected limits (3.3); therefore, the variable is transformed into logarithmic values (Table 35).

The total number of police is another variable which is normalized to the number of full time equivalent of police divided by population. Minimum value is 0.0002 and maximum value is 0.0106 with a mean value of 0.00203. This is one of the boundaries of the study because only large agencies which deploy 100 and over have been considered within the scope of the study. The range is very wide because there are big cities with larger populations. For example, the New York, Chicago and Los Angeles police departments are within the context of the study. When logarithmic values are utilized, 2,078 cases are present with a mean of -6.359 and a standard deviation of 0.624. The range is 4.19. In order to keep this vital variable in the analysis, transformation into a natural logarithm is essential because skewness and kurtosis values are higher than normality assumption limits.

**Table 33: Descriptive Statistics of Education and Number of Police**

	N	Range	Mean	Std. Deviation
Total Hours of Training	2,078	240	37.53	25.315
LogNumPol	2,078	4.37	-6.359	0.624

### 6.2.3. Demographic, Social and Economic Variables of Crime

In this section, population, regions, racial heterogeneity, family disruption, and poverty variables are described. Population is the first value to be introduced in this section. Minimum value is 21,118 and maximum value is 9,871,506 with a range of 9,850,388 for city and county populations. Its mean is 293,670 where the standard deviation is 586,394. Due to high values in both skewness and kurtosis values of the population, its logarithmic transformation is used within the study. When descriptive statistics of population (log) are considered, its mean is 11.98 and the range is 6.15 with a 0.970 standard deviation.

The regions variable indicates the North Eastern (1), Midwestern (2), Western (3) and Southern (4) parts of the U.S. When frequencies of the regions variable are shown, the South cases show the most frequency (43.2 percent) in number (898), while the Midwest cases show the least frequency 301 (14.5 percent). Successively, the West cases represent 516 (24.8 percent) and the Northeast cases represent 363 (17.5 percent).

**Table 34: Regions of States**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Northeast	363	17.5	17.5	17.5
	Midwest	301	14.5	14.5	32.0
	South	898	43.2	43.2	75.2
	West	516	24.8	24.8	100.0
	Total	2,078	100.0	100.0	

The racial heterogeneity variable is measured by the use of a percentage of nonwhites in this section. The minimum value is 2.5 and the maximum value is 80 that show a large range with a value of 77.50. The mean value is 23.62 (percentage of nonwhites) with a 13.89 standard variation. This range indicates considerable differences of racial heterogeneity among cities and counties of the U.S.

Family disruption is another explanation of the crime variable to be examined in this section. A single headed family is used as the measure of family disruption. The minimum value is 5.74 and the maximum value is 25.87 with a 20.13 range. The mean is 13.11 with a 3.22 standard deviation. The wide range also shows high variances in family disruption. Poverty is described as percent of poverty and found with a minimum of 1.70 and maximum of 34.3. The range is 32.6 and the mean is 11.926 with a 4.435 standard deviation. This variant shows the existence of high poverty discrepancies among large cities and counties.

**Table 35: Descriptive Statistics of Concentrated Disadvantages**

	N	Range	Mean	Std. Deviation
Percent Non-White	2,078	77.5	23.62	13.8882
Percent Female Headed Family	2,078	20.13	13.11	3.22
Percent Poverty	2,078	32.6	11.93	4.43485

#### 6.2.4. Policing Variables

Community policing (COP) and problem oriented policing (POP) variables are considered to be influential policing variables based on the literature review, and referred to as control variables. The COP variable is represented by a dummy variable (0 and 1) that indicates the absence or presence of the COP unit. As to Table 36, more than half of the police agencies (59.8 percent) employ a COP unit and fewer police agencies (40.2 %) did not have a community policing unit through the years 2000 and 2007.

**Table 36: Community Policing Unit**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	826	39.7	40.2	40.2
	Yes	1,231	59.2	59.8	100.0
	Total	2,057	99.0	100.0	
Missing	System	21	1.0		
Total		2,078	100.0		

Problem oriented policing is measured by presence of Encouraged SARA type applications in the police organization. Based on the data, more than half of the police agencies (53.3 percent) utilize SARA type projects and 46.7 percent do not apply SARA type projects in their operations.

**Table 37: Encouraged SARA**

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	970	46.7	46.7	46.7
	Yes	1,105	53.2	53.3	100.0
	Total	2,075	99.9	100.0	
Missing	System	3	.1		
Total		2,078	100.0		

The data year is a supporting secondary variable to help classification of variables in the database in terms of data collection years. As mentioned earlier, these three years are: 2000, 2003 and 2007.

### 6.3. Bivariate Analyses

Bivariate analysis enables the examination of the relationship between two variables (Nachmias and Nachmias, 2000). In this section, seven hypotheses are tested to understand the effect of GIS use in police performance. The results of each hypothesis provide more information about different aspects of the study. Different methods are employed to test hypotheses in SPSS, such as correlation and regression analysis. Correlation analysis measures the associations between variables and linear regression is used “to predict one variable from the other” (Tabachnick and Fidell, 2007; p.56). In this study, the DV is continuous and a few independent variables are discrete while some of the others are continuous. In correlation analysis, Pearson Correlation provides the sign and correlation value R. In the current study,

Pearson's Correlation is partly used when the IV is continuous. When the data is dichotomous, an independent samples t test is used to capture the relationship. Results are indicators of a relationship, not the causality. Specifically, the prediction of variables and their interactions with DV are measured at the next step where multiple regression analysis is used.

The consideration and solution of some issues prior to data analysis is vital for accurate data analysis. The importance of screening is underlined for significance testing to improve data quality (Tabachnick and Fidell, 2007). According to Field (2009), the data must be normally distributed to meet Pearson's assumption. Similarly to this, Weisberg (2005) states "errors are often assumed to be normally distributed" and that is a necessity to use regression analysis (p.20). This means errors are assumed to be independent and normal with covariance and the normality is met or the sample size is large enough (Weisberg, 2005). Screening essentials (Tabachnick and Fidell, 2007), accuracy of data, missing data, outliers, normality, linearity and data transformation issues are to be considered solved in this subsection before bivariate and multivariate analyses.

### **6.3.1. Data Accuracy**

The data of the study was mainly compiled from official records that strengthen the accuracy of the data. Specifically, the data was combined from the Law Enforcement and Management Statistics (LEMAS) survey, The Uniform Crime Reports (UCR) and the Bureau of Census record sources. Additionally, the data for form of government and region variables were compiled manually from open online sources and entered into the dataset by hand. Descriptive statistics records of dependent and independent variables are accessible above and at the appendix part for further inspection. The majority of means and standard deviations of variables

are seen as normal; nonetheless, some of these require transformations because of their deviations in skewness and kurtosis. These variables and handling of problems are presented in the following sections.

### 6.3.2. Missing Cases

The occurrence of missing cases is another key issue to be considered before starting an analysis. Both patterns of missing data and data amount indicate the seriousness of the problem (Tabachnick and Fidell, 2007). In the study, the Missing Case Analysis tool of SPSS was used to detect missing cases (Table 45). As shown in the output table below, six variables have missing cases in different percentages. These are LOGEDU, HOTSPOT, COMPMAP, CANUNIT, COPUNIT and SARA variables. In the log of education variable, 58 cases are missing, which constitutes 3 percent of all cases. In the crime analysis unit and community policing variables, 21 cases are missing, and this represents 1.1 percent of all data. Particularly, 856 cases are missing in both hotspot and computer mapping variables. This is because the LEMAS 2000 data do not provide questions for hotspot analysis variable that successively affect the constitution of the computer mapping (composite) variable. There are 636 cases representing LEMAS 2000 data and this means 220 (856 minus 636) cases are missing in practice. In short, there are 645 cases for the year 2003 and 627 cases for 2007 that amount to 1,272 in total. Although 44.9 percent is reported in Table 43, this represents 17 percent of 1,272 when 220 cases are considered to be missing data. According to Tabachnick and Fidell (2007), “there are as yet no firm guidelines for how much [missing] data can be tolerated”; but the authors also state how missing data (hotspot analysis variable) should be handled in the study. Initially, the deletion of missing variables is recommended if missing data is random. Another alternative is keeping missing cases with an

additional dummy variable. The final advice is to repeat analysis with and without the missing data. In the study, the missing cases are kept within the study for the sake of benefiting from their values in context of other variables, and a repetition of analysis is considered if analysis results indicate unexpected values.

**Table 38: Univariate Statistics**

	N	Mean	Std. Deviation	Missing		No. of Extremes'	
				Count	Percent	Low	High
<b>logOverallCrime</b>	1908	1.6596	1.02442	0	.0	18	20
<b>logViolRate</b>	1908	.4231	1.12299	0	.0	21	18
<b>logPropRate</b>	1908	1.2832	1.02623	0	.0	19	24
<b>logPOP</b>	1908	11.9036	.88507	0	.0	0	21
<b>LogNumPolice</b>	1908	-6.3356	.56360	0	.0	52	8
<b>logEDU</b>	1850	3.4841	.58473	58	3.0	61	88
<b>logAGE</b>	1908	2.6184	.14570	0	.0	47	79
<b>PrcNonWhite1</b>	1908	22.9621	12.79539	0	.0	0	32
<b>PrcPoverty2</b>	1908	11.5356	3.87460	0	.0	0	19
<b>PrcFmlHeadFmly3</b>	1908	12.9250	2.97173	0	.0	0	10
<b>REGIONS</b>	1908			0	.0		
<b>PROFORMGOV</b>	1908			0	.0		
<b>CMAPPING</b>	1908			0	.0		
<b>HOTSPOT</b>	1052			856	44.9		
<b>Compmapping</b>	1052			856	44.9		
<b>CANUNIT</b>	1887			21	1.1		
<b>COPUNIT</b>	1887			21	1.1		
<b>SARA</b>	1905			3	.2		
<b>GENDER</b>	1908			0	.0		

### 6.3.3. Normality

Bradley (1982) emphasizes that statistical results become less and less robust when data distributions stay away from normality (as cited by Tabachnick and Fidell, 2007). In particular, Skewness and Kurtosis values are indicators of non normality. "Skewness refers to the symmetrical nature of distribution, whereas kurtosis refers to peakedness of the curve (Singh,



2007; p.140-141). When non normality is detected (over 3.3.), the safest advice is “to use transformations of variables to improve their normality” (Tabachnick and Fidell, 2007; p.78). In the study, this advice is considered based on output values to enhance the analyses (Table 26). As partly mentioned earlier, crime rates (overall, violent and property), population, number of police and age variables (Appendix 1) are transformed into natural logarithmic (Ln) values to comply with the normality assumption. According to Tabachnick and Fidell (2007), “after a distribution is normalized by a transformation, the mean is equal to the median” (p.87). To verify the normality of the logged six variables, their means and medians are rechecked after the transformation process. As seen below, these six values are seen either as equal or very close to their median values.

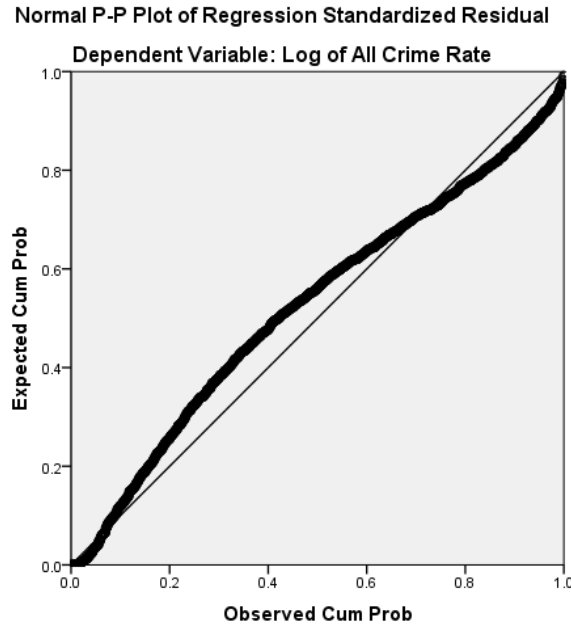
**Table 39: Mean and Median Values of Logged Variables**

		Log of Overall Crime Rate Per 100,000 citizens	Log of Violent Crime Rate Per 100,000 citizens	Log of Property Crime Rate Per 100,000 citizens	Log of Population	Log of Number of Police	Log of Total hours of training	Log of Percent Young 15-24 Age
N	Valid	1931	1931	1931	1931	1931	1871	1931
	Missing	0.0	0.0	0.0	0.0	0.0	60.0	0.0
Mean		1.6	0.4	1.3	11.9	-6.35	3.5	2.6
Median		1.6	0.4	1.2	11.7	-6.26	3.7	2.6

The study analyzes the population of large police agencies where the number of cases is high (1931). In other words, the study benefits from a large dataset and having extensive data will more likely provide more meaningful results than having less data, considering the central limit theorem.

Finally, Tabachnick and Fidell (2007) said that “if the residuals plot looks normal, there is no reason to screen the individual variables for normality” in regression. When this diagnosis

was made by using a log of overall crime rates as DV, the Normal P–P Plot of Regression standardized residual looked normal as seen in the chart (Figure 14) below.



**Figure 14: Normal P–P Plot of Regression Standardized Residual for Overall Crime Rate**

#### 6.3.4. Linearity

Linearity tests whether there is a linear relationship (straight line) between two variables or not (Tabachnick and Fidell, 2007). The presence of a straight line is required because Pearson’s  $r$  can only be captured if there is a linear relationship. In other words, nonlinear relationships are ignored in the test. In bivariate correlation testing and linear regression analysis, the Pearson  $r$  is used. According to Tabachnick and Fidell (2007), the linearity is roughly inspected by assessment of Scatter Plots. Weisberg (2005) also verifies the efficacy of Plots in finding failures of assumption. Scatter Plots of each continuous variable are displayed below in the Scatterplot Matrix (Figure 15, 16) and all Plots show fit lines on outputs.

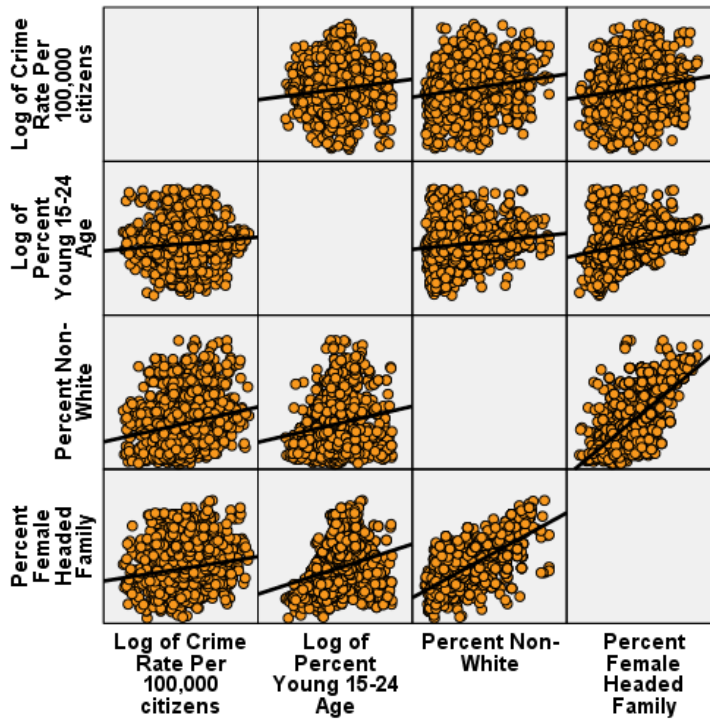
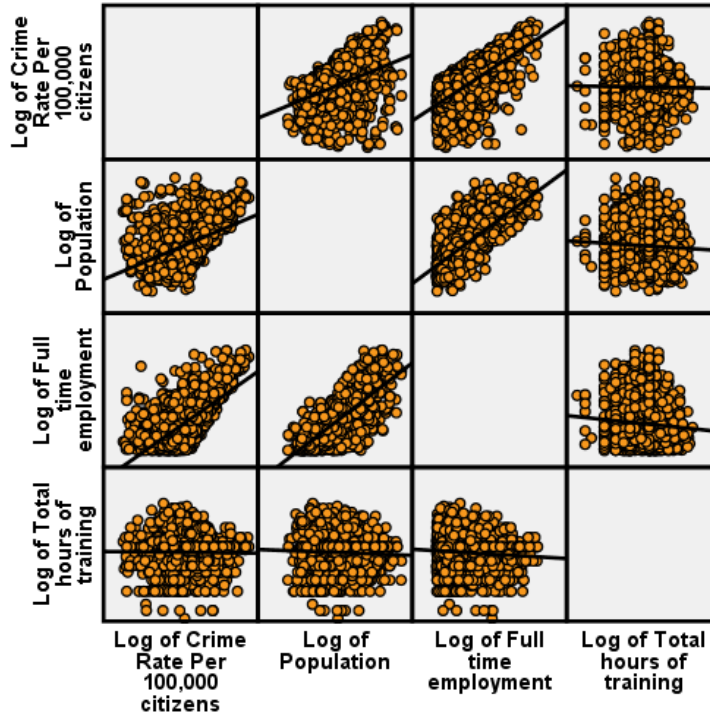


Figure 15 and 16: Scatter Plot Outputs for All Continuous Variables at two Matrixes

### 6.3.5. Outliers

'Outliers' is another concern in data analysis because the presence of extreme cases in a dataset can influence and/or distort expected results (Tabachnick and Fidell, 2007). There are several outliers if data is to be checked by the naked eye. In the study, the outliers of the dataset are detected by using the z score feature of descriptive statistics. Cases having a 3 z score value and over are detected as potential outliers. In fact, these values are real and coming from population data; however, keeping these values can risk results and the generalizability of the study (Tabachnick and Fidell, 2007; p.56). Super large populations and their high crime rate values can be analyzed in the future by specially designed studies that better fit the study at hand. Therefore, 170 outliers from all variables are deleted from the dataset. Originally, there were 2,078 cases in the dataset and after removal of outliers, 1,908 cases remained. Among the dichotomous variables, no outliers were detected as to both z scores and histogram graphs. None of their values shows an extreme uneven split (see all histograms in the appendix). Unimportant distributions and other differences are noted in following section under the Homoscedasticity Testing section. Deleted outliers are also kept in another dataset in case further analysis may be needed using the original data.

## 6.4. Hypotheses Testing

The first hypothesis magnifies the relationship between crime rate and presence of a professional form of government (IV) in the city or county. To test the hypothesis, a new dichotomous variable called Professional Form was derived from the Form of Government variable. In the dataset, 1,908 cases have a form of government value and 1,052 cases have a GIS Use value. Particularly, the study hypothesizes that: *"The crime rate decreases within GIS user local police departments as the locality has a professional form of government"*. That means

when a city or county has a professional form of government and police organizations use GIS, the crime rate is expected to decrease in the jurisdiction of the police organization compared to other forms of governments. In order to test this hypothesis, an independent samples t test was conducted because the data type of IV (professional form of government) is dichotomous. Results indicate significant differences between GIS user police departments that have a professionalized form of government and GIS user police departments that do not;  $t(1,501) = 4.508, p < .05$ . Group statistics show that overall crime rate within the jurisdiction of GIS user police departments that are under a professional form of government ( $M=1.57, SD=.96$ ) is lower than the overall crime rate within the jurisdiction of GIS user police departments that are not ( $M=1.79, SD=1.09$ ). See Tables 40 and 41. 0.05

When property crime rate and violent crime rate are individually considered as DV, findings show similar significant results in the same direction. Specifically, group statistics indicate that violent crime rate within the jurisdiction of GIS user police departments that are under a professional form of government ( $M=.32, SD=1.07$ ) is lower than the violent crime rate within the jurisdiction of GIS user police departments that are not ( $M=.58, SD=1.18$ ). Likewise, property crime rate within the jurisdiction of GIS user police departments that are under a professional form of government ( $M=1.2, SD=.96$ ) is lower than the violent crime rate within the jurisdiction of GIS user police departments that are not ( $M=1.4., SD=1.1$ ).

Based on results, the hypothesis that “The crime rate decreases within GIS user local police departments as the locality has a professional form of government” was supported.

**Table 40: Independent Samples Test (Hypothesis Testing-I Overall Crime Rate)**

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
DV1-Log of Crime Rate Per 100,000 citizens	Equal variances assumed	24.011	.000	4.626	1906	.000
	Equal variances not assumed			4.508	1500.935	.000

**Table 41: Group Statistics (Hypothesis Testing-I Overall Crime Rate)**

	Professional form of government		N	Mean	Std. Deviation	S.E. Mean
	0	1				
DV1-Log of Crime Rate Per 100,000 citizens	0	1	771	1.7907	1.09944	.03960
			1,137	1.5708	.96063	.02849

The second hypothesis focuses on the relationship of presence of full time specialized crime analysis personnel and crime rate: *“The crime rate decreases within GIS user local police departments as the police have crime analysis unit.”*

To test the second hypothesis, an independent samples t test was conducted again. Results indicate a significant difference between GIS user local police departments that have full time specialized crime analysis personnel and GIS user police departments that do not;  $t(1,110) = -15.782, p < .05$ . Group statistics show that crime rate in the jurisdiction of GIS user local police departments that have full time specialized crime analysis personnel ( $M=1.88, SD=.99$ ) is higher than the crime rate in the jurisdiction of police departments that do not have full time specialized crime analysis personnel ( $M=1.14, SD=.89$ ). See Tables 42 and 43. Similarly, when violent crime rate and property crime rate were separately analysed, there was a significant relationship in the same direction. Based on results, the hypothesis: *“the crime rate decreases within GIS user local police departments as the police have crime analysis unit”* was rejected. In other words, having full time specialized crime analysis personnel indicates higher crime rates.

**Table 42: Independent Samples Test (Hypothesis testing-II)**

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
DV1-Log of Crime Rate Per 100,000 citizens	Equal variances assumed	6.079	.014	-15.092	1,885	.000
	Equal variances not assumed			-15.782	1110.0	.000
					40	

**Table 43: Group Statistics (Hypothesis testing-II)**

	Crime analysis unit	N	Mean	Std. Deviation	Std. Error Mean
DV1-Log of Crime Rate Per 100,000 citizens	No	544	1.1418	.89521	.03838
	Yes	1,343	1.8838	.99509	.02715

The third hypothesis examines the relationship between Police Strength and Crime Rate. The specific hypothesis is that *“The crime rate decreases within GIS user local police departments as the locality has stronger police strength.”*

To test this hypothesis, correlation analysis is used to capture the relationship between variables because both of the variables (crime rate and police strength) are continuous type data. As to analysis results, the two variables were positively correlated and the correlation was found to be significant at the level of 0.01,  $r = .199$ ,  $p < .05$ . When violent and property crime rate were used as DV, the correlation was still found significant and  $r = 0.202$  (violent) and 0.190 (property) crime rates. In other words, the crime rate is higher when police strength is higher (Table 44). Thus, the hypothesis that *“the crime rate decreases within GIS user local police departments as the locality has stronger police strength”* was rejected.

The fourth hypothesis inspects the link between the education of police personnel (training hours) and crime rate. This hypothesis is worded as *“The crime rate decreases within GIS user local police departments as the police personnel has higher training hours”*. The type

of data for the training hour variable is continuous; therefore, correlation analysis is used to test the hypothesis. Findings revealed no significant correlation between two variables  $p = .633$ . See Table 44. Based on this finding, the fourth hypothesis that “The crime rate decreases within GIS user local police departments as the police personnel has higher training hours” was rejected.

**Table 44: Correlations (Hypothesis testing-III and IV)**

		DV1-Log of Crime Rate Per 100,000 citizens	Log of Police Strength: Full time equivalent / population	Log of Total hours of training
DV1-Log of Crime Rate Per 100,000 citizens	Pearson Correlation	1	.199**	-.011
	Sig. (2-tailed)		.000	.633
	N		1,908	1850
Log of Police Strength: Full time equivalent / population	Pearson Correlation		1	-.027
	Sig. (2-tailed)			.244
	N			1,850
Log of Total hours of training	Pearson Correlation			1
	Sig. (2-tailed)			
	N			

\*\* . Correlation is significant at the 0.01 level (2-tailed).

The fifth hypothesis states that “*Computer mapping in police agencies decreases crime rates*”. For the purpose of this test, using GIS is a combined variable derived from crime mapping and hotspot variables. Due to the fact that the Use of GIS variable is the dichotomous type, the independent samples t test is applied in order to test the hypothesis.

As to the t test scores, there was a significant difference between police departments that use GIS and those that do not;  $t(1,020) = -5.536, p < .05$ . Group statistics show that crime rate in the jurisdiction of GIS user police departments ( $M=1.82, SD=1.00$ ) is higher than crime rate in the jurisdiction of non GIS user police departments ( $M=1.47, SD=.99$ ). See Tables 45 and 46.



When violent and property crime rates are singly used as DV, there were similar findings and significant difference in the same direction.

Based on results, the fifth hypothesis that “Computer mapping in police agencies decreases crime rates” was rejected.

**Table 45: Independent Samples Test (Hypothesis testing-V)**

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	df	Sig. (2-tailed)
DV1-Log of Crime Rate Per 100,000 citizens	Equal variances assumed	.631	.427	-5.539	1,050	.000
	Equal variances not assumed			-5.536	1,019.788	.000

**Table 46: Group Statistics (Hypothesis testing-V)**

	Computer mapping, GIS use (Crimemapping+Hotspot)				
	N	Mean	Std. Deviation	Std. Error Mean	
DV1-Log of Crime Rate Per 100,000 citizens	0	1.4723	.99678	.04179	
	1	1.8152	1.00473	.04572	

The sixth hypothesis concentrates on the relationship between using crime mapping and crime rate. This hypothesis states that “use of crime mapping in police agencies decreases the crime rates”. As mentioned earlier, using GIS is a combined variable from the crime mapping and hotspot variables. For the purpose of the current test, the effect of “use of crime mapping” (use of first level GIS) was explored. Again, because crime mapping is a dichotomous variable, an independent samples t test was conducted.

Results indicate a significant difference between police departments that use crime mapping and those do not;  $t(1,062) = -12.052, p < .05$ . Group statistics show that crime rate in the jurisdiction

of police departments using crime mapping (M=1.82, SD=1.01) is higher than crime rate in the jurisdiction of police departments that do not use crime mapping (M=1.23, SD=.92). See Tables 47 and 48. When DV is used as violent crime rate, the crime rate in the crime mapping nonuser area (M=.0026, SD=1.04) is remarkably lower than the crime mapping user area (M=.59, SD=1.1). In other words, this discrepancy in violent crime rate is the highest among the overall, property and violent crime rates.

Based on these results, the sixth hypothesis that “Use of crime mapping in police agencies decreases the crime rates” was rejected.

**Table 47: Independent Samples Test (Hypothesis testing-VI)**

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	df	Sig. (2-tailed)
DV1-Log of Crime Rate Per 100,000 citizens	Equal variances assumed	5.118	.024	-11.601	1,906	.000
	Equal variances not assumed			-12.052	1062.231	.000

**Table 48: Group Statistics (Hypothesis testing-VI)**

		Crime mapping: Use of first level GIS				
		N	Mean	Std. Deviation	Std. Error Mean	
DV1-Log of Crime Rate Per 100,000 citizens	No	537	1.2394	.92866	.04007	
	Yes	1,371	1.8242	1.01342	.02737	

Hotspot analysis was accepted as the secondary usage of GIS at police organizations and its relation to crime rates was investigated as the seventh hypothesis in this study. The seventh hypothesis claims that “Use of hot spot identification (another subset of computer mapping) in

*police agencies decreases the crime rates*". Again, because the data type of the hotspot use variable is dichotomous, the hypothesis was tested by conducting an independent samples t test.

According to t test results, there was a significant difference between police departments that use hotspot identification and those do not;  $t(1,041) = -3.621, p < .05$ . Group statistics show that crime rate in the jurisdiction of police departments that use hotspot identification ( $M=1.73, SD=1.02$ ) is higher than crime rate in the jurisdiction of police departments that do not use hotspot identification ( $M=1.50, SD=.98$ ). See Tables 49 and 50. When violent and property crime rates were used as DV, no meaningful change was found.

Thus, the hypothesis that "Use of hot spot identification (another subset of computer mapping) in police agencies decreases the crime rates" was rejected.

**Table 49: Independent Samples Test (Hypothesis testing-VII)**

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	T	Df	Sig. (2-tailed)
DV1-Log of Crime Rate Per 100,000 citizens	Equal variances assumed	1.529	.217	-3.612	1,050	.000
	Equal variances not assumed			-3.621	1041.098	.000

**Table 50: Group Statistics (Hypothesis testing-VII)**

		Hotspot Identification: Use of second level GIS			
		N	Mean	Std. Deviation	Std. Error Mean
DV1-Log of Crime Rate Per 100,000 citizens	No	492	1.5099	.98857	.04457
	Yes	560	1.7350	1.02605	.04336

(This part of page 27 was intentionally left blank in order to better present the Summary of Hypothesis Testing Table)

When the same hypotheses were retested for 2007 data, the found relationships did not change. Only, the values of GIS use variables' findings became brighter and sharper than former hypotheses testing. That can be interpreted that the use of GIS in higher crime rates areas is consciously preferred by the authorities. The values were reported at the Table 51.

**Table 51: Summary of Hypothesis Testing**

Hypothesis	Accept/Reject	Type of Test	P	Explanation for 2000, 2003 and 2007 (Longitudinal)	2007 (Cross sectional)
H1: "the crime rate decreases within GIS user local police departments as the locality has a professional form of government"	Accept	t-test	p<.05	Crime rate in the jurisdiction of GIS user police departments that are under a professional form of government (M=1.57, SD=.96) is lower than crime rate in the jurisdiction of GIS user police departments that are not (M=1.79, SD=1.09)	(M=1.52, SD=.95) (M= 1.75,SD=1.08)
H2: "the crime rate decreases within GIS user local police departments as the police have crime analysis unit."	Reject	t-test	p<.05	Crime rate in the jurisdiction of GIS user local police departments that have full time specialized crime analysis personnel (M=1.88, SD=.99) is higher than crime rate in the jurisdiction of police departments that have full time specialized crime analysis personnel (M=1.14, SD=.89)	(M=1.71, SD=1) (M=.87, SD=.79)
H3: "the crime rate decreases within GIS user local police departments as the locality has stronger police strength."	Reject	Correlation	p<.05	The two variables (police strength and crime rates) were positively correlated	Positively correlated
H4: "the crime rate decreases within GIS user local police departments as the police personnel has higher training hours"	Reject	Correlation	P=.633	No significant correlation between two variables	Insignificant (P= .384)
H5: "computer mapping in police agencies decreases crime rates"	Reject	t-test	p<.05	Crime rate in the jurisdiction of GIS user police departments (M=1.82, SD=1.00) is higher than crime rate in the jurisdiction of non GIS user police departments (M=1.47, SD=.99)	(M=1.83,SD=1.03) (M=1.3, SD=0.9)
H6: "use of crime mapping (a subset of computer mapping) in police agencies decreases the crime rates"	Reject	t-test	p<.05	Crime rate in the jurisdiction of police departments using crime mapping (M=1.82, SD=1.01) is higher than crime rate in the jurisdiction of police departments that do not use crime mapping (M=1.23, SD=.92)	(M=1.73, SD=0.99) (M=0.85, SD=0.8)
H7: "Use of hot spot identification (another subset of computer mapping) in police agencies decreases the crime rates".	Reject	t-test	p<.05	Group statistics show that crime rate in the jurisdiction of police departments that use hot spot identification (M=1.73, SD=1.02) is higher than crime rate in the jurisdiction of police departments that do not use hotspot identification (M=1.50, SD=.98).	(M=1.81, SD=1.04) (M=1.31, SD=0.9)

## 6.5. Multiple Regression Analysis and its Assumptions

At this phase, standard multiple regression analysis (Enter Method) is used to understand correlations of independent variables with a continuous dependent variable based on the Information Technology Capacity model (Kim and Bretschneider, 2004). Causality is mainly a logical and experimental result and regression results show simply relationships. Simplicity and extensive use of regression compared to other multivariate analysis is highlighted in most facets of science (Singh, 2007). It is also noted by Tabachnick and Fidell (2007) that a poor fit of regression models is unavoidable if adequate screening, assessment of fitness of cases and assumptions of regressions are violated. “For multiple regression to produce the best linear unbiased estimates, it must meet the bivariate regression assumptions” (Lewis-Beck, 1980; p.58) and the absence of perfect multicollinearity. The assumptions of multiple regression are listed as Ratio of Cases to IV’s, Absence of Outliers, Absence of Multicollinearity and Singularity, Normality, Linearity, Homoscedasticity, Independence of Errors, and Absence of Outliers in the solution by Tabachnick and Fidell (2007). This list has been followed throughout the study and assumptions are met within bivariate and multivariate analysis phases before analyzing the proposed model. Formerly, accuracy of data, missing data, outliers, normality, linearity and data transformation issues were resolved in the bivariate analysis section above. In this section, ratio of cases to IV’s, Homoscedasticity, Absence of Multicollinearity and Singularity issues are addressed.

While predicting DV in multiple regression, the least number of IV’s are advised as the best. Nonetheless, the literature stresses on accounting for necessary tested variables in order to control other effects while measuring the effect of the intended new contributors. In this study,

the Information Technology Capacity (ITC) theoretical model (Kim and Bretschneider, 2004) is used as a set of variables to explain the effect of GIS use in police performance. As control variables, effectual crime variables and policing variables are used based on the literature review. The details of these variables are presented in both literature review and methodology chapters.

As an exception to ITC model variables, the Education variable is not used in multiple regression because no significant relationship was captured in the former bivariate analysis of the study. This is because “a general goal of regression, then, is to identify the fewest IVs necessary to predict DV where each IV predicts a substantial and independent segment of the variability in the DV” (Tabachnick and Fidell, 2007; p, 122). In fact, Education is not a primary variable of the ITC model; instead, it is suggested as a control variable.

After providing an interpretation of multiple regression results, the proposed ITC model is processed for Overall Crime Rate (DV1), Property Crime Rate (DV2) and Violent Crime Rate (DV3). Successively, their separate interpretations and discussions are provided. The endeavor to explain crime rates aims to explore the effect of GIS use in policing performance, considering the abovementioned significant aspects.

#### **6.5.1. Ratio of Cases to IV's**

In terms of meeting multiple regression assumptions, Ratio of Cases is one of the considerations to be met before the data analysis. According to Tabachnick and Fidell (2007), “the cases to IVs ratio has to be substantial or the solution will be perfect - and meaningless (p.120)”. The rule of thumb in Green's (1991) suggestion is  $N > 50 + 8m$ , where m refers to number of IVs in multiple correlations (as cited by Field, 2009). This formula is different, that is

“(N>104+m)”, when individual predictors are tested (Tabachnick and Fidell, 2007, p.120). In the study, there are 17 IVs and, according to the formula ( $N > 50 + 8 * 17 = 186$ ), there must be at least 186 cases for the analysis (as cited by Tabachnick and Fidell, 2007). 2,078 cases meet the assumption of ratio of cases. Although there are some missing cases in different variables, the minimum case number is 1,052 for the Hotspot and Computer Mapping variables and this value is considerably higher than the minimum required number of 186.

### **6.5.2. Homoscedasticity**

Homoscedasticity refers to the approximate equal distribution of residuals around the band. In each plot, a fit line is used to show Homoscedasticity because cases are distributed around fit lines. In other words, no heteroscedasticity exists in these variables because there is no curve line by plots. Rather, a fit line shows the existence of a relationship among between variables. According to plots’ outputs, nonlinearity is not seen in these variables but there is a little skewness in some variables. Overall linearity check for all variables can be made when multiple regression analysis is executed at once. According to Tabachnick and Fidell (2007; p, 125), “examination of residuals scatter plots provides a test of assumptions of normality, linearity and homoscedasticity between predicted DV scores and errors of prediction”. Normal P Plot and Scatter plot outputs are shown in Figures 15 and 16. These also verify normality, linearity and homoscedasticity of variables.

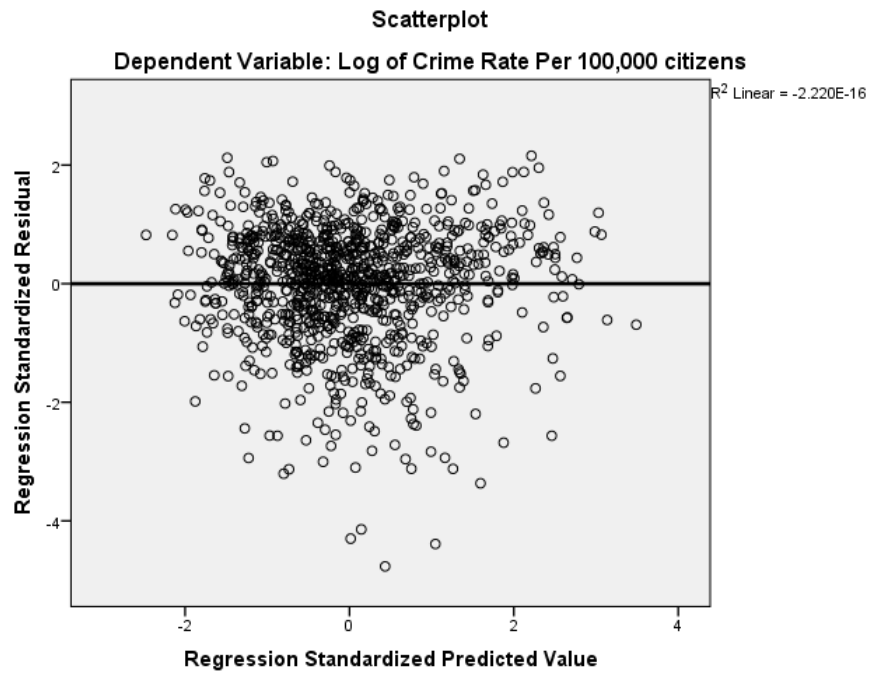
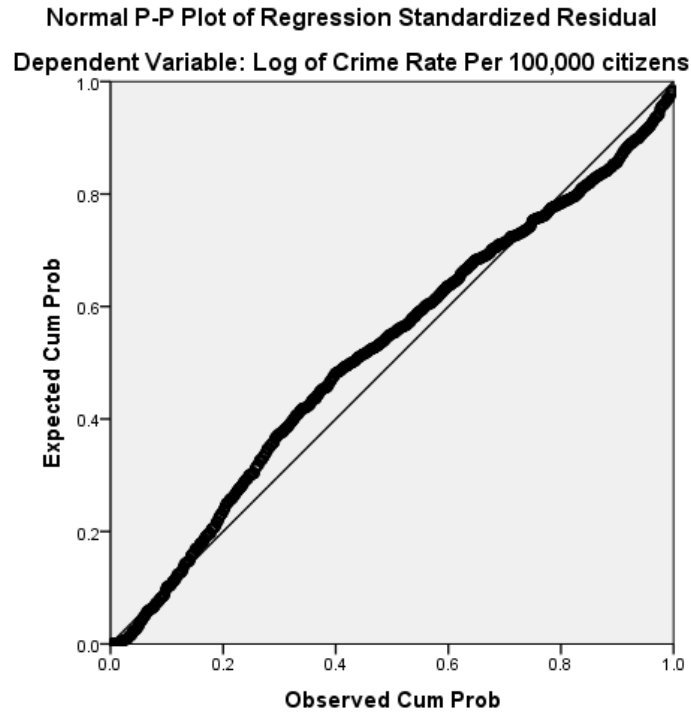


Figure 17 and 18: Normal P Plot and Scatter Plot Outputs for Overall Crime Rate (DV)



### 6.5.3. Multicollinearity and Singularity

Correlation refers to a measure which points out size and direction of a linear relationship (Tabachnick and Fidell, 2007). Correlation of variables can be larger or smaller than normally expected. It is important to spot correlations among continuous and discrete variables before making meaningful interpretations. Inflated and deflated correlations are threats while studying datasets. In other words, high and very low correlations can have potential adverse effects on regression estimates. As a solution to these threats omitting one of these variables and / or forming a composite variable are recommended when correlation values are found over 0.70. Collinearity occurs when high correlation is found between two variables in bivariate analysis. Multicollinearity is found when one or more variables are largely correlated with more than one variable. According to Tabachnick and Fidell (2007; p.89), “either bivariate or multivariate correlations can create multicollinearity or singularity”. Singularity occurs when variables are perfectly correlated (Field, 2009). These issues arise as problems of any study when values of variables are found to be very highly correlated (0.90 and over). According to Singh (2007), “there must be no perfect correlation among them, or multicollinearity” (p.179). The presence of multicollinearity or singularity can result in logical and statistical problems as well. To understand correlations of variables, a correlation matrix was prepared in Excel (Appendix 3) by using the data analysis tool.

In the matrix, Violent, Property and Overall crime are found to be highly ( $r=0.7$  and over) correlated variables. This high correlation risk is cleared by using each of the variables separately for each analysis. Other high correlations exist between Computer mapping & Crime mapping (0.743) and Computer mapping & Hotspot analysis (0.825) variables. Similarly, each

variable is singly used in all analyses that prohibit multicollinearity. Finally, the Percent of Female Headed Family is highly correlated with both Poverty (0.713) and Nonwhites (0.677).

Tolerance and The Variance Inflation Factor (VIF) are ways to test multicollinearity. The Collinearity Diagnostic test is used to check. If the tolerance value is less than  $<0.10$  there can be a problem and no variable provides a value below this level. VIF value is an indicator to catch multicollinearity. When VIF value is 3 and over, this signals the ‘probability’ of multicollinearity. Moreover, multicollinearity is present at a ‘very likely’ level when VIF is 5. Multicollinearity is present ‘definitely’ when VIF is 10 and over. According to Field (2009), when VIF values are below 10 and tolerance values are above 0.2, “we can safely conclude that there is no Collinearity within our data” (Table 52).

**Table 52: Coefficients<sup>a</sup>**

Model		Collinearity Statistics	
		Tolerance	VIF
1	Regions of states	.485	2.061
	Professional form of government	.825	1.212
	Crime mapping	.790	1.265
	Crime analysis unit	.709	1.410
	Community policing unit	.929	1.076
	Encouraged SARA	.885	1.130
	Gender percent of male	.611	1.636
	Log of Population	.634	1.577
	Log of Total hours of training	.966	1.035
	Log of Percent Young 15-24 Age	.753	1.328
	Percent Non-White	.450	2.221
	Percent Poverty	.349	2.867
	Percent Female Headed Family	.218	4.584
Log of Full time /Population	.524	1.907	

a. Dependent Variable: Log of Crime Rate Per 100,000 citizens

When multicollinearity is diagnosed, ignoring or deleting variable(s), summing or averaging options are presented (Tabachnick and Fidell, 2007). In the study, Percent of female headed values are close to the limit. The tolerance value is 0.218 and the VIF value is 4.584, and this variable will be measured twice—that is, within and out of the system. Both values are reported to note the differences.

## **6.6. Multiple Regression Analysis of Crime Rates**

In multiple regression, the equation is  $Y=A + B_1X_1 + B_2X_2 + B_3X_3+\dots B_kX_k$  where  $b_1$ ,  $b_2$  and so on are the coefficients that describe the size of the effect of the independent variables on Y. The F value indicates the significance of the explanatory overall model and the sign of the coefficient indicates direction of the effect. In addition, the coefficient (B) tells us the magnitude of the increase or decrease by each unit of predictive IVs, where all other independent variables are constant. R-square indicates the explained variance of the crime, where t score indicates whether the b value is different from 0 (Field, 2009). In these analyses, standard multiple regression with the enter method is used instead of sequential and stepwise regressions. In this technique, all variables are entered into the equation model at once and are interpreted in terms of what each IV adds to the explanation of Crime Rate.

### **6.6.1. Multiple Regression Analysis of Overall Crime Rate**

At the first model, overall crime rate was reflected in the DV and ITC variables (Use of GIS, Form of government, Crime analysis unit, Police strength); demographic and socio-economic crime variables (age, gender, population, regions, ethnic heterogeneity, family disruption, poverty). Powerful policing techniques (community policing unit and encouraged

SARA) were entered as IVs into the multiple regression model. According to Singh (2007), the multiple regression result, the  $R^2 = 75$  and above value, is considered a very good model. If  $R^2$  value is between 50–75 percent this model is accepted as good; if the resultant value is between 25–50 percent, this is considered fair; and below 25 percent, the value is considered poor.

At the first model, multiple regression analysis results show correlations between suggested independent variables and Crime Rate (Appendix 4). The strength of the model is  $R = 0.737$  and the overall explanatory power of the model is  $R^2 = 0.543$ . According to Singh (2007), this is a good model. This high explanatory power can be the sign of comprehension of most essential IVs in the model. F value is 80.878 at the  $p < 0.001$  level and this indicates overall significance (.000) of the model. As to the output, nine independent variables were found significantly correlated with DV (Table 53). The Crime analysis unit, Community policing unit, Encouraged SARA, Police strength, Professional form of government, Population, Percent poverty, and West and Northeast regions variables contribute to the explanation of crime rate. However, six independent variables were found insignificant in explanation of the variance. These IVs are Computer Mapping, Percent Young, Gender, Female headed family and Regions. The South region was excluded automatically from the test because of its tolerance value. While the contributions of the Crime Analysis Unit, Community Policing Unit, Police Strength, Population, Percent Poverty and West regions variables are positive; the Northeast region, Professional Form of Government and Encouraged SARA variables contribute to the explanation of overall crime rate in a negative way.

Specifically, the most effectual IV explanation of crime rate was found to be population ( $t = 23.845$ ) because it had the highest standardized Beta value of 0.639. This result infers that

cities and counties with higher population are most likely have higher crime rates if other contributors are held constant.

Police strength was found to be the second contributive ( $t=16.237$ ) variable for Crime Rate. According to its Beta value (0.480), one unit change in Police strength, separately, leads to a 0.480 unit change on crime rates. This infers that the cities and counties that deploy more police tend to have a higher crime rate compared to others. Naturally, there may be other interpretive aspects to be considered, but the subject of the study is not to focus on potential causes of each IV.

The third significant independent variable in explanation of crime rate was found to be the Northeast region of the U.S. If a city or county is located in the Northeast part of the U.S., most likely, lower crime rates are experienced. In other words, if a city or county is located in the Northeast region of the U.S., this leads to a -0.152 change in crime rates. Of course, this does not mean that all cities located in the Northeast region have lower rates than other regions. The explanation of crime rate in the context of the Northeast region is remarkable because this region is also the most populated part of the U.S.

The fourth significant variable found in explanation of crime is a professional form of government ( $t=5.432$ ). If a city or county has a professional form of government, it would have a lower crime rate than one with a non professional form of government. Specifically, having a professional form of government leads to a -0.130 (B) change in crime rates in U.S. cities and counties.

The fifth important explanatory variable of crime was determined as the percentage of poverty ( $t=3.111$ ). One unit change in poverty leads to 0.111 unit change in crime rates. This determination is not a big surprise. In other words, the more poverty occurs in a city/county, a higher crime rate is likely experienced.

The sixth significant explanatory variable of crime was found to be encouraging SARA projects ( $t=4.682$ ) in policing. SARA projects are a representation of Problem Oriented Policing (POP). If a city/county police agency employs POP tactics, this leads to a 0.106 change (B) in crime rates. In other words, the cities that apply POP tactics tend to have a higher crime rate compared to others.

The seventh explanatory variable of crime was found to be having a crime analysis unit. If a police organization has a crime analysis unit, this leads to a 0.79 change in crime rates. In fact, several agencies mention having crime analysis units in their organizations and the presence of these units can also be an indicator of a higher use of technology in policing applications.

The final significant explanatory factor was found to be the community policing unit (COP) ( $t=3.270$ ) at the first multiple regression analysis results. When a city/county police has a COP, the crime rate was found to be higher in these areas. In other words, when a city has a community policing unit, this leads to a 0.72 change in crime rate. The relationship is positive and it can be interpreted in the light that the cities that deploy community policing units tend to have higher crime rates.

**Table 53: Summary of Multiple Regression Results for Overall Crime Rate (DV)**

<b>DV: Overall Crime Rate</b>	<b>Std. Error</b>	<b>Beta</b>	<b>T Score</b>	<b>Sig.</b>
<b>Population</b>	<b>0.030</b>	<b>0.639</b>	<b>23.845</b>	<b>0.000</b>
<b>Police Strength</b>	<b>0.057</b>	<b>0.480</b>	<b>16.237</b>	<b>0.000</b>
<b>Northeast Region</b>	<b>0.074</b>	<b>0.152</b>	<b>-5.370</b>	<b>0.000</b>
<b>Professionalized Form of Government</b>	<b>0.049</b>	<b>0.130</b>	<b>-5.432</b>	<b>0.000</b>
<b>Poverty</b>	<b>0.009</b>	<b>0.111</b>	<b>3.111</b>	<b>0.002</b>
<b>Problem Oriented Policing SARA Projects</b>	<b>0.046</b>	<b>0.106</b>	<b>4.682</b>	<b>0.000</b>
<b>Crime Analysis Unit</b>	<b>0.060</b>	<b>0.79</b>	<b>3.293</b>	<b>0.001</b>
<b>West Region</b>	<b>0.065</b>	<b>0.78</b>	<b>2.697</b>	<b>0.007</b>
<b>Community Policing</b>	<b>0.045</b>	<b>0.72</b>	<b>3.270</b>	<b>0.001</b>

\* Dependent Variable: DV1-Log of Crime Rate per 100,000 citizens

### **6.6.2. Multiple Regression Analysis of Violent Crime Rate**

At the second model, the violent crime rate was used as a DV instead of the overall crime rates, where all other IVs were the same (Appendix 5). The intent of the analysis was to realize whether the effects of IVs were mainly the same or otherwise compared to the former analysis. Therefore, noticeable differences are only reported in this section.

Based on the multiple regression application, results show similar correlations between independent variables and Violent Crime Rate (DV). The strength of the model is  $R=0.719$  instead of  $R=0.737$  and the overall explanatory power of the model is  $R^2= 0.517$  instead of  $R^2= 0.543$ . Although the F value is a bit smaller than that in the former analysis (F is equal to 72.947 instead of the previous value of 80.878 at the  $p<0.01$  level), these results also clearly indicate the significance of the model.

Conversely, the Gender variable was found to be significantly ( $t=-2.175$ ) correlated in this model. One unit change in 'Percent of Male' leads to a 0.63 change (increase) in violent crime rates. On the other hand, the West region was found to be insignificant in the justification of violent crime rates, whereas it had been found significantly ( $t=2.697$ ) correlated before with a 0.78 Beta value for overall crime rates. Different values and scores are displayed in the summary Table 54 for detailed comparisons.

**Table 54: Summary of Multiple Regression Results for Violent Crime Rate**

<b>DV: Violent Crime Rate</b>	<b>Std. Error</b>	<b>Beta</b>	<b>T Score</b>	<b>Sig.</b>
<b>Population</b>	<b>0.034</b>	<b>0.662</b>	<b>23.322</b>	<b>0.000</b>
<b>Police Strength</b>	<b>0.063</b>	<b>0.475</b>	<b>15.623</b>	<b>0.000</b>
<b>Northeast Region</b>	<b>0.083</b>	<b>-0.164</b>	<b>-5.637</b>	<b>0.000</b>
<b>Professionalized Form of Government</b>	<b>0.055</b>	<b>-0.129</b>	<b>-5.249</b>	<b>0.000</b>
<b>Poverty</b>	<b>0.010</b>	<b>0.82</b>	<b>2.242</b>	<b>0.025</b>
<b>Problem Oriented Policing SARA Projects</b>	<b>0.051</b>	<b>0.84</b>	<b>3.622</b>	<b>0.000</b>
<b>Crime Analysis Unit</b>	<b>0.067</b>	<b>0.70</b>	<b>2.848</b>	<b>0.004</b>
<b>West Region</b>	<b>0.072</b>	<b>0.025</b>	<b>0.837</b>	<b>0.403</b>
<b>Community Policing</b>	<b>0.050</b>	<b>0.77</b>	<b>3.426</b>	<b>0.001</b>

### 6.6.3. Multiple Regression Analysis of Property Crime Rate

In the third model, DV was set as Property Crime rates to capture differentiations among IVs (Appendix 6). The third model was also found to be a significant and powerful model in explanation of the phenomenon. R is 0.724 and the R<sup>2</sup> is 0.524. This means that the model explains 52.4 percent of the variance of the property crime rate. F value is 75.109 and significant at the  $p<0.001$  level. Model findings are similar and agree with the first main model. All contributors and insignificant variables of crime are found to be the same except in the case of different values. These detailed results are displayed in the summary in Table 55 below.



**Table 55: Summary of Multiple Regression Results for Crime Rates (DV)**

<b>Applied DVs *</b>	<b>Number of Cases</b>	<b>F</b>	<b>R</b>	<b>R<sup>2</sup></b>	<b>Sig.</b>
<b>Overall Crime Rate</b>	<b>1908</b>	<b>80.878</b>	<b>0.737</b>	<b>0.543</b>	<b>0.000</b>
<b>Violent Crime Rate</b>	<b>1908</b>	<b>72.947</b>	<b>0.719</b>	<b>0.517</b>	<b>0.000</b>
<b>Property Crime Rate</b>	<b>1908</b>	<b>75.109</b>	<b>0.724</b>	<b>0.524</b>	<b>0.000</b>

\*Multiple regression analysis was applied separately for each of the listed aspects above.

#### **6.6.4. Effect of GIS Use**

Available data for the Use of GIS variable is entirely absent for 2000 and is only partially available for the year 2003. Specifically, there are 645 cases and 220 cases that are reported as missing cases for 2003 data. This missing number constitutes 34.1 percent of all the cases in 2003. In the 2007 dataset, there are 627 cases, and all the police organizations have values for crime mapping and hotspot analysis variables. In order to compose the third variable, crime mapping and hotspot analysis variables are summed up. In particular, 1,052 cases report Use of GIS out of a total of 1,908. In other words, 856 cases did not provide data for Use of GIS for all years. The percentage of missing cases is 44.9% in the years 2000, 2003 and 2007. Conversely, the Crime Mapping variable has values for all reported cases, and there is no missing data reported for this variable for all three years.

At this stage and in these circumstances, to replicate the same multiple regression analysis for the 2007 data that provides all required variables in full can present a more accurate way to see the actual picture. In fact, this reapplication can also provide a cross check to better understand real effect of GIS use in recent policing. The main difference with this analysis will be the change in methodology. The overall methodology of the study is longitudinal, but at this phase, cross sectional data analysis is used to analyze only 2007 data. Furthermore, the percent female headed household variable is removed from this analysis for two reasons. First, the VIF

value (4.216) of the variable is higher than 3, which signifies the probability of multicollinearity. Second, none of the former analysis found the percent female headed variable significant. Therefore, this variable is not reused in the model.

According to regression results (Appendix 7), significant contributive variables are different to those in former analysis findings. The strength of the model is  $R=0.760$  and the overall explanatory power of the model is  $R^2= 0.568$ . That means this model is a good model, according to Singh (2007), and these results are a bit stronger than those of all of the formerly presented models. F value is 59.799 at the  $p<0.001$  level and this indicates overall significance (.000) of the model. As to output (Appendix 7), seven IVs were found significantly correlated with DV. The Crime Analysis Unit, Police Strength, Professional Form of Government, Population, Percent Poverty, Northeast Region and Computer Mapping variables contribute to explaining crime rate. Conversely, seven IVs were found to be insignificant in explaining the variances. These are Community Policing, SARA, Percent Young, Age, Gender, and South. The West variable was excluded automatically from the test because of its tolerance value.

Conversely, Computer mapping was found to be positively correlated and significant in the model. Similarly, the contributions of Crime Analysis Unit, Police Strength, Population and Percent Poverty are positive; Professional form of government and Northeast Region contribute to the results in a negative way. Especially, Population ( $t=19.467$  &  $Beta =0.640$ ), Police Strength ( $t=15.719$  &  $Beta=0.565$ ), Northeast Region ( $t= -5.565$  &  $Beta= -0.229$ ), Professional form of Government ( $t=-4.104$  &  $Beta= 0.120$ ), Poverty ( $t=2.833$  &  $Beta=0.093$ ), Computer Mapping ( $t=2.760$  &  $Beta=0.82$ ) and Crime Analysis ( $t=2.529$  &  $Beta= 0.75$ ) are indicated as significant factors explanatory of crime rates. The Table 56 shows the overall picture for 2007.

**Table 56: Summary of Multiple Regression Results for Crime Rates (DV) of 2007**

<b>Applied DVs *</b>	<b>Number of Cases</b>	<b>F</b>	<b>R</b>	<b>R<sup>2</sup></b>	<b>Sig.</b>
<b>Overall Crime Rate, 2007</b>	<b>627</b>	<b>59.774</b>	<b>0.760</b>	<b>0.578</b>	<b>0.000</b>
<b>Violent Crime Rate, 2007</b>	<b>627</b>	<b>52.441</b>	<b>0.738</b>	<b>0.545</b>	<b>0.000</b>
<b>Property Crime Rate 2007</b>	<b>627</b>	<b>55.561</b>	<b>0.748</b>	<b>0.560</b>	<b>0.000</b>

\*Multiple regression analysis was applied separately for each of the listed aspects below.

When crime mapping (primary use of GIS) is used in the Multiple Regression equation instead of GIS use, findings can be more comprehensible. This is because using crime mapping is more prevalent in most police organizations in the context of GIS use results. The police are also more experienced in using and interpreting these simple maps. Successively, Hotspot Analysis is used in multiple regression models instead of Crime Mapping to capture more the effect of GIS use on crime rates.

The findings of last analysis are summarized below in Table 57 to show the differences in GIS usages. Primarily, it is imperative to highlight that all GIS use levels (Crime Mapping, Hot spot Analysis and Computer Mapping) were found significantly contributive in the explanation of crime for 2007. The first level GIS use (Crime Mapping) is the most common and its Beta effect (0.125) is the highest of all, which explains the change (Appendix 10). Computer Mapping, overall GIS use, was found to be the second explanatory factor of crime and its Beta value was 0.82 (Appendix 10). Hotspot Analysis, secondary usage of GIS, was found to be the less significant contributive of explanation of crime with a 0.68 Beta score (Appendix 11). These values below are an observable effect of the increasing usage of GIS. These are indicators of a new organizational change in the policing area and GIS, use of which is on the rise, is seen as one of the most recent significant instruments employed by the police in the fight against crime.

**Table 57: Summary of Multiple Regression Results for Use of GIS Variables 2007**

Independent Variable*	Overall Crime Rate (DV)					
	Number of Cases	F	R	R <sup>2</sup>	Beta	t score
USE OF GIS (IV)						
Crime Map; First level GIS	627	60.726	0.763	0.581	0.125	3.650
Hotspot; Second Level GIS	627	59.390	0.759	0.576	0.68	2.307
Computer Mapping, GIS USE	627	59.774	0.760	0.578	0.82	2.760

\*Multiple regression analysis was applied separately for each of the listed aspects below.

## 6.7. Summary and Discussion of Findings

In this section, the findings of the study, submitted above, are discussed based on the reviewed literature. As seen in Tables 51 and 53, all statistical results are presented based on tested relationships and correlations between crime rate and IVs.

Although GIS use has gone a long way from its conception to date in police organizations, a few researches have attempted to measure its effect on policing outcomes. There is a new rising crop of studies on the subject in the last decade.

In this section, the findings of the current study are summarized; successively, the relevant literature is discussed and similarities and dissimilarities are emphasized briefly to better discern the relation and interaction of variables. Throughout, seven hypotheses and the findings of three multivariate statistical models are summarized and discussed.

According to bivariate analysis results, a significant relationship was found between having a professional form of government in a city/county and crime rate. If a city has a professional form of government and their police organization uses GIS, the crime rate is significantly lower compared to that in other police jurisdictions.

In Wilson's (1968, 1977) studies, the council and mayor type of governments are identified as unreformed (unprofessional) form of governments. In addition, the professionalized form of government is referred to as the council - manager type form of government. In fact, Wilson's idea about the effect of local politics goes back to the 1970s and these ideas are regenerated by several others in the 2000s. While Maguire and Uchida (2000) highlight importance of local contingencies, including the form of government in policing outputs, Hassell and colleagues (2003) underline the contribution of the local political culture as one of the major determinants of policing styles. In previous studies, professional municipal management and the form of government were found to be explanatory factors of crime (Wilson and Bolan, 1977). Other relevant issues; the structure of city governance (Maguire and Uchida, 2000), local elected officials and political leaders (Koper and Moore, 2001), form of local government and the variation in city politics (Stucky, 2005), local political context and type of government (Stucky, 2005), political context (Velez, 2006), and effect of political dynamics (Stucky, 2006) were found to be influential in explaining crime as well. As opposed to other studies, a little support was found in verification of Wilson findings by Zhao and colleagues in 2006. Additionally, Kim and Bretschneider (2004) underlined the contribution of the administrative authority of the city to the information technology capacity of the local government in that the administration indirectly had an effect on produced local services as well.

The findings of the current study is parallel to earlier research indicating roughly the effect of government management in produced services, including policing performance. Particularly, the findings highlight the effects of having professional forms of government on crime rates. In summary, the findings with respect to this relationship confirm the effect of forms of government on crime rates. As a recommendation for future research, having an up to date

official dataset providing types of government within cities would be very critical to start relevant studies.

Secondly, a significant positive association was found in the study between having full time specialized crime analysis personnel and crime rate. Specifically, crime rates were found to be significantly higher in a GIS user city/county that has full time specialized crime analysis personnel compared to police areas that do not.

Eck (1987) underlines the effect of crime analysis on crime. In former studies, it was found that crime analysis is not predicted by crime rate (O'Shea & Nichoills, 2003). According to Boba (2005), some of the expected results of crime analysis are apprehension, crime and disorder reduction. Crime analysis' role in supporting decision making within police departments is also underlined by several researchers (Leipnik and Albert, 2003; Gul, 2009; Demir, 2009). Paulsen (2004) states that, by itself, crime mapping is not useful unless trained personnel such as a crime analyst are deployed that help to understand crime patterns. The study of Zehner (2005) on GIS and crime analysis also found that crime rate can be reduced by using these instruments. Levine (2006) pointed out the contribution of crime analysis in producing hotpots and, consequently, to explore crime trends. In a recent study, Gul (2009) found that crime analysis is linked with police decision making. In a similar research, Demir (2009) focused on the effect of crime analysis and crime mapping in proactive responses to problematic areas. In this study, it was found that police effectiveness and increasing clearance rates are partially affected by use of crime analysis and mapping. Briefly, these studies found mixed results in that having a crime analysis unit plays a mediator role in fighting crime. Current study finding is parallel to prior research supporting the

suggestion that having full time specialized crime analysis personnel (unit) is an indicator of higher crime rates in that area.

Thirdly, a positive significant relationship was found between Police Strength and crime rate. In other words, crime rate was found to be higher if police strength was stronger in those areas. Besides, this significant relationship was more than doubled in GIS user police areas compared to non GIS user areas.

According to Maguire (2001), crime rate levels can be significantly explained by police strength. While prior research considered the effect of police strength on crime (Loftin & McDowall, 1982), Crank (1990) found a wide variety of arrest rates, and Chamlin and Langworthy (1996) did not find a relation between police strength and crime over time. While Wells and colleagues (2001) found that police strength (organizational size) is the most significant single predictor of crime rates in the context of the operational style of police, the National Research Council found inadequate evidence to draw a strong conclusion about the relationship of police strength and crime rates (Skogan & Frydl, 2004). The findings of the current study confirm the importance of police strength; however, the context of organizational size and the variety of its usage may produce diverse results in different areas when considering other relevant factors.

As to the fourth hypothesis, conversely to what the ITC theory thought, no significant relationship was found between the level of education of police personnel and crime rates. Notably, no significant correlations were found involving education level of police personnel in neither GIS user nor in non GIS user areas.

The fifth hypothesis of the study resulted in one of the most contributive findings of the dissertation research. The Use of GIS and police performance were found to be significantly linked when all cases were considered (1,098) within the U.S. In other words, GIS use and crime rate are significantly related. This means that when a police organization uses GIS (police organization uses both crime mapping and hotspot analysis), crime rate is significantly higher in these cities and counties compared to non GIS user police areas.

In particular, a recent line of research focused on exploring the contribution of GIS use on dissimilar police performance outcomes. In their research, Pain and colleagues (2006) found a decrease in fear of crime; Garican and Heaton (2006) found simultaneously higher scores both in crime reduction and an increased recording in crime rates. In fact, this study (2006) did not provide a significant link between decreasing crime rates and an increase in clearance rates. According to Black, crime rate refers to the number of crimes known by the police and clearance rate refers to the proportion of known crimes solved by arrest or exceptional means by law enforcement agencies (as cited in Arslan, 2011). In the same line of research, Hekim (2009) did not find a constant relationship between utilization of information technology in police departments and clearance rates. Beyond these, Demir (2009) showed partial evidence of an increase in police effectiveness (measured by increasing clearance rates by arrests) when crime mapping and crime analysis were used. Gul (2009) found links between increasing crime rates and increasing crime analysis to support decision making. Garicano and Heaton (2010) did not show evidence on the existence of a significant association involving increased police productivity measured by clearance and crime rates. Overall, the aforementioned studies indicate mixed findings in showing the benefits of GIS use. One of the recent studies (Hekim, Gul and Akcam, 2013) remarkably states that “the relationship between clearance rates and departmental



use of information technologies is not significant". The subject matter of the study is parallel to the current study; however, they mention some of the data problems and limitations. This means that prior research did not show a clear contribution of GIS to police performance (by measuring reducing crime rates, fear of crime, clearance and effectiveness). The findings of the current study show the significant relationship between GIS use in police organizations and crime rates in cities and counties of the U.S., considering data available between the years 2000 and 2007 (Table 45). This result illustrates that GIS use in police agencies is significantly higher in higher crime rate areas.

With respect to the sixth hypothesis, a significant relation between crime mapping and crime rate was found. This means, if police organizations use crime mapping, crime rates are higher in these areas. The magnitude effect of Crime Mapping is the highest of all among the other GIS use variables.

Evidence on the effect of crime mapping on crime is obvious. The effect of crime mapping was indicated in various ways, such as, on the concentric zone model, (Burgess, 1925), social disorganization theory (Shaw & McKay, 1942), concentration of gangs (Weisburd & McEwen, 1997), crime in Connecticut (Groff & LaVigne, 2002), increased analytical capability of law enforcement to develop more effective solutions to crime and social disorder (Boba, 2005), a supportive tool for crime prevention and solution initiatives when interpreted based on criminological theories (Eck, 1987), several tasks in police agencies (Hirschfield and Bowers, 2001) and the crime reduction process (Chainey and Ratcliffe, 2005). Complimentary to GIS use and police performance links provided above, using the crime mapping feature of GIS use was

found to be the most explanatory of crime rate, compared to hotspot analysis and Use of GIS in the current study.

It was found by tackling the seventh and final hypothesis of this study that crime rates are higher in hotspot user areas compared to non hotspot identification user areas. The relationship of hotspot analysis and crime rate is significant but weaker compared to computer mapping and use of crime mapping.

The effect of hotspot use reflects one of the crucial policing tactical operations called hotspot policing; therefore, its effect was measured several times in different areas. In the literature, patrols and directed hotspots (Sherman & Weisburd, 1995), crime and geography (Cohen & Felson, 1979), the Minneapolis hotspots (Sherman et al., 1989), use of hotspot policing (Weisburd & Lum, 2005), the consistent and strong effect on targeted emergency crime (Weisburd & Green, 1995), the efficacy of hotspot policing (Braga and Weisburd, 2006), the effect of hotspot policing on reducing crime (Weisburd and Eck, 2004) and The National Research Council report (Skogan & Frydl, 2004) constitute some relevant examples. The National Research Council (2004) concluded with strong empirical support for hotspot policing in their research review. The finding of the current study confirms the positive effect of using hotspot analysis on crime rates. Additionally, the use of hotspot analysis was found to have the lower significant explanatory factor with respect to crime among other GIS use variables.

There can be several reasons why using hotspot policing was found to be less significant in the context of crime rate. One of these reasons may be that hotspot analysis is a more recent application of GIS than crime mapping. This can be an indicator of the novelty of hotspot identification usage in police organizations. Additionally, only a few police organizations are

using hotspot identification compared to a crime mapping application. In fact, out of 1,908 cases, 1,371 organizations are using crime mapping while a fewer number of police organizations (560) are using hotspot analysis. Moreover, experiencing hotspot analysis may be uneconomic, difficult or impractical for police agencies when compared to crime mapping. Finally, low significance values can be expected because there are high numbers of missing cases in LEMAS data pertaining to use of the hotspot analysis variable.

**Table 58: Summary Results of Multiple Regression Models**

Independent Variable*	Explanatory Results			
	F	R	R <sup>2</sup>	Significance
<b>Multiple Regression Models</b>				
<b>DV: Overall Crime Rate</b>	<b>80.878</b>	<b>0.737</b>	<b>0.543</b>	<b>0.000</b>
<b>DV: Violent Crime Rate</b>	<b>72.947</b>	<b>0.719</b>	<b>0.517</b>	<b>0.000</b>
<b>DV: Property Crime Rate</b>	<b>0.724</b>	<b>0.724</b>	<b>0.524</b>	<b>0.000</b>
<b>ITC based Variables</b>	<b>Standard Error</b>	<b>Beta</b>	<b>T</b>	<b>Significances</b>
<b>Form of Professionalized Government</b>	<b>0.049</b>	<b>-0.130</b>	<b>-5.432</b>	<b>0.000</b>
<b>Police Strength</b>	<b>0.057</b>	<b>0.480</b>	<b>16.237</b>	<b>0.000</b>
<b>Crime Analysis Unit</b>	<b>0.060</b>	<b>0.79</b>	<b>3.293</b>	<b>0.001</b>
<b>Demographic Variables</b>				
<b>Population</b>	<b>0.030</b>	<b>0.639</b>	<b>23.845</b>	<b>0.000</b>
<b>Northeast</b>	<b>0.074</b>	<b>-0.152</b>	<b>-5.370</b>	<b>0.000</b>
<b>West</b>	<b>0.065</b>	<b>0.78</b>	<b>2.697</b>	<b>0.007</b>
<b>Socioeconomic Variables</b>				
<b>Poverty</b>	<b>0.009</b>	<b>0.111</b>	<b>3.111</b>	<b>0.002</b>
<b>Policing Variables</b>				
<b>Community Policing</b>	<b>0.045</b>	<b>0.72</b>	<b>3.270</b>	<b>0.001</b>
<b>Encouraged SARA</b>	<b>0.046</b>	<b>0.106</b>	<b>4.682</b>	<b>0.000</b>

\*\* IV results are based on overall crime rate DV: Correlation is significant at the  $P < 0.01$

According to multiple regression results of the overall model, nine independent variables were found to be significantly correlated with crime rate: Population, Police strength, Northeast region, Professional form of government, Poverty, Problem oriented policing SARA projects,

Crime analysis, West region, and Community policing variables are explanatory of crime rate. Conversely, five independent variables were found to be insignificant in explanation of the phenomenon. These are Computer Mapping, Percent Young, Gender, Female headed family and Regions. While contribution of Crime Analysis, Community Policing, Police Strength, Population, Percent Poverty, SARA projects and West regions variables were positive; Professional Form of Government and Northeast region were contributive to the explanation in a negative way. In other words, having a professionalized form of government and being in the Northeast region are indicators of lower crime rates in large police agencies of U.S. cities and counties.

Specifically, the most contributive variable was found to be population. Police strength was found to be the second contributive variable in explanation of crime rate. The third significant variable was found to be settling in the Northeast region of the US. The fourth significant variable was the presence of a professional form of government. The fifth important explanatory factor of crime was determined to be the percentage of poverty. The sixth significant factor was encouraging employment of SARA projects and the seventh explanatory variable of crime was found to be the existence of a crime analysis unit in a police organization. Eight significant explanatory variables of crime related to the region ( $t=2.697$ ) and the final significant explanatory variable of crime was found to be a community policing unit.

Although exceptions were found in some cities, a general positive relationship between city size and crime rate is indicated as one of the facts of criminology in explanation of crime (Rotolo & Tittle, 2006). Reviewed and presented literature within the study also verifies this reality (Beasley & Antunes, 1974, Flowers, 1989, Groves, 1989; Glaeser & Sacerdote, 1999;

Fox, 2000; Ousey, 2000; Nolan, 2004; Stucky, 2005; Zimring, 2007), considering a few exceptions (Li & Rainwater, 2000). In the current study, a strong positive relationship between population and crime rate in multiple regression results was found that is parallel to the presented literature above.

Region was found to be influential in the explanation of crime rates in the current study. In the literature, this relationship had been found before (Flanago & Sherbenou, 1976; Land, McCall & Cohen, 1991; Winsberg, 1993; Qusey, 2000) at different sublevels. Specifically, living in the South was found to be linked with higher crime rates (Flanago & Sherbenou, 1976), and this was confirmed by Qusey (2000) in subsequent years in relation to serious crime rates. In Qusey's (2000) study, the lowest crime rated region was found to be the Northeast where lower crime rates were recaptured for Northeastern states (As cited by Levitt, 2004). Parallel to the literature findings, the Northeast and West regions were found to be linked with crime rate in the current study. Specifically, Northeast region was found significantly linked with lower crime rates while West region was found significantly linked with higher crime rates. As a note, South region was excluded from the multiple regression test because of its tolerance value.

Poverty was found to be one of the significant explanatory factors of crime rate in the current study. In fact, this link was found formerly in several studies, explained as a determinant of crime (Flango and Sherbenou, 1976); or an exploration of the following: link between poverty and crime (Miethe, et al., 1991; Pratt & Cullen, 2005); poverty and violent crime (Hsieh and Pugh, 1993), drug and market expansion (Grogger, 2000), poverty and crime victimization (Cragila, et al., 2000), and market and crime (Partridge & Rickman, 2006). The findings of the current study are parallel to those in former studies.

Problem oriented policing (POP) also was found to be positively and significantly related with crime rates in the current study. The operationalization of POP consisted of the use of SARA projects within police agencies. When literature was reviewed, the effectiveness of POP was found to be exceptional (Read & Tilley, 2000) in the field, and increasing evidence was noted (Weisburd & Eck, 2004), as well as a supportive growing body of research indicated by the review committee (Skogan & Frydl, 2004). Although POP studies are optimistic, recent study findings do not result in different outcomes from former studies. According to Tilley and Scott (2012), assessments of POP projects provide weak results and major challenges in implementation. The result of the current study indicates the existence of a link between POP and crime rates; however, this relationship is not causal.

Finally, community oriented policing (COP) was found to be one of the significant explanatory factors of crime rate in the current study. In the literature, COP was indicated as a prevalent and major police innovation (Maguire et al., 1997; Skogan, 2006). Yet, a slight effect of COP was found on the reduction of violent crime rates (MacDonald, 2002), as well as a capacity to affect violent and property crime rates, albeit not drug crime rates at the beat level (Connell et al., 2008). Although The National Committee declared evidence on the efficiency of COP in reducing fear of crime (Skogan & Frydl, 2004), study findings on crime reduction are mixed. This study finding confirms the effects of COP in the longitudinal part; however, its effect remains insignificant as only the 2007 LEMAS dataset has been used.

When the violent crime rate was used as a DV alternatively, a significant explanatory model was found where only the Gender variable was found significantly effectual, conversely

from the former model. When Property crime rate was used as a DV instead of Overall crime rate, no additional or missing significant variable was found.

When the overall crime rate DV was used for only 2007 data, a ‘very good’ explanatory model was found. In this analysis, seven IVs were found to be significantly correlated. These are: Crime Analysis Unit, Police Strength, Professional Form of Government, Population, Percent Poverty, Northeast Region and Computer Mapping. In the results, seven IVs were found to be insignificant. These are: Community Policing, Encouraged SARA, Percent Young, Age, Gender, and South (Appendix 7).

As opposed to former analyses, Use of GIS, so called computer mapping, was found to be positively significant in the model. Similarly, the contribution of Crime Analysis Unit, Police Strength, Population and Percent Poverty were positive; whereas, Professional Government and Northeast Region contributed negatively to the explanation.

When Crime mapping (prevalent GIS use) was used instead of Computer Mapping in Multiple Regression, the propositions of the current study were found to be brighter (See table 53). In brief, all types of GIS use (Crime Mapping, Hotspot and Computer Mapping) were found to be significantly linked in the explanation of crime when the 2007 LEMAS was analyzed.

In summary, the results of hypothesis testing and findings of multiple regressions mainly overlap within the study. When IVs were tested throughout the years (2000-2007), the effect of GIS use was unclear. When Use of GIS was tested for only 2007, where the LEMAS dataset fully includes all targeted IV values, a significant link was found between Use of GIS and Police Performance.

## CHAPTER 7

### Conclusion

In order to understand the impact of Geographic Information Systems (GIS) use to police performance in U.S. cities and counties, this research was designed as a macro level study of crime where external factors were primarily focused. In the study, crime rate was used as a measure to explore the impact of GIS use within the context of police performance.

Crime is a complicated event emerging from a combination of various interconnected factors. In this regard, demographic and societal variables including effectual policing strategies were considered based on reviewed theories and previous studies.

The emergence of GIS as capturing, managing, manipulating, analyzing and displaying the computer mapping system has promised many benefits in improving delivery of services (Harries, 1999). In spite of decreasing costs in computerization, software and maintenance, the adoption and efficient use of GIS in organizations rely on various resources. This is the reason why, in this study, information technology capacity theory based variables (Kim & Bretschneider, 2004) were considered so as to measure the "the ability of the local government to effectively apply IT (GIS) to achieve desired ends" (p.2).

Although GIS offers several functions, the use of GIS in the police was conceptualized as computer mapping because the primary use of GIS was mainly centered on its automated mapping attribute. More information on GIS and other relevant issues has been provided in detail in previous chapters.



Within the light of a recent line of research examining the contribution of GIS use on different police performance outcomes, the current study aims to measure effect of GIS use on crime rates in cities and counties of the U.S. As opposed to former studies, this study used a conceptualization of computerized mapping (McEwen & Taxman, 1995) within the police performance methodological context (Roberts, 2006) to measure ‘the organizational impact’ of GIS use. The Information Technology Capacity (ITC) approach was used as a recent comprehensive theoretical framework to involve the most related aspects of the issue to test the adoption of a new technology (use of GIS) into local police agencies.

Considering the limitations of previous studies, national longitudinal data set was studied to understand the contribution of GIS use in police organizations over a seven-year period. The specific target of the study was to understand the effect of GIS use in policing on crime reduction efforts. Remarkably, systematic data collection of Law Enforcement and Management Statistics (LEMAS) facilitated comparisons of the GIS adopter and non-adopter organizations. Specifically, LEMAS became a very effectual dataset to apply advance statistical techniques to measure the use of GIS for 2000, 2003 and 2007, which also drew the scope of the study.

The main assumption of the study was that the use of GIS in police organizations would increase overall analytical capability. This was, consequently, supposed to increase performance of police that was measured by crime rates in those jurisdictions. Particularly, the higher the use of GIS by the police, the more likely it would produce a higher information technology capacity in that organization; therefore, increasing police performance would result in higher crime reduction. The focus of the study was arranged specifically to measure the use of GIS and its

impact on police performance. Within this logical framework, the research question was established: Does use of GIS contribute to police performance?

In this framework, two sets of factors were examined mainly to measure the impact of GIS use to police performance: correlates of crime and information technology capacity based variables. Specifically, police performance was quantified as crime rate, which was the dependent variable of the current study. In this respect, the study examined associations and correlations between crime rates and organizational, environmental and managerial factors affecting the level of IT capacity in a local government. In the study, correlates of crime and effectual policing strategies were used as control variables to examine the impact of GIS use on police performance.

### **7.1. Policy Implications**

The use of GIS by law enforcement agencies and its impact on police performance in the U.S. were examined throughout the study. The descriptive findings of the present study enlighten the current state of GIS use in U.S. police agencies between 2000 and 2007. Specifically, the use of GIS and the employment of crime analysis units in police agencies have been on the rise from 2000 to 2007. Additionally, the contribution of GIS use on police performance was found to be statistically significant, but in an opposite direction. Overall, the results of the present study indicate significant links between having a professionalized form of government and crime rate, having full time specialized crime analysis personnel and crime rate, police strength and crime rate, the use of GIS and crime rate, population and crime rate, being located in the Northeast and West regions and crime rate, poverty and crime rate, having encouraged SARA type projects and having a community policing unit in police agencies and crime rate. Reported results have the

potential to affect both policy makers and police practices about use of GIS in police agencies. In brief, these findings can illuminate the way of thinking and acting of policy decision makers and the police practitioners in Turkey.

From the research, it transpires that the current state of GIS use in large police agencies is growing. When screened data was used for 1908 cases in the descriptive analysis, the use of crime mapping was nearly the same (415 and 412 police agencies) for 2000 and 2003, and it jumped to 544 in 2007. According to the screened LEMAS records, the use of hotspot analysis in police agencies also showed a sharp increase from 185 in 2003 to 375 in 2007. Finally, GIS use was previously most likely weak in 2000. Remarkably, there was a sharp increase in the use of computer mapping that is GIS use, from 115 in 2003 to 368 in 2007.

The study concluded various potential contributions to the policy makers and policing areas. First of all, having broad and specific pictures of the GIS phenomena in policing from 2000 to 2007 have provided a fruitful ground to make better decisions. Next, the tested variables and the magnitude of their effects in the use of GIS were captured more precisely. Following this, the net impact of GIS use in police performance for longitudinal and cross sectional data was examined. Finally, a brighter answer was presented to the question of whether the use of GIS has a meaningful effect in increasing police performance.

In terms of policy makers, the findings of the study have presented essential points to increase awareness as to the importance of GIS use in the police since bureaucratic organizations learn incrementally. According to the findings of the current study, the actual use of GIS is sharply rising and its effect on police performance (crime rates) is significant. Besides these, the momentum to use GIS in police agencies has gone upward from 2000 to 2007. Consequently,

keeping up to date the city management and police practitioners about current and upcoming trends in GIS use in policing should be considered by both policy makers and the police agencies.

The captured effect, the rising momentum in GIS use in police agencies, can have a big influence on non-GIS user police agencies as well. Most likely, this growing drive toward GIS use can bring forth legal and other relevant preoperational implications and considerations, such as, setting up better regulations, providing guidance for adoption and funding and supervision of GIS use to the political agenda. Above all, exploring GIS use in police agencies can provide a clearer ground on its effects so enhanced decisions can be made about whether to invest more in GIS adoption in police agencies or not. Specifically, the findings can facilitate decision making in starting, continuing and developing more budgetary support for GIS utilization.

The federal government as a result of general guidance can fund the cost of GIS adoption. In particular, the current governmental contributive funds are available only for large police agencies (COPS, 2009); therefore, small police organizations and low populated areas can be considered for this funding as well. In fact, the effect of the GIS funds can be more influential for smaller organizations because their actual budget, most likely, cannot cover these types of capital investments by themselves.

In the phase of bivariate analyses, a significant link was found between having a professionalized form of government and crime rate. When a city is governed under a professionalized form and their police organization uses GIS, the crime rate is expected to be significantly lower compared to that in other areas. According to the International City / County Management Association (ICMA) surveys, 53% of all localities were under the Council Manager

Form of government in 2002 and there was a slight percentage increase to 58% in 2011. In fact, there are also other contributory factors, such as having a chief appointed official in the municipality to be considered instead of or in addition to the form of government as another explanatory factor to these types of research questions. Although the effect of having professionalized form of government is small in magnitude, it is nonetheless statistically significant. It can be of interest to policy makers and voters to rearrange or update the form of government in a city or county if they do not have a similar form of government concept to deliver better security services.

In the study, the next contributive variable of the crime rate was found to be related with having full time specialized crime analysis personnel. That means crime rates are significantly higher if a GIS user police agency has a full time crime analyst compared to one that does not. In fact, 31.5% of the 2,859 agencies only responded to this question in the LEMAS survey. From these records, 57.7% of these had a crime analysis unit in the years 2000 and 2007. In particular, 61.3% (390) of all agencies (636) had a crime analysis unit in 2000 and this number remained nearly the same in 2003 with 61.4% (396) of all agencies (645). In 2007, the number of police agencies having a full time crime analyst showed a sharp increase to 88.8 % (557) out of 627 police organizations; that was a strong signal of increase in analytical capability. In fact, this increase was supposed to result in a crime rate reduction; however, it was found that higher crime rates were related to having a full time crime analyst. This finding indicates that having a crime analyst is not an adequate explanatory factor by itself and more factors are supposed to be considered to understand its role in reducing crime rates.

The link between police strength and police performance has been obvious for years. Interestingly enough, the magnitude of this significant relationship was found to be two folded in GIS user police areas, when compared to non-GIS user areas, in the study. This may be another signal of increase in invested instruments (e.g., resources, technology, specialized person, etc.) on focused high crime rated areas. In fact, use of GIS does not contribute to increasing number of employed police personnel by itself. There must be other illustrative factors to be explained by future studies.

Contrary to the proposed ITC-based fourth hypothesis, the study found that general training is not a significant factor in reducing crime rates. In fact, education and / or training the personnel may be one of the most acceptable explanatory variables in the discussion on crime; however, the study suggests the lack of importance of in service training within the context of GIS use. Rather, this finding may highlight the value of selection and employment processes of specialized persons as crime analysts; and/or, more investment should be considered for specialized training of the police administration and the crime analysts on GIS use because its successful implementation and full utilization relies on this (Masser & Onsrud, 1993; Goodman, 1992).

Notably, the study showed the link between GIS use and police performance in the U.S. Ironically, significant relation was found on the opposite direction considering the proposition. In other words, if a police organization uses GIS, there is an indication of higher crime rates in those areas compared to non-GIS user police areas. In fact, this can put the responsibility on police practitioners (both administrators and crime analysts) because adoption of GIS is a very supportive technology to fight crime; on the contrary, it does not assure reduced crime rates by

itself. This point should enlighten effective management of GIS and other resources in policing. To have assortment of correct policing strategies may be one of the other contributory solutions.

The magnitude of the effect of crime mapping was found to be the highest in all the GIS use levels. This finding implies that more positive results can be expected from hotspot analysis and other factors (GIS uses) when latest technology applications are more frequently used along the years. This means the use of GIS and its sublevels should be encouraged and supported by the police.

When findings of correlations are considered, population emerges as one of the most explanatory variables of crime in the current study. Continuously, most studies suggest corroborating results to underline the importance of population in the explanation of crime. Specifically, several studies found significant links between population density and crime (Smith, 1957; Beasley & Antunes, 1974; Flowers, 1989), urbanization and decreasing informal social control (Sampson and Groves, 1989), urban size difference and crime (Fox, 2000), crime rate and population (Nolan, 2004), and urban size and variety of crime (Zimring, 2007), with few exceptions (Li and Rainwater, 2000). In fact, urbanization is an ongoing and inevitable process; however, this process can be better managed within a more eligible and dynamic policy.

Considering these and similar findings, relevant authorities, such as governments, should open wider areas for settlement to minimize population density, thus increasing the quality of life in terms of security. In other words, a sprawling city model (Bogart, 2006) can be one of the safer and manageable alternatives to be considered for policy makers, as opposed to densely populated cities. Naturally, the city governance must be compact in one-way or another. And, this suggestion doesn't conflict with new urbanism understanding. Specifically, the master plan

of metropolitan authorities should address and provide ample measures to provide adequate spaces and areas supposed to ensure peaceful interactions for individuals and groups of people. Additionally, the police should adjust their structures, resources and strategies to better comprehend the highly populated areas.

Police strength is also indicated as the second contributive variable in explanation of crime rate. An increased police presence in a particular jurisdiction does not necessarily guarantee crime reduction in that area. There is a very strong and clear line of research showing traditional policing by itself cannot assure a reduced crime rate. The Kansas City case is one of these landmark studies that disapprove some of the standard policing tactics (Foundation, 1974). In fact, several innovative policing tactics came to the public agenda after the 1990s as a remedy to promise safer communities. When the relevant research is reviewed, community policing, problem oriented policing and hotspot policing strategies were found to be influential in reducing fear of crime and crime rates. Among these three, hotspot policing was the most appealing in reducing the crime rate. In fact, hotspot analysis is one of the primary ways of GIS use that was conceptualized within the computer-mapping concept in the study. This is why the object of the present study was set up to measure the effect of GIS use as an alternative to traditional policing strategies. Consequently, the use of GIS in police agencies should be clearly supported and funded by the federal and state governments in the relevant localities. Police practitioners should be updated about the effect of GIS use and its varying functions.

Additionally, the Northeast and West regions were also found to have higher concentrations of crime rates. Naturally, poverty was also determined to be one of the contributive variables of crime. Finally, having encouraged SARA type projects, which is an



application of the problem oriented policing concept, as well as having a community policing unit were found to be related to crime rates. Interestingly enough, gender emerged when violent crime was used as a DV instead of overall crime rates. This finding underlines the dominant role of males in violent crimes.

When the study examined the 2007 records, the effects of community policing and problem oriented policing projects diminished compared to that prompted by the use of crime mapping. This finding also indicates the changing nature of policing strategies in reducing crime rate through the years. Based on these findings, governmental policy and support on policing strategies can be reviewed and reshaped. Finally, the study verifies the convenience of the information technology capacity framework to explore the ability of a local government to effectively apply GIS to reach desired ends.

## **7.2. Limitations of the Study**

A study offers most benefits to an audience when its potential limitations are well thought out. Any study can have restrictions and be beneficial if these are adequately addressed. The main limitations of the current study are presented below to meet this need.

The current study is a macro level study, which provides a general picture of GIS use in police agencies over a seven-year period. Although regions have been considered within the study concept, findings of the study cannot be generalizable for sublevels, such as individual locations. In particular, case studies can be suggested to provide more specific and accurate results to meet these kinds of purposes. The primary objective of the present research is to measure the impact of GIS use to policing performance. In order to meet this end, the literature

review and research design chapters were set within a crime study context. The researcher does not hold a criminal justice degree in the U.S. but he has a general police understanding because of his Bachelor's degree in policing, an ongoing career and 17 years experience as a police manager in Turkey. Throughout the study, the focus was on what GIS use does to police performance, not on the how. In the study, the overall organizational impact of GIS utilization in police agencies at the societal level was examined. In other words, the roots of the GIS phenomena at the user end levels were not directly explored.

The specific object of the study was measurement of a cutting edge technology (GIS use) that changes and is updated yearly. Although the study was concerned with merely having GIS in a police organization as the main value, use of GIS at different levels of the organization can produce an array of policing values in reducing crime rate. GIS technology and its use are growing in importance and this phenomenon has changed over the years. Therefore, the measured object (GIS use) in 2000 was different from that in 2007. Crime phenomena and policing tactics in fighting crime are also dynamic and have changed dramatically through the seven-year period under study. Even though the study involved measurement of major policing tactics, changing police strategies may themselves result in various reduced crime rates.

In addition to these, the official secondary data of GIS use is only available for a seven-year period. Due to the fact that the data was collected via the LEMAS survey, the researcher does not have a methodological control of it. Available research in the measurement of the police outcome by GIS use is few. That fewness also constrains the researcher in making better comments and extractions for the findings of the current study. Although the longitudinal nature of the study has captured some benefits overall, cross sectional analysis for 2007 has provided

specific, accurate and recent results than the former approach. Finally, the time resource is an extra limitation of the study because the researcher is required to accomplish the study within a specific time period.

### **7.3. Suggestions for Future Studies**

The findings of the study indicated that use of GIS in policing sharply increased between 2003 and 2007, flagging the need for more research on understanding the effect of GIS in policing agencies. In particular, the use of GIS nearly tripled among police agencies while crime analysis units were established and expanded from 2003 to 2007. However, few studies are available in the measure of overall use of GIS in policing. Specifically, previous studies have enlightened simply the decrease in fear of crime (Pain and colleagues, 2006), increase in crime reduction and recording crime rates (Garican and Heaton, 2006), utilization of information technology in police departments and clearance rates (Hekim, 2009), increase in police effectiveness if crime mapping and crime analysis are used (Demir, 2009), linkage between increasing crime rates and increasing crime analysis to support decision making (Gul, 2009), lack of evidence on existence of a significant association with increasing police productivity measured by clearance and crime rates (Garicano and Heaton, 2010) and insignificant relationship between clearance rates and departmental use of information technologies (Hekim, Gul and Akcam, 2013). In fact, research on the study of police outcomes is not only rare but findings are also mixed. This need can draw more research on different dimensions, such as how to use GIS, which software is more effectual, to what extent a police organization must have a GIS capacity, how many crime analysts the organization must have, and what is a best place to

have a GIS in policing. In other words, new studies must confront the reality of the link between the use of GIS and crime rate and its nature must be closely examined in detail.

As mentioned earlier, this study is a macro level study attempting to gauge the general effect of GIS use in the U.S. that lacks the examination of mezzo and micro level dimensions of GIS use in law enforcement agencies. Future studies should focus on smaller areas, such as regions, metropolitan areas and large and small cities separately to test the particular effect of GIS use because their findings can represent more precise and customized results specific to the areas. In particular, priority should be given to the larger and capital city analyses because the majority of larger cities have been using GIS since 2000. A case study can be one of the designations of studies to be considered. In the present study, only large police agencies were tested because of its scope. In fact, the same study can be replicated for the smaller police agencies as well as to explore the nature of these agencies in GIS use.

The current research benefited from a sufficient secondary database to study the subject; however, specialized surveys can also be designed to collect richer and more comprehensive datasets. Consequently, better comprehension and measurement can be available on targeted topics. Having a recent, up to date official dataset providing types of city government would also be a very helpful in measuring the more precise effect of such forms of government.

Several approaches are available to measure information technology applications in service delivery. Testing the effect of GIS use within a diverse theoretical framework can provide more discernible results. Although the study has used general correlates of crime to explore GIS use, future studies can add, subtract, change or use different variables considering

different theoretical approaches. City level crime data was used to capture the effect of GIS use; nonetheless, different sublevels can be similarly magnified to provide more insightful findings.

In the current study, crime rates, as objective measures, were used as a proxy to evaluate police performance. Subjective measures, such as satisfaction surveys, can also be used by police administrators and officers to capture perceptions in using GIS. Additionally, one can consider more benefits in testing the effect of GIS use on specific types of crime. Otherwise, one may consider the use of GIS can be better conceptualized within a new definition. In addition to these, another dependent variable instead of crime rates can be used and crime rate can be applied as an IV in order to control their correlations as it was suggested in the dissertation meeting. As demonstrated in this study, for the year of 2007, further cross sectional approaches can be designed to capture more recent effects of GIS use.

The study of GIS use in Turkish police organizations is a very recent concept because diffusion of GIS is recent and only partly available systematically at some provinces of Turkey. On the other hand, focusing on individual case studies can be a very fruitful basis on which to build GIS studies involving smaller police units. Due to the fact that GIS use is more readily available and employed for specific types of crimes, relevant crime rates can be purposely examined and these studies can provide brighter results. In Turkey, more research should be initiated by the policy makers to capture the phase of GIS diffusion in police agencies; therefore, more foreseeable / reasonable policies can be brought to the governmental agenda. In terms of policing, the Turkish National Police should bridge a formal structure, for example, an institutional platform which enables necessary knowledge, counseling and funding opportunities for all, to alleviate the gap between GIS user and non-user police agency services.

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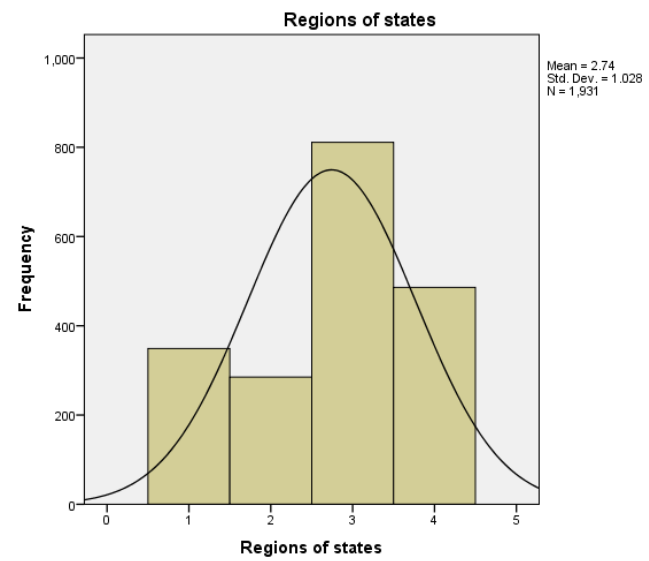
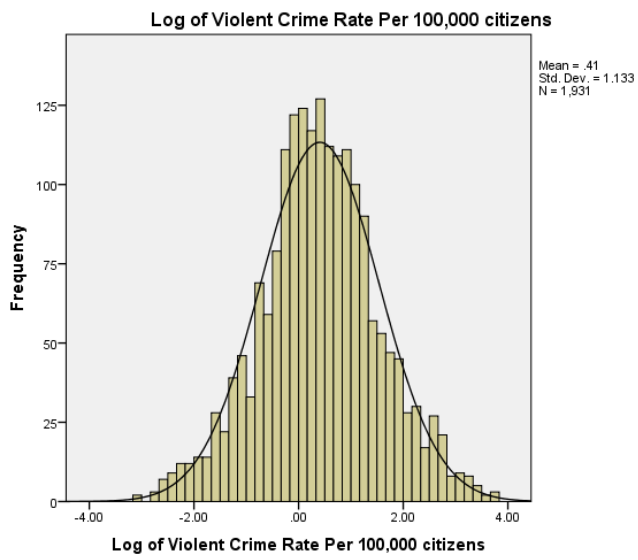
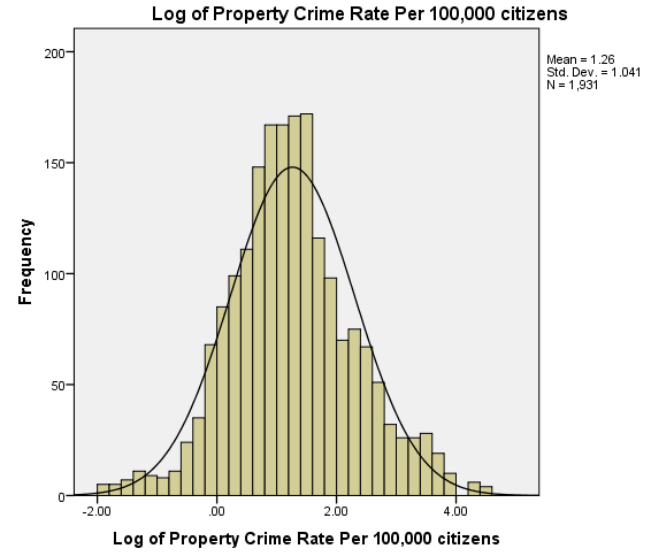
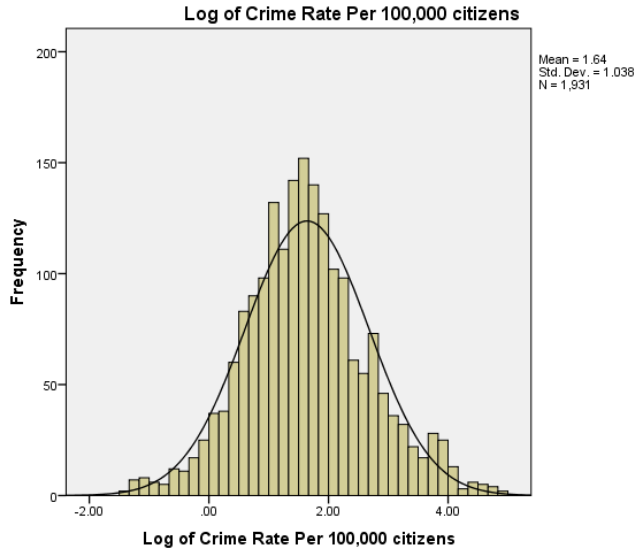
## APPENDICES

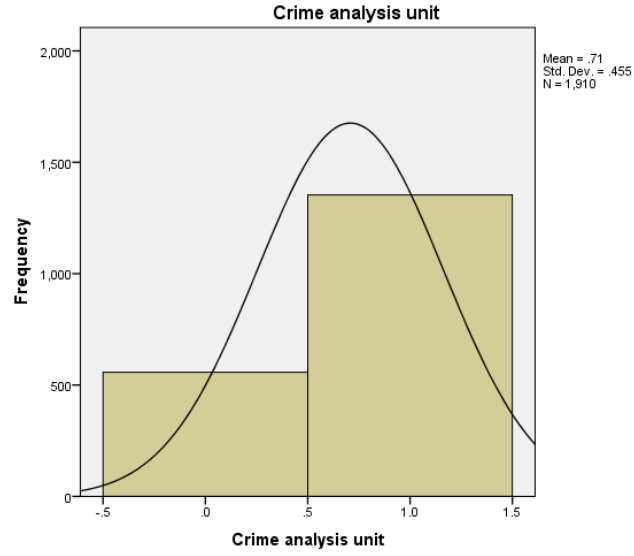
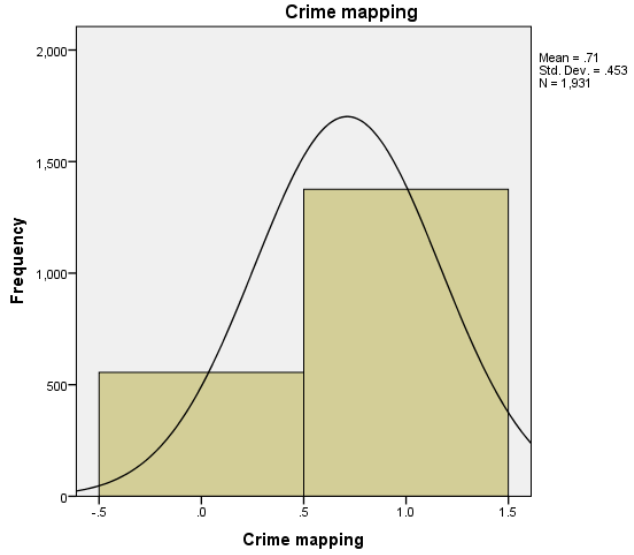
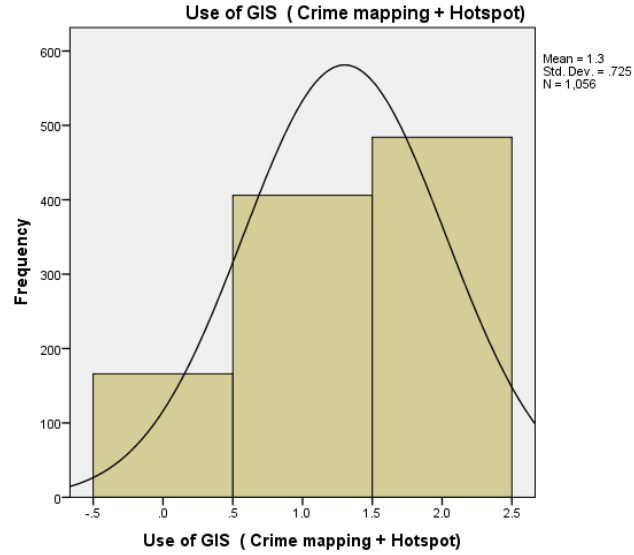
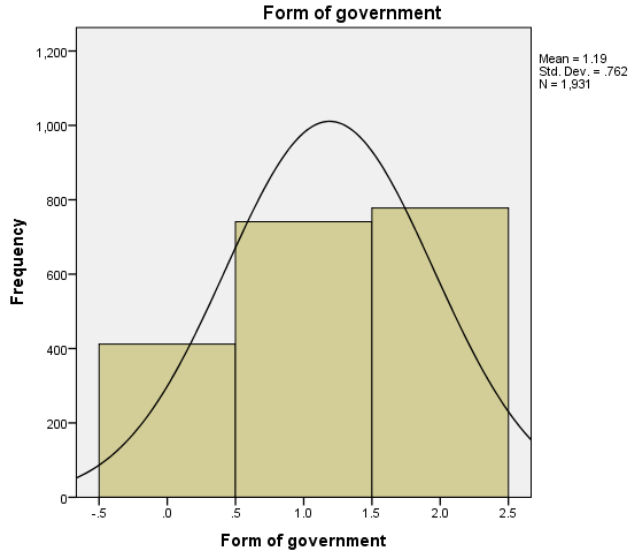
### Appendix 1: Normality: Skewness and Kurtosis Values of Variables

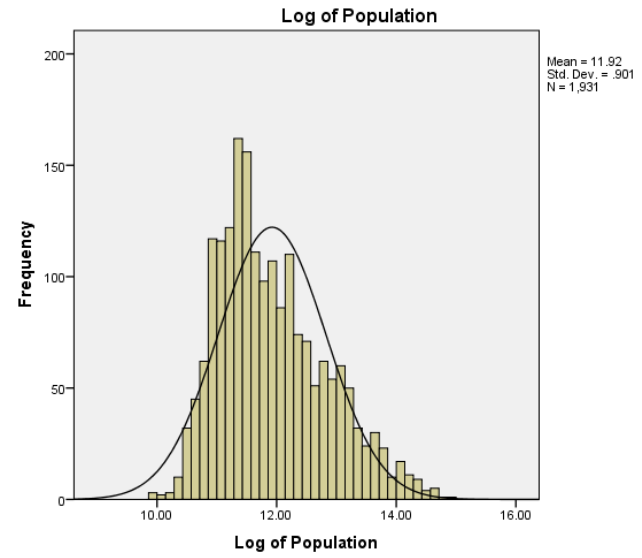
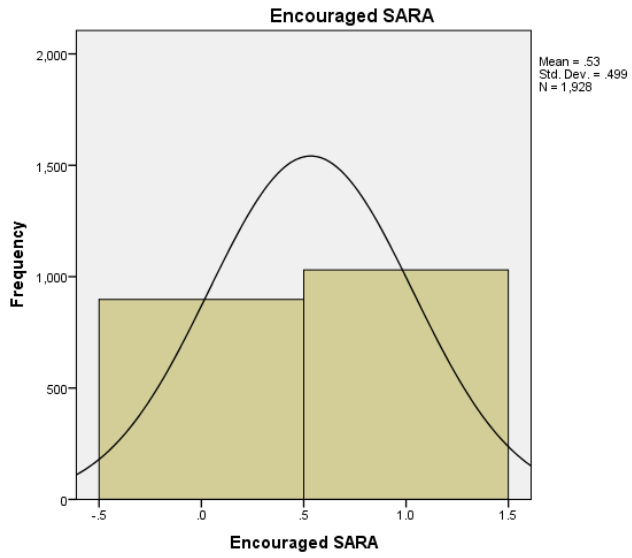
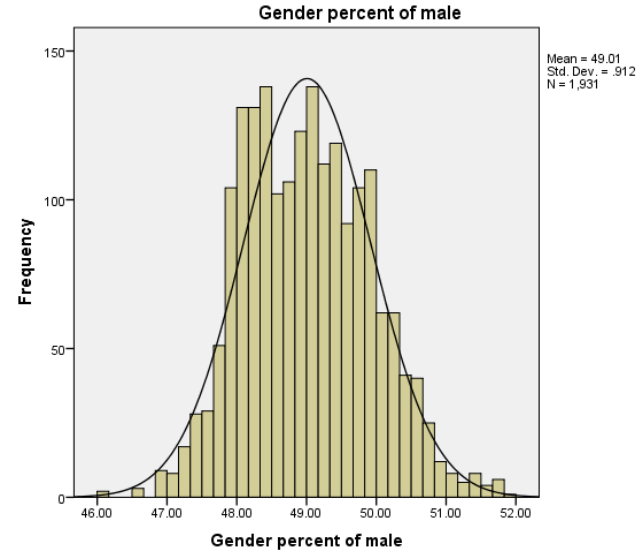
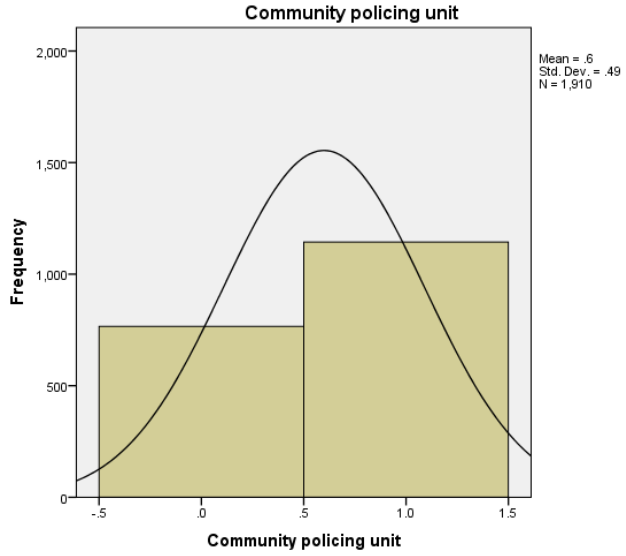
Descriptive Statistics								
	N	Range	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Regions of states	2078	3	2.75	1.02	-0.50	0.05	-0.84	0.11
Form of government	2078	2	1.19	0.77	-0.34	0.05	-1.23	0.11
Crime mapping	2078	1	0.71	0.46	-0.91	0.05	-1.17	0.11
Use of second level crime mapping	1146	1	0.53	0.50	-0.12	0.07	-1.99	0.14
Use of GIS ( Crime mapping + Hotspot)	1146	2	1.29	0.73	-0.51	0.07	-0.99	0.14
Crime analysis unit	2057	1	0.71	0.45	-0.93	0.05	-1.13	0.11
Community policing unit	2057	1	0.60	0.49	-0.40	0.05	-1.84	0.11
Encouraged SARA	2075	1	0.53	0.50	-0.13	0.05	-1.98	0.11
Gender percent of male	2078	8.00	48.98	1.00	0.19	0.05	0.80	0.11
Percent Non-White	2078	77.50	23.62	13.89	0.99	0.05	0.74	0.11
Percent Poverty	2078	32.60	11.93	4.43	1.00	0.05	2.18	0.11
Percent Female Headed Family	2078	20.13	13.11	3.22	0.79	0.05	0.65	0.11
POPULATION	2078	9850388	293673.21	586395.71	8.88	0.05	113.39	0.11
FULL-TIME EQUIVALENT	2078	51380	532.11	1877.25	18.55	0.05	425.11	0.11
TOTAL HOURS OF TRAINING	2078	240	37.53	25.32	2.15	0.05	8.35	0.11
AGE Percent Young (between 15-24)	2078	16.52	13.98	2.29	1.20	0.05	3.01	0.11
Overall Crime Rate Per 100,000	2078	272.61	10.79	20.29	5.93	0.05	47.80	0.11
Violent Crime Rate Per 100,000	2078	79.01	3.38	6.53	5.89	0.05	46.13	0.11
Property Crime Rate Per 100,000	2078	198.56	7.41	14.07	6.18	0.05	53.24	0.11
Valid N (listwise)	1133							

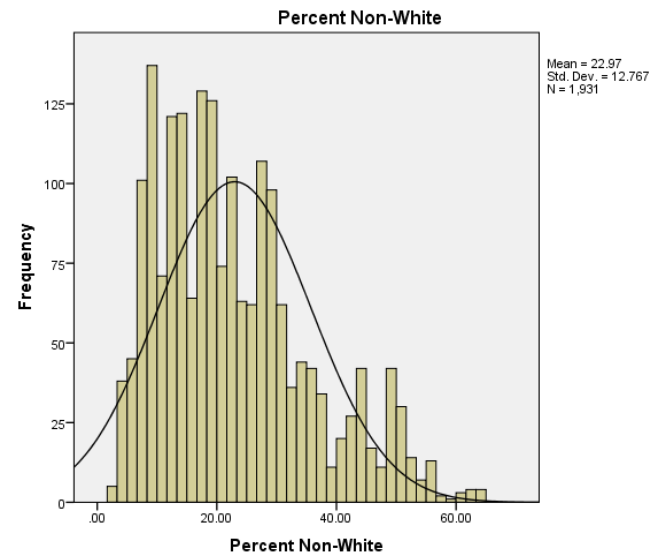
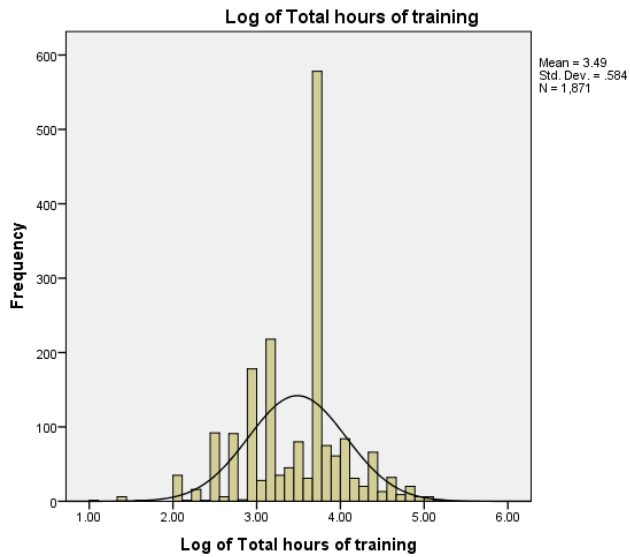
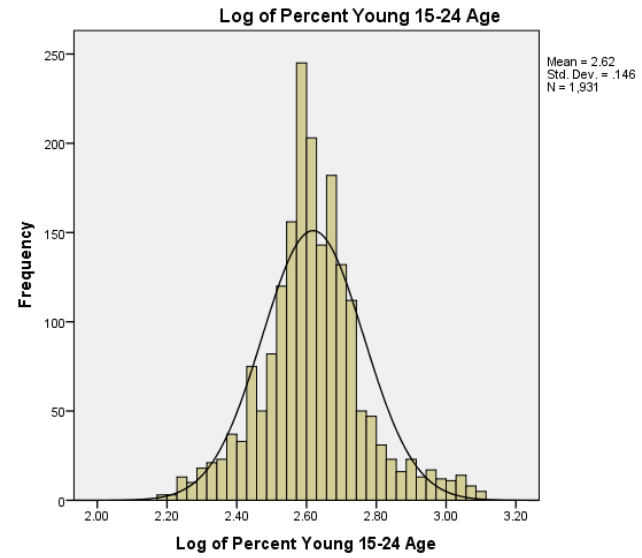
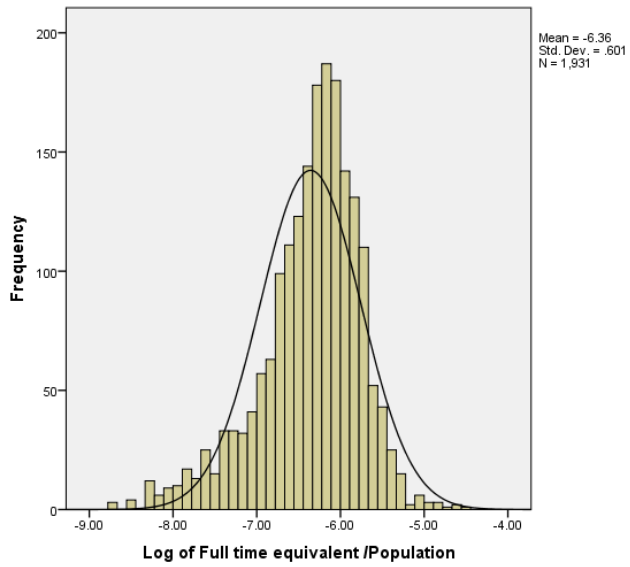
(Highlighted numbers indicate excessive numbers which are above limits of normality assumptions)

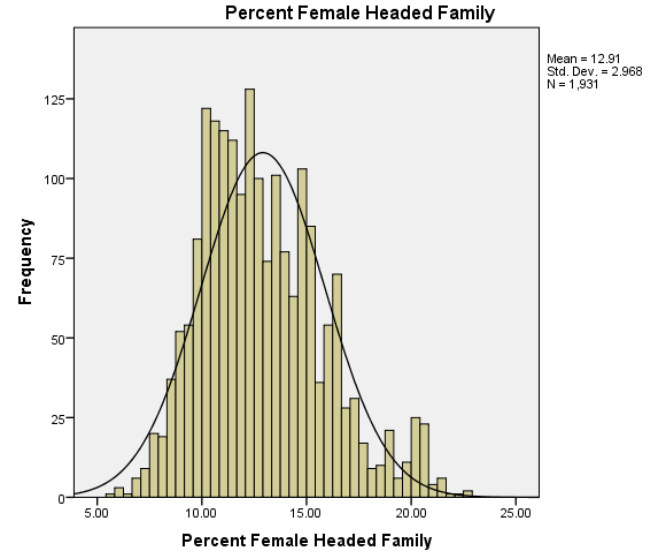
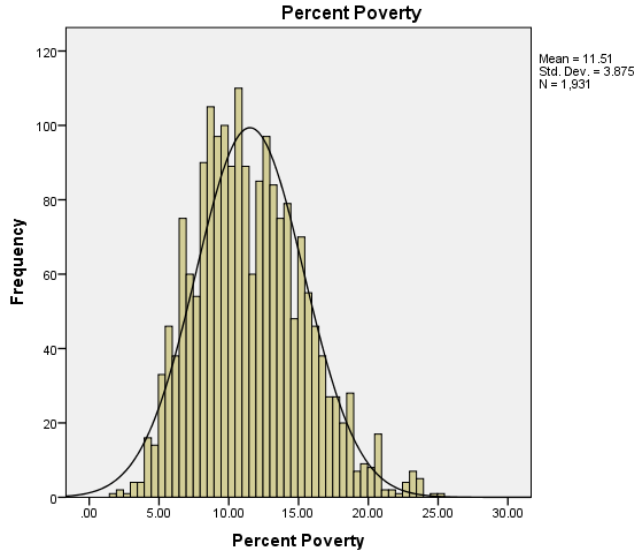
### Appendix 2: Frequency Histograms of Variables, below, Showing Normal Curve



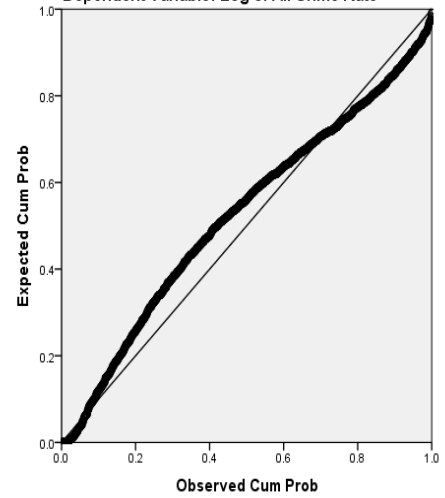








Normal P-P Plot of Regression Standardized Residual  
Dependent Variable: Log of All Crime Rate



### Appendix 3: Correlation Matrix

	X1	X2	X3	X4	X5	X6	X7	X8	X9	X10	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20
<b>X1</b>	1																			
<b>X2</b>	0.951	1.000																		
<b>X3</b>	0.991	0.902	1.000																	
<b>X4</b>	0.248	0.207	0.264	1.000																
<b>X5</b>	0.207	0.199	0.205	-0.201	1.000															
<b>X6</b>	0.275	0.250	0.278	0.135	0.035	1.000														
<b>X7</b>	0.114	0.097	0.117	0.029	-0.006	0.235	1.000													
<b>X8</b>	0.210	0.186	0.215	0.100	0.015	0.743	0.825	1.000												
<b>X9</b>	0.332	0.319	0.330	0.230	-0.036	0.426	0.183	0.394	1.000											
<b>X10</b>	0.141	0.139	0.139	-0.059	0.076	0.050	0.058	0.064	0.180	1.000										
<b>X11</b>	0.183	0.146	0.194	0.180	0.045	0.171	0.078	0.121	0.217	0.153	1.000									
<b>X12</b>	0.026	-0.002	0.043	0.477	-0.148	0.073	-0.014	0.026	0.125	-0.026	0.109	1.000								
<b>X13</b>	0.418	0.413	0.407	0.324	-0.230	0.043	0.030	0.045	0.167	-0.014	0.034	0.189	1.000							
<b>X14</b>	-0.01	-0.01	-0.02	-0.03	-0.01	0.038	0.03	0.024	0.029	0.062	0.008	-0.05	-0.03	1.000						
<b>X15</b>	-0.013	-0.006	-0.016	0.023	-0.033	-0.009	0.038	0.030	0.024	0.029	0.062	0.008	-0.049	-0.079	1.000					
<b>X16</b>	0.109	0.104	0.109	0.169	0.044	0.009	0.033	0.041	-0.013	-0.039	-0.020	0.176	0.087	0.044	-0.019	1.000				
<b>X17</b>	0.184	0.180	0.180	0.119	0.113	0.048	0.011	0.018	0.046	0.055	-0.028	-0.180	0.046	0.187	-0.125	0.156	1.000			
<b>X18</b>	0.204	0.217	0.192	0.205	0.074	0.037	-0.019	0.005	0.042	-0.001	-0.089	-0.166	-0.006	0.132	-0.072	0.393	0.394	1.000		
<b>X19</b>	0.158	0.191	0.137	-0.112	0.190	0.022	0.012	0.016	-0.012	0.053	-0.145	-0.384	-0.086	0.142	-0.099	0.267	0.677	0.713	1.000	

X1=Log all X2=logvio X3=logpro X4=Regions X5=Forofgov X6=Cmapping X7=Hotpsot X8=Compmap X9=Canunit X10=Copunit X11=SARA X12=Gender X13=logpop X14=logNumPol X15=logedu X16=logage X17=PrcNonwhite X18=Percpoverty X19=PerFemale

(Numbers which are in red colors indicate highly correlated variables that are above the limits of desired correlation levels)

#### Appendix 4: Multiple Regression Overall Crime Rate for all years (2000, 2003 and 2007)

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.737 <sup>a</sup>	.543	.536	.69019

**ANOVA<sup>a</sup>**

Model	Sum of Squares	df	Mean Square	F	Sig.
1 Regression	577.911	15	38.527	80.878	.000 <sup>b</sup>
Residual	487.321	1023	.476		
Total	1065.232	1038			

a. Dependent Variable: DV1-Log of Crime Rate Per 100,000 citizens

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	1.064	1.630		.653	.514
Computer mapping, GIS use	.029	.046	.014	.635	.526
Crime analysis unit	.197	.060	.079	3.293	.001
Community policing unit	.148	.045	.072	3.270	.001
Encouraged SARA	.214	.046	.106	4.682	.000
Log of Police Strength:	.920	.057	.480	16.237	.000
Professional government	-.268	.049	-.130	-5.432	.000
Log of Population	.724	.030	.639	23.845	.000
Log of Per. Young 15-24 Age	.090	.173	.012	.521	.603
Gender: Percent of male	-.062	.032	-.054	-1.931	.054
Per. Female headed family	-.002	.015	-.005	-.102	.919
Percent Non-white	-.001	.003	-.013	-.415	.678
Percent Poverty	.029	.009	.111	3.111	.002
Northeast, region	-.398	.074	-.152	-5.370	.000
, region	.101	.072	.035	1.405	.160
West, region	.175	.065	.078	2.697	.007

a. Dependent Variable: DV1-Log of Crime Rate Per 100,000 citizens



## Appendix 5: Second Regression, DV is Violent Crime Rate for 2000, 2003 and 2007

### Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.719 <sup>a</sup>	.517	.510	.76891

### ANOVA<sup>a</sup>

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	646.925	15	43.128	72.947	.000 <sup>b</sup>
	Residual	604.828	1023	.591		
	Total	1251.753	1038			

a. Dependent Variable: DV2-Log of Violent Crime Rate Per 100,000 citizens

### Coefficients<sup>a</sup>

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	.195	1.816		.107	.914
Crime analysis unit	.190	.067	.070	2.848	.004
Community policing unit	.172	.050	.077	3.426	.001
Encouraged SARA	.184	.051	.084	3.622	.000
Log of Police Strength:Full time equivalent / population	.986	.063	.475	15.623	.000
Professional form of government	-.288	.055	-.129	-5.249	.000
Log of Population	.789	.034	.642	23.322	.000
Log of Percent Young 15-24 Age	.098	.193	.013	.510	.610
Gender: Percent of male	-.078	.036	-.063	-2.175	.030
Percent Female headed family	.020	.017	.055	1.204	.229
Percent Non-white	-.005	.003	-.060	-1.810	.071
Percent Poverty	.023	.010	.082	2.242	.025
Northeast, region	-.466	.083	-.164	-5.637	.000
Miswest, region	.060	.080	.019	.754	.451
West, region	.061	.072	.025	.837	.403
Computer mapping, GIS use (Crimemapping+Hotspot)	.006	.052	.003	.113	.910

a. Dependent Variable: DV2-Log of Violent Crime Rate Per 100,000 citizens

## Appendix 6: Third Regression Analysis, DV is Property Crime Rate for 2000, 2003 and 2007

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.724 <sup>a</sup>	.524	.517	.70774

a. Predictors: (Constant), Computer mapping, GIS use (Crimemapping+Hotspot), West, region, Percent Poverty, Community policing unit, Professional form of government, Miswest, region, Encouraged SARA, Log of Population, Crime analysis unit, Log of Percent Young 15-24 Age, Percent Non-white, Northeast, region, Gender: Percent of male, Log of Police Strength: Full time equivalent / population

**ANOVA<sup>a</sup>**

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	564.296	14	40.307	80.470	.000 <sup>b</sup>
	Residual	512.915	1024	.501		
	Total	1077.211	1038			

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		S. Coefficients	t	Sig.	
	B	Std. Error	Beta			
	(Constant)	.139	1.654		.084	.933
1	Crime analysis unit	.203	.061	.081	3.313	.001
	Community policing unit	.146	.046	.071	3.157	.002
	Encouraged SARA	.226	.047	.111	4.833	.000
	Log of Police Strength	.892	.058	.463	15.404	.000
	Professional government	-.263	.051	-.127	-5.208	.000
	Log of Population	.700	.031	.614	22.487	.000
	Log of Per. Young 15-24 Age	.063	.177	.009	.357	.721
	Gender: Percent of male	-.048	.033	-.042	-1.476	.140
	Percent Non-white	.000	.002	-.006	-.221	.825
	Percent Poverty	.027	.007	.103	3.801	.000
	Northeast, region	-.397	.073	-.151	-5.419	.000
	Miswest, region	.110	.074	.038	1.495	.135
	West, region	.237	.066	.105	3.576	.000
	Computer mapping, GIS use	.039	.047	.019	.823	.411

a. Dependent Variable: DV3-Log of Property Crime Rate Per 100,000 citizens

## Appendix 7: Fourth Regression Analysis, DV is Overall Crime Rate for 2007

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.760 <sup>a</sup>	.578	.568	.66665

a. Predictors: (Constant), Computer mapping, GIS use (Crimemapping+Hotspot), Gender: Percent of male, Log of Percent Young 15-24 Age, Community policing unit, Miswest, region, Professional form of government, Encouraged SARA, Log of Population, Percent Non-white, Crime analysis unit, South,region, Percent Poverty , Log of Police Strength:Full time equivalent / population, Northeast, region

**ANOVA<sup>a</sup>**

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	371.903	14	26.564	59.774	.000 <sup>b</sup>
	Residual	271.984	612	.444		
	Total	643.887	626			

a. Dependent Variable: DV1-Log of Crime Rate Per 100,000 citizens

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		S. Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.775	1.988		.390	.697
	Crime analysis unit	.241	.095	.075	2.529	.012
	Community policing unit	.045	.056	.022	.812	.417
	Encouraged SARA	.079	.058	.039	1.365	.173
	Log of Police Strength	1.272	.081	.565	15.719	.000
	Professional government	-.249	.061	-.120	-4.104	.000
	Log of Population	.727	.037	.640	19.467	.000
	Log of Per. Young 15-24 Age	.381	.221	.050	1.726	.085
	Gender: Percent of male	-.028	.039	-.025	-.731	.465
	Percent Non-white	-.001	.002	-.009	-.301	.763
	Percent Poverty	.024	.008	.093	2.833	.005
	Northeast, region	-.605	.109	-.229	-5.565	.000
	Midwest, region	-.005	.099	-.002	-.055	.956
	South, region	-.147	.079	-.072	-1.864	.063
	Computer mapping, GIS use	.168	.061	.082	2.760	.006

## Appendix 8: Fifth Regression, DV is Violent Crime Rate for 2007

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.738 <sup>a</sup>	.545	.535	.75084

a. Predictors: (Constant), Computer mapping, GIS use (Crimemapping+Hotspot), Gender: Percent of male, Log of Percent Young 15-24 Age, Community policing unit, Miswest, region, Professional form of government, Encouraged SARA, Log of Population, Percent Non-white, Crime analysis unit, South,region, Percent Poverty , Log of Police Strength:Full time equivalent / population, Northeast, region

**ANOVA<sup>a</sup>**

Model	Sum of Squares	df	Mean Square	F	Sig.
1					
Regression	413.891	14	29.564	52.441	.000 <sup>b</sup>
Residual	345.018	612	.564		
Total	758.909	626			

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		S. Coefficients	T	Sig.
	B	Std. Error	Beta		
(Constant)	.570	2.239		.255	.799
Crime analysis unit	.195	.107	.056	1.812	.071
Community policing unit	.049	.063	.022	.779	.436
Encouraged SARA	.038	.065	.017	.586	.558
Log of Police Strength	1.341	.091	.549	14.721	.000
Professional government	-.288	.068	-.128	-4.217	.000
Log of Population	.788	.042	.638	18.719	.000
1 Log of Perc. Young 15-24 Age	.414	.249	.050	1.665	.096
Gender: Percent of male	-.057	.044	-.045	-1.291	.197
Percent Non-white	-.002	.003	-.023	-.741	.459
Percent Poverty	.029	.009	.103	3.043	.002
Northeast, region	-.534	.123	-.186	-4.360	.000
Midwest, region	.069	.112	.022	.612	.541
South, region	-.018	.089	-.008	-.204	.838
Computer mapping, GIS use	.145	.069	.065	2.111	.035

a. Dependent Variable: DV2-Log of Violent Crime Rate Per 100,000 citizens

## Appendix 9: Fifth Regression, DV is Property Crime Rate for 2007

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.748 <sup>a</sup>	.560	.550	.68309

a. Predictors: (Constant), Computer mapping, GIS use (Crimemapping+Hotspot), Gender: Percent of male, Log of Percent Young 15-24 Age, Community policing unit, Miswest, region, Professional form of government, Encouraged SARA, Log of Population, Percent Non-white, Crime analysis unit, South,region, Percent Poverty , Log of Police Strength:Full time equivalent / population, Northeast, region

**ANOVA<sup>a</sup>**

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	363.539	14	25.967	55.651	.000 <sup>b</sup>
	Residual	285.564	612	.467		
	Total	649.103	626			

a. Dependent Variable: DV3-Log of Property Crime Rate Per 100,000 citizens

**Coefficients<sup>a</sup>**

Model		Unstandardized Coefficients		S. Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.429	2.037		-.211	.833
	Crime analysis unit	.259	.098	.080	2.655	.008
	Community policing unit	.056	.057	.027	.972	.331
	Encouraged SARA	.094	.059	.046	1.594	.111
	Log of Police Strength	1.248	.083	.553	15.055	.000
	Professional government	-.239	.062	-.115	-3.842	.000
	Log of Population	.706	.038	.619	18.452	.000
	Log of Perc. Young 15-24 Age	.359	.226	.047	1.586	.113
	Gender: Percent of male	-.008	.040	-.007	-.212	.833
	Percent Non-white	.000	.003	-.002	-.052	.958
	Percent Poverty	.022	.009	.083	2.503	.013
	Northeast, region	-.651	.111	-.245	-5.840	.000
	Miswest, region	-.045	.102	-.015	-.438	.661
	South,region	-.205	.081	-.099	-2.532	.012
	Computer mapping, GIS use	.178	.062	.086	2.847	.005

a. Dependent Variable: DV3-Log of Property Crime Rate Per 100,000 citizens

## Appendix 10: Sixth M. Regression, DV is Overall Crime Rate for 2007 Crime Mapping IV

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.763 <sup>a</sup>	.581	.572	.66360

a. Predictors: (Constant), Crime mapping: Use of first level GIS, Percent Non-white, Log of Population, Community policing unit, Log of Percent Young 15-24 Age, Encouraged SARA, Miswest, region, Professional form of government, Gender: Percent of male, South,region, Percent Poverty , Crime analysis unit, Log of Police Strength:Full time equivalent / population, Northeast, region

**ANOVA<sup>a</sup>**

Model	Sum of Squares	Df	Mean Square	F	Sig.	
1	Regression	374.384	14	26.742	60.726	.000 <sup>b</sup>
	Residual	269.503	612	.440		
	Total	643.887	626			

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		S. Coefficients	t	Sig.
	B	Std. Error	Beta		
1	(Constant)	.488	1.981	.246	.806
	Crime analysis unit	.084	.112	.026	.748
	Community policing unit	.047	.056	.023	.851
	Encouraged SARA	.093	.057	.046	1.632
	Log of Police Strength	1.274	.080	.566	15.889
	Professional government	-.236	.060	-.114	-3.906
	Log of Population	.735	.037	.646	19.948
	Log of Per. Young 15-24 Age	.394	.219	.052	1.797
	Gender: Percent of male	-.027	.039	-.023	-.695
	Percent Non-white	-.001	.002	-.006	-.204
	Percent Poverty	.022	.008	.085	2.610
	Northeast, region	-.577	.108	-.218	-5.322
	Miswest, region	.014	.099	.005	.138
	South,region	-.126	.079	-.061	-1.600
	Crime mapping: First level GIS	.375	.103	.125	3.650

a. Dependent Variable: DV1-Log of Crime Rate Per 100,000 citizens

## Appendix 11: Sixth M. Regression, DV is Overall Crime Rate for 2007 (Hotspot Analysis)

**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.759 <sup>a</sup>	.576	.566	.66788

a. Predictors: (Constant), Hotspot Identification: Use of second level GIS, West, region, Percent Poverty , Community policing unit, Professional form of government, Miswest, region,

Log of Population, Encouraged SARA, Log of Percent Young 15-24 Age, Percent Non-white, Crime analysis unit, Northeast, region, Gender: Percent of male, Log of Police

Strength: Full time equivalent / population

**ANOVA<sup>a</sup>**

Model	Sum of Squares	df	Mean Square	F	Sig.	
1	Regression	370.892	14	26.492	59.390	.000 <sup>b</sup>
	Residual	272.995	612	.446		
	Total	643.887	626			

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		S. Coefficients	t	Sig.	
	B	Std. Error	Beta			
1	(Constant)	.601	1.956	.307	.759	
	Crime analysis unit	.258	.095	.080	2.708	.007
	Community policing unit	.048	.056	.024	.858	.391
	Encouraged SARA	.081	.058	.040	1.407	.160
	Log of Police Strength	1.276	.081	.567	15.729	.000
	Professional government	-.249	.061	-.120	-4.093	.000
	Log of Population	.730	.037	.642	19.531	.000
	Log of Per. Young 15-24 Age	.392	.221	.051	1.773	.077
	Gender: Percent of male	-.029	.039	-.025	-.738	.461
	Percent Non-white	-.001	.002	-.009	-.309	.758
	Percent Poverty	.024	.008	.093	2.828	.005
	Northeast, region	-.456	.089	-.172	-5.115	.000
	Miswest, region	.134	.089	.046	1.502	.134
	West, region	.146	.079	.063	1.848	.065
	Hotspot: Second level GIS	.141	.061	.068	2.307	.021

a. Dependent Variable: DV1-Log of Crime Rate Per 100,000 citizens

## VITA

Ulvi Kun was born in Bursa, Turkey in 1973 and he is a Turkish citizen. He graduated from Ankara Police College in 1991 and he holds a B.A. degree from Turkish National Police Academy. After his graduation in 1995, he was appointed to the Ankara Police College as a first level police manager and trainer. Then, Vocational Police High School (PMYO) Erzurum became his second appointment for completion of a mandatory assignment between 2002 and 2012. One of his articles “Preventing Terrorist Attacks to Critical Infrastructure(s) by Use of Crime Prevention through Environmental Design” (English) was published in 2007 which was a proceeding of the NATO Advanced Research Workshop on Terrorist Operations in Washington DC. During his assignment in Erzurum PMYO, he was assigned as a mid level police administrator and director of education department for the high school for two years. At that term, his article which magnifies the German Police Organization (Turkish) was published in National Turkish Police Magazine. Later, he was appointed to the Center for Police Studies in Erzurum as a manager and a researcher. In May, 2013, his article on Human Recognition and Communication (Turkish) was published by Turkish National Police Academy Publications. In September, 2013, Turkish Interior Ministry provided a scholarship as a study abroad where he focused on City Security Systems in United Kingdom. His study on the subject will be published as another book chapter within 2014 by Turkish National Police Academy Publications. Lately, he was appointed to the Turkish National Police Academy, Ankara as a lecturer. Since then, he has been serving as a chief superintendent and researcher as well. Ulvi Kün is married with Sıdıka Kün and the family has two children. Their names are Yusuf and Nida.



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<sup>i</sup> “Evolving Strategy of Policing” is a historical study of American policing in the twentieth century (Kelling and Moore, 1988). The political era is introduced with close ties between police and politics in the study (1988). The time period discussed is from the 1840s to the early 1900s, which is partly different from Fogelson’s focus (1977). The political era of policing was explained as a primarily political term in authorization, functioning in crime control, order maintenance and broad social services. The nature of the organizational design was decentralized and geographical; the relationship to the environment was close and personal. The demand was “managed through links between politicians and precinct commanders, and face to face contacts between citizens and foot patrol officers” (1988, p.4). Foot patrol and rudimentary investigations were the primary tactics at this time. Police success was measured as political and citizen satisfaction with social order as the outcome.

The reform era was developed in reaction to the political era in the 1930s according to authors (1988, p. 5-9). The era thrived in 1950 - 1960s and began to go downhill in the 1970s. The reform era included both basic and new elements of policing. The authorization legitimacy of policing stemmed from both law and professionalism during this term. The function of policing was primarily crime control and organizational design and was classically centralized. The relationship to the environment was professionally remote, and demands were channeled mainly through central dispatching activities. At this time, the tactics and technology of policing relied more on preventive patrol and rapid response to service calls. Police success and failure were measured mainly as crime control. Specifically, “the primary measures of police effectiveness was the crime rate as measured by the Uniform Crime Reports” (1988, 7). Number of arrests, response time, and number of passing police were also used as additional measures of police effectiveness during this time.

According to Kelling and Moore, the Reform era has been seen as diminishing and giving way to a new era: “community problem solving” (1988, p.10-13). Law has been mentioned as the continuing major legitimating foundation for policing in the community strategy era. The idea of isolating the police from the neighborhood has lost strength during this time and community support has become the more powerful source of authorization. Police function has broadened with the inclusion of crime prevention and problem solving efforts in addition to crime control. The organizational design of the police has become more decentralized. Newly opened stations, reopened precincts in neighborhoods, and the establishment of beat offices in schools and churches are examples of decentralization. The police defend the values of law and professionalism but they also listen to community concerns as this solidifies their relationship to the environment. Citizens are encouraged to report only emergencies via 911; other reports have been channeled through other means in order to understand underlying factors. Problem solving efforts were added to existing patrol servicing at this time. Increasing quality of life in the neighborhoods became a measure in addition to citizen satisfaction as the outcome of the policing. According to Reiss (1992, 91), “(c)ommunity policing may be viewed as a reaction against the centralization of command and control in a police bureaucracy”. He (1992) concludes his statements about the evolution of policing by saying that “(p)olice organizations do not stand still. They undergo continuous, often imperceptible, change”.

<sup>ii</sup> The Kansas City Preventive Patrol Service Experiment changed the police view on traditional patrol service with cars. According to Kappeler and Miller (2006), preventive police patrols in cars was the dominant policing strategy in the post World War II period. The experiment was held between 1972 and 1973 and it was evaluated by the Police Foundation (Kelling, Pate, Dieckmann and Brown, 1974). Kelling et al. (1974) stressed the importance of preventive police patrols by calling them the ‘backbone of police’ and ‘a primary function of policing’ in their Kansas City study. In the study, five beats were selected for the experiment. Five of these beats were labeled as “reactive” beats and were entered only in response to calls of residents. Another five were labeled as “proactive” beats as they were patrolled two or two more times than in the case of a normal service. And, the final five beats were assigned a normal routine patrol as the “control” group. Data was collected from “victimization surveys, reported crime rates, arrest data, a survey of local businesses, attitudinal surveys, and trained observers who monitored police-citizen interaction” (Police Foundation, 1974). The essential finding of the experiment is that: “decreasing or increasing routine preventive patrol within the range tested in this experiment had no effect on crime, citizen fear of crime, community attitudes toward the police on the delivery of police service, police response time, or traffic accidents” (Kelling et al., 1974, 28). These findings implied that the police should focus on targeted

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preventive patrol servicing instead of routine ordinary patrol service. Bayley (2006) identifies the importance of this study as the presentation of increasing effects of patrol visibility. Another study, the Newark Foot Patrol Experiment in 1981, found parallel results to the Kansas City experiment and here it was determined that actual crime was not affected by foot patrols. The limits of the Kansas City experiment was claimed in terms of its representation (Sherman, 1993), methodologies (Farrington, 1982), and used patrol dosage (Larson, 1975). Although some criticized the design of the study, the Kansas City Police Experiment produced a big impact on the police and police researchers (7).

Separation of emergency and nonemergency calls in a patrol unit was examined by Tien, Simon and Larson (1978). 20.6% more calls were experienced in an emergency call group that increased back up car service by 2.6%. In this group, an 18% increase was found in manpower efficiency. The other group, called 'crime prevention,' showed a 105.5% increase in crime clearances and arrests. This improvement occurred because of the rise of immediate follow up after commission of a felony. Additionally, this improvement led 61.4% decrease in detective bureau's clearance rates. Overall response time did not change in this study. This study suggests that mitigated function oriented approaches are needed while managing detective workloads. In summary, the separation enabled more efficiency in routine service calls and an increase in arrest rates.

Traditional police response in terms of type of contacts (Dean, 1980), rapid response (Spelman & Brown, 1981 & 1984) and differential police response (McEwen, Connors, and Cohen, 1984) were questioned. In Dean's (1980) study, citizen ratings of the police were examined in terms of type of contacts. Favorable attitudes towards the police were found to be relevant to police citizen contacts. Specifically, four types of contacts were analyzed: contacts with victims, contacts for assistance, contacts to stop the citizen, contacts of citizens for information need. When only the number of contacts was measured, little influence of citizens' ratings was found. Noticeably, the police style of handling contacts was found to have a very strong impact on citizen ratings. This means that citizen satisfaction may vary depending on the contact type. Spelman and Brown (1981 & 1984) examined how the assumption of rapid response to citizen calls would improve the police effectiveness in connection with suspect apprehension. The study was conducted in Jacksonville, FL.; Peoria, IL; Rochester, NY; and San Diego, CA. Around 4000 victims, witnesses, and bystanders were interviewed about 3,300 serious crimes. Specifically, police response time and citizen crime reporting were examined. The findings of the study are very parallel to the conclusion of the Kansas City study. Citizen reporting time was found to be more important in the case of arrests at the scene than the police response time. Indeed, rapid response to events was found to be necessary in only one out of four cases that led 29 cases out of 1000 to lead to suspect apprehension. No substantial effect was found in the arrests if citizens delay response time. The efforts of the police in reducing response time will increase the likelihood of apprehension when it is combined with speedy reporting. Various causes were also found in this study as explanatory of the delay in reporting crime. In fact, the highlight of the study was that the reporting time of the citizen is more influential than police response time. The differential police response (DPR) approach was examined in three cities by McEwen, Connors, and Cohen (1984). The DPR system enabled alternative responses for screened calls. Four different response types were considered in these implementations. This approach resulted in sizable reductions in nonemergency calls for an immediate dispatcher unit. This enabled more time which was devoted to focus on crime prevention, directed patrol and other policing activities. DPR application showed a high level of satisfaction in surveys when the calls were handled as emergency and nonemergency calls. Evaluation of the DPR model concluded with support for the DPR model application by police agencies in varied environments.

Some scholars also questioned the investigation effect of the police on crime (Greenwood & Petersilia, 1975; Chaiken & Greenwood & Petersilia, 1976). The Criminal Investigation Process within the police of serious reported crimes was examined over two years by Greenwood and Petersilia (1975). The findings indicate that traditional policing approaches to criminal investigation do not affect the rates of solved cases. Routine administrative procedures provided solutions for most of the cases and investigative efforts were advised to be lessened or shifted to a new unit to improve the effectiveness of the process. Criminal apprehensions would be increased if investigative

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work could be refined. It was also claimed that a higher apprehension rate could be achieved by enhancing investigations than by enhancing patrol and citizen cooperation. The study (1975) suggests a reduction in follow up investigations (except serious crime), the establishment of a new unit to investigate major-serious crimes, preparing strike forces, and shifting post arrest investigations to the prosecutor. The criminal justice process was examined in municipal and county police departments by Chaiken, Greenwood, and Petersilia (1976). It was found that criminal investigators spend 7% of their time on crime solving activities. Half of the investigators worked in post arrest processing. It was also stated that collected evidence can be more helpful for crime solving when the police have evidence processing capabilities. In summary, it was found that traditional criminal investigations have little effect on resolving crime cases. These and similar studies constituted a new mindset that stresses that the traditional police are not as influential as they are supposed to be either in crime prevention or crime control (Gottfredson & Hirschi, 1990; Bayley, 1995).

Eck (1983) analyzed investigative data on burglary and robbery in three jurisdictions to understand the role of detectives, police officers and other contributors and its effect on investigations. He found that detectives and police officers were equally contributing to solve robbery and burglary cases. The follow up work of detectives was determined to be of importance in identifying and arresting the suspects. In this process, investigators stayed dependent on the provided information of victims, witnesses, informants, colleagues and police records.

Skogan (1979) examined available information to police to explore the limits of police productivity in inapprehension. He hypothesized that “an important determinant of the ability of the police to apprehend criminal is information”. The assumption was that the inability of the police to reach adequate information limits police capacity to solve crimes. The evidence of the study suggests that if the police rely on only readily available information resources, their ability will not be much better. It was suggested that more information could be collected from victims, witnesses, bystanders and patrols to solve more crimes if the police had better strategies to elicit, record and analyze.

The police strength and its effect on crime were also questioned under the economic theory in Detroit by Loftin and McDerwal (1982). In general, they found no evidence in connection to the systematic relationships in proposed economic theory considering the attributes of organizational and political variables. Although their findings are mixed in the case of most propositions, they report that a small relationship can exist between hiring additional police and violent crime.

<sup>iii</sup> The team policing concept is known as an early innovation and a departure from traditional policing (Sherman & Milton, 1973; Schwartz & Clarren 1977; Albright & Siegel, 1979). In 1967, the President Commission suggested that “police departments should commence experimentation with a team policing concept” (Ryan, 2003). The idea of team policing was to balance the efficiency needs of centralized police administration and to respond adequately to decentralized community needs (Sherman and Milton, 1973). The implementation phase included deployment of adequate quasi autonomous patrol teams in neighborhoods in order to improve police service delivery and job satisfaction. This approach was examined in seven U.S. cities and field experiences in planning, implementation and evolution were observed by Sherman and Milton (1973). Findings showed both success and shortcomings in these cities. Another experimental study was designed to measure team policing effectiveness over a 30 month period in Cincinnati, Ohio (Schwartz & Clarren 1977). According to findings, team policing was found to be more beneficial during the first 18 months, however, its satisfactory benefits diminished for the most part thereafter and decentralized management decisions started to undermine the policing efforts. Furthermore, team policing and its transformation into neighborhood team policing were debated (Albright & Siegel, 1979). Consequently, experiences and their mixed results diminished the prevalence of team policing in the U.S. police departments.

<sup>iv</sup> Computer aided dispatch (CAD) support in community policing was studied by McEwen in 2002.