CRIME AND RISK MAPPING FROM HISTORIC

COUNT DATA IN LEICESTER CITY

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ABSTRACT

This thesis map crime and risk of three crimes from the historic count data in

Leicester city from 1999/2003. Observed risk is assess by mapping the crime data and

normalized with beat area and population density. As a result of the normalization

different pattern emerges, these reveal the ability the GIS to show risk when

normalized using different denominators.

Objective risk is measured by statistical relationship between the various socio-

economic factors or variables that are used as surrogate to arrive at the statistical view

of risk. To arrive at the statistical view of risk, these variables are regressed against

crime. The model of mathematical risk assessment is the main focus of the current

study. Using mathematical method risk assessment can be objectively defined so that

two people can take the same data and come up with a similar result. The result of this

study may be useful for insurance industry, police operation and decision making.

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CHAPTER ONE

BACKGROUND TO THE STUDY

1:1 INTRODUCTION

The geography of crime, which focuses on understanding the interplay between crime, space and society through analysis of offences, offenders and the effects of crime, can usefully be explored using Geographic Information System (GIS). Crime mapping replaces the traditional paper "pin-maps" to indicate criminal activity in an area. It involves 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 user (Hirschfield and Bowers 2001). Information derived from crime mapping includes the location of 'hotspots' or relatively high reported crime rates, which is helpful to patrol officers. With crime mapping it is also possible to infer the underlying processes that are causing a particular crime cluster. The types of crime, spatial patterns in the sequence, and location of a series of related crime events, can be explored. This is helpful in a deductive form of enquiry that can provide intelligent support for criminal investigations. The graphical displays for viewing crime data make the information more understandable, and therefore accessible, to less technologically experienced policy makers.

Geographically referenced data will greatly improve the chances of accurate 'hits' when searching for incidents of repeat victimization. Other information such as the street network and land use pattern can be super-imposed upon the crime map to search for relationships between risk factors and victimization and, thus provide a more holistic view of crime in its environment. The spatio-temporal changes and

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distribution of crime can be monitored over time and related to various crime prevention measures and policing.

GIS can also be used to integrate digital orthophography with other information about an area to give the line officer a more 'fleshed out' picture (La Vigne and Groff 2001). Orthophotos provide a more realistic, detailed picture of the environment and can be linked with GIS to enable the analysis of crime with more specificity. Other data such as health, economic and social service data can be integrated into crime data in collaboration with other city and county agencies in an effort to pool resources and to address public safety problems in a comprehensive manner.

Vigne and Groff (2001) trace the evolution of crime mapping in the United States, from the descriptive to the analytic. They point out that the diffusion of GIS into crime analysis has been slow primarily because of cost (hardware, software, and training) and complexity. However in the late 1980s GIS became available at a more reasonable cost and as a result a number of police departments began to experiment with mapping and GIS programmes. Hirshfield and Bowers (2001) present a number of recent and largely European studies. Such studies are largely based on the mapping of observed crime.

The various studies reviewed all attempted to map crime hotspots which show the heaviest cluster of criminal activity. The overall objective of such work was to assist law enforcement agents in carrying out their duties more effectively and demonstrate the need for community partnership in crime control.

This study will map crime and the risk of crime. Estimation of risk based upon observed data can be done in several ways: firstly, from the trend of historical count data, second, by modelling, third, by analogy with similar situations and if no data is available, fourth, by comparison with similar activities has been employed to assess risk (Royal Society 1992). In the current study the risk estimate will be done by using the historic count crime data. Such map will display the spatial variation in the crime trend over the years.

According to Johnston et al (2000) population density is the number of people in relation to the space that they occupy. Johnston et al (2000) argued that the simplest measure, crude density of population, is the number of people per square kilometre or other unit area and is most useful for small units such as counties. They concluded that for urban areas, measures such as persons per room, per house or unit area are useful refinements. Therefore, the standardization/normalization is done against population density. Also population is an important basis for resource allocation and planning.

Area is also used in the standardization/normalization because an area is the measurement of the extent of part of surface enclosed within a boundary (Bloomsbury, 2001). The unit area is related to the areal differentiation of the beat. Normalizing against beat area will reveal the spatial across the city. The physical, social and human interaction takes place in space. Crime occurs in a location and the location of any crime is in space. Using area which is a measure of physical boundary will be another way of displaying or analysing the risk of crime.

The normalization is done in the ArcMap using the area and enumeration district as parameters to measure risk across the police beat. Through this process one can evaluate the risk posed to human or property by the use of a specific socioeconomic variable. There are many views to risk for clarity various terms such as observed, objective and subjective risk will be defined. One view is the probability of an occurrence of an event with an adverse effect and severity of that effect (World Health Organization 2003).

1:1.1 OBSERVED RISK

Observed risk can be defined as occurrence, for instance crime the probability of occurrence or hazards directly from historic count data (Royal Society 1992). In the current study, observed risk is assessed through mappings based on police recorded crime data between 1999 and 2003 in Leicester. The crime figures are normalized or standardized by the area and population of enumeration district to derive the observed risk. While this provides a useful measure of crime risk in an area, these are unweighted indexes; therefore a more rigorous computation is required to arrive at risk estimate. The problem is addressed in the current study by the estimate of objective risk through the use of mathematical and statistical analysis.

1:1.2 OBJECTIVE RISK

According to Bernstein (1983 p 8) objectivity is the basic conviction that there is or must be some permanent, ahistorical matrix or framework to which we can ultimately appeal in determining the nature of rationality, knowledge, truth, reality, goodness or rightness.

Objective risk can be defined as the statistical view of risk (Royal Society 1992 p 94). By statistical inferences from historical occurrence data derived from past circumstances similar to the current issue at hand. In the current study, past crime data is combined with the census variables. Therefore, using these definitions, objective risk is measured using modelled relationship between the various socio-economic variables understand to affect crimes of different types. In this study, the statistical view of risk is arrived at by regressing the variables age, ethnicity (race), employment, tenure amenities, lone parent and car against crimes of different types. The mathematical method of risk assessment is objective in the sense the result are replicable given identical data, although the immediate choice of underlying ambiguity variables is acknowledge as objective.

Risk is the combination of a specific hazard and the likelihood that the hazard occurs (probability)*(hazard) = risk (World Health Organization 2003). In other words, (probability)*(hazard) = risk. To arrive at the statistical view of risk, these variables are regressed against crime. The surrogate variables used in current study include age, ethnicity (race), employment status, lone parent, tenure amenities and car. These factors may be are related to crime and affect personal or property risk assessment especially when risk is view as the probability that an adverse event (or series of events) will occur.

Risk analysis can be done qualitatively or quantitatively (Cobra 2003). Qualitative risk analysis only estimated potential loss is used by analysing interrelated elements such as threats, vulnerabilities and controls. The quantitative risk analysis objective risk by employing the probability of an event occurring and the likely loss should it

occur. In the risk literature quantitative risk analysis makes use of single figure produced from probability and loss. This generally called 'loss expectancy'. This is calculated for an event by multiplying the potential loss or magnitude by the probability. Thus it is possible to rank events in order of risk and make decision based upon this. The problem is addressed in the current study by the estimate of objective risk through the use of mathematical modelling.

The risk of victimization or attack should commensurate with security. The process to determine which security measures and controls are appropriate and cost effective, is quite often a complex and sometimes a subjective matter (Cobra 2003). Cobra (2003) argued that one of the prime functions of objective risk analysis is to put the process of risk minimization or security onto more objective basis using mathematical modelling.

1:1.3 SUBJECTIVE RISK

Subjectivity focus on the meanings that people give to their environment, not the environment itself (May 2001 p13). Subjective risk has been defined as people's perception of risk (Royal Society 1992 p 98), while Otway (1990) suggested that subjective risk is concerned with hazard or technology perception. What is common to the above definitions is perception. That is how human being perceives their environment. The psychological risk can be related to how people perceive risk and involves people's belief, attitudes and feelings. Subjective risk is not addressed in the current study because it will be involve other method that is not used in the current study.

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1:2 STATEMENT OF THE PROBLEM

This study begins by mapping and analysing the observed risk of crime, and moves on to develop models of risk that may provide qualitative information of the type that may aid policing resources allocation and decision making. Observed risk has been assessed by mapping of spatial temporal pattern and hotspot of historic count crime data, while objective risk will be calculated by the relationship of socio-economic factors to crime occurrence.

1:3 AIM AND OBJECTIVES

The research is aimed at mapping crime and analysing objective risk of crime in a geographic information environment for policing resource allocation. Towards this end the specific objectives of the study are:

To map crime via hotspot and spatial temporal pattern of crime as observed risk

To assess objective risk by mapping crime regressed against socio-economic indicators.

1:4 CHAPTER SUMMARY

This chapter has described the aim and objectives of this study. This aim is to map crime and show the spatial variation during the period from 1999/2000 to 2002/2003 financial year. The objectives are to build overall crime risk model and may be useful to predict the potential future crime pattern. The types of risk have been identified and described. The next chapter is the review of the literature that is relevant to the current study.

CHAPTER TWO

LITERATURE REVIEW

2:1 INTRODUCTION

The purpose of this chapter is to review previous studies of the geography of crime to place the current study wider body of academic literature and to justify the aims of this study. There is an extremely diverse ranges addressing issues of crime include studies relating to urban crime (Herbert, 1982), behavioural geography and criminal behaviour (Regert 1989), the micro-environments of violence (Davison 1989), social relations, neighbourhood structure and fear of crime (Smith 1989), policing the criminal (Mawby 1989), a combination of qualitative analysis and ethnographic data to analyse vulnerability (Hope and Foster 1992), the importance of multiple victimization (Ellingworth et al. 1995), objective and subjective measures of personal vulnerability, (Clerigi and Killias 2000), measures security against residential burglary (Evans (2001), the relationship between crime and city (Mawby and Simmonds 2004), the frequently stolen items (Wellsmith and Burrell 2005) and the geography of urban crime (Knox and Pinch 2006).

Many studies have employed GIS, with studies addressing repeat victimization (Ratcliff and McCullagh, 1998), mapping crime principle and practice (Harries 1999), domestic burglary (Craglia et al, 2000), methods for automating the geographical analysis of crime incident data (Turton and Openshaw, 2001), combating crime through partnership (Chainey, 2001), GIS and journey to crime (Costello and Wiles,

2001), GIS and spatial analysis examining crime occurrence (Murray et al 2001), mapping crime and community problems (Hubbs, 2003) and operationalizing GIS to investigate serial robberies (Hill, 2003).

The aim of the current study is to estimate the risk of victimization from four years historic crime data. Therefore, this literature will focus solely on previous studies related to risk of victimization. The review is divided into three broad sections. The first section is on risk of victimization as a general issue. In this section, previous studies on social economic variables are reviewed and grouped and discussed under the following subsections; target and location, vulnerability, economic gain, age, population density, and ethnicity. This theme is related to the surrogate socio-economic variables used in objective risk analysis.

The second section covers victimization and the built environment. A crime occurs when four things concur: a law, an offender, a target and a place (Brantingham and Brantingham 1981). Brantingham and Brantingham (1981) argued further that without a place in time and space where the other three come together, there is no crime. It is this element of spatial dimension that is crucial to the geography of crime. The current study is placed within a city environment and one of the major characteristics of a city is its built environment. Evans and Herbert (1989) further argued that urban environment plays an important part in the social conditions, which in turn affects crime. The discussion in this section is classified under environmental improvement and neighbourhood.

The third section covers the previous application of GIS in crime analysis. The studies reviewed in this section cover a range of crimes, but the underpinning theme is the application of GIS. These articles introduce hotspot mapping and the diffusion of GIS as a technology in the police service.

2:2 RISK OF VICTIMIZATION

(a) TARGET AND LOCATION

It was pointed out earlier that for crime to occur, both target and a place must combine with other factors. Target in this case refers to the object or the victim of the criminal events. The location refers to the specific place or site where the crime is committed. This discussion of the reviewed literature is centred on distance travel (distance barrier) to commit an offence and the economic returns from the criminal act. The emphasis in this subsection is target which may be related to economic returns.

Box et al. (1988) study the risk of victimization and fear of crime in United Kingdom, using the data from the British crime survey and concluded that factors such as gender, age, race, neighbourhood cohesion, confidence in the police, level of local incivility, experience of victimization, perception of risk and assessment of offence seriousness combine to form a theoretical account of 'fear'. The authors pointed out that many people are haunted by the thought that a stranger could pounce on them at any moment on the street, at home and rob, assault or in case of female victims, rape. The fear of crime is regarded as a major social problem that attracted the attention of social scientist for the past decades. Box et al. (1986) stated that the consequences of fear of crime are numerous: it fractures the sense of community and neighbourhood

which transform some public places into no-go areas (Morgan, 1978; Wilson, 1975), because fear of victimization leads to more prosperous citizens protecting themselves and their property or moving from the neighbourhood (Sampson and Wooldredge, 1986), the incidence of crime may be display on those already suffering other social and economic disadvantages (Lea and Young, 1984); it reduces the appeal of liberal penal policies such as decarceration and rehabilitation, thus paving the way for more incarceration and punishment (Cullen at al. 1985; Hough 1985; Langworthy and Whitehead, 1986); it creates a seed-bed of discontent from which vigilante justice might flourish and thus undermines the legitimacy of the criminal justice system, particularly when courts are seen as being soft, displaying more compassion for the offender than the victim.

Furthermore, people afraid of being criminally victimised or becoming a crime target change their habits (Garofalo, 1981; Krahn and Kennedy, 1985; Rigel et al., 1982; Skogan, 1986). They tend to stay at home more, in surroundings they have made safer (income permitting) with locks, chains, bars and alarms. When they do go out, they tend to avoid activities, which they perceive as dangerous. Each excursion beyond the relative safety of home is like walking through a minefield.

Research has suggested that the following factors are considered to be responsible for fear of crime and victimization. Many citizens may feel vulnerable for a number of reasons such as inability to physically or economically protect themeselve, and to be incapable of making a fast retreat, while others may feel less able to cope with the emotional consequences of being a victim (Toseland, 1982). Research has identified four groups who fall into this vulnerability category: the old (Antunes et al., 1977;

Baldassare, 1976; Clarke and Lewis, 1982; Giles-Sims, 1984; Jaycox, 1978; Jeffords, 1982; Miethe and Lee, 1984; Yin, 1980, 1982), women (Gordon et al.1980; Riger, 1978; Warr, 1984, 1985), the poor and ethnic minorities (Taylor and Hale, 1986).

People may come to be fearful of criminal victimization because they perceive their immediate environment to be threatening. Thus noisy neighbours and loud parties, graffiti, teenagers hanging around the streets corners, drunks and tramps on the street, rubbish and litter lying around, boarded-up houses and flats with broken windows may all signify to some individuals that the neighbourhood is declining, disorderly, unpredictable and threatening (Hunter and Banmer 1982; Lewis and Maxfield, 1980; Maxfield, 1984; Taylor and Hale, 1986; Wilson and Kelling, 1982). A feeling that the immediate neighbourhood is in economic decline and the community changing for the worst may produce not only a generalized anxiety but also, a specific fear of crime (Eve and Eve, 1984). In addition, some individuals without social support to help them through a post-victimization period may feel isolated and therefore afraid. Thus people without friends in the neighbourhood will probably fear crime more because they feel they would be unable to cope with it (Hartuagel, 1979). The absence of friends might be mitigated where people perceived that their neighbours helped each other, hence creating a strong sense of neighbourhood cohesion and community (Kennedy and Silverman, 1985; Silverman and Kennedy, 1985).

The knowledge of crime can result in fear of victimization. For instance, a commonly accepted belief that people who have been victimized, particularly in their neighbourhood or know others who have been similarly victimized will tend to be more afraid (Balkin, 1979; Hough, 1985; Skogan, 1987; Stafford and Galle, 1984).

Media reports can also promote fear of crime. Baker et al. (1983), Garofalo (1981) and Heath (1984) all support the view that when the press portrays a particular image of crime-random choice of victims, criminal behaviour and victimization risks. The public perception of police being effective and efficient at clearing-up crimes and apprehending criminals, responding to calls quickly and having a physical presence on the ground all lead to lower levels of crime (Baker et al. 1983; Krahn and Kennedy, 1985). Recent victims may not develop fear if they believe that the police will arrest the culprits and justice will prevails.

Ellingworth et al. (1995) show the importance of multiple victimization in determining crime rates using the first four of the British crime survey (1982-92). The patterns of property and personal crime victimization were investigated. They point out that all official sources of crime information are misleading, because they fail to highlight the extent to which crime victimization is concentrated on particular individuals and households. Previous crime statistics in England and Wales remain the definitive source of crime information for political and media purposes. Crimes known to police are aggregated and subdivided by type and police beat. Nowhere is there any indication as to how crime victimization is shared between citizens. Police recording systems in the author's view are inadequate in identifying repeat victimization of the same dwellings or the same people. However, their study confirms the notion that crime victimization is heavily concentrated on a small proportion of the population.

However, Hough and Mayhew (1983) in their analysis of the British crime survey concluded that although elderly people are more likely to feel unsafe on the streets

after dark, they are no more worried about burglary or assault than younger people. The principle concern expressed by the elderly is "being mugged". This specific fear, the concern about mugging makes them appear to feel unsafe outside at night (Mawby, 1988).

Pain (1995) argues that gender composition has an adverse effect on fear of crime. Gender is the strongest predictor of fear of crime in old age (Clarke and Lewis 1982; Smith, 1989). Two thirds of elderly people in the United Kingdom are women (Equal Opportunities Commission, 1993). Women are far more concerned about crime, particularly interpersonal violence than men.

Pain (1995) assesses the relationship between the risk of victimization amongst the elderly. His study shows the chances of victimization, the temporal and spatial parameters to conceptualisation of risk. Cook et al. (1978) Todd (1981) Feinburg (1981) and Yin (1980) all assert that crime has a greater impact on elderly people and it can have a severe effect on their quality of life. On the otherhand, Clarke and Lewis 1982, Cutler (1980), Hough and Mayhew (1983) and Mayhew et al. (1993) argue that while elderly people seem to suffer as much or more from the fear of crime as young people, they appear to be the least likely of all groups to be victimized. In the Islington crime survey, for example, only 15 per cent of those who reported having been victims of violence are aged over 45 years (Jones et al 1986). On this basis Hough and Mayhew (1983) describe fear among elderly people as an irrational phenomenon which ought to be tackled on a separate footing to the actual crime occurrence.

Mawby (1988) stresses that greater seriousness of crime for elderly people, which Kosberg (1983) refers to as the impact of their 'diffused' as opposed to 'actual' victimization. The low social status and generalized feelings of insecurity which elderly people experience in western society may heighten their concern about victimization (Maxfield, 1987).

Trickett et al. (1995) argue that if area differences turned out to be a function exclusively of victim prevalence, crime control activity would need to be spread throughout the communities suffering much crime, since people who had not yet been victimized in those areas would be at substantial risk of falling victim. Whereas, if area differences are to be purely a function of the number of victimizations per victim, crime control should concentrate upon the victimized population, since they are the only group at heighten risk in high crime areas

The differences in incidence and prevalence of victimization rate between the British crime survey regional constituencies are found to correlate with differences in their social, economic and demographic characteristics (Osborn et al. 1992). Smith (1986) observes regional differences in the BCS (1982), which is a reflection of different degrees of urbanization, the possible role of crime as an externality to regional development and impact of economic change. In England and Wales between 1982 and 1988 property crime and personal crime became even in their distribution across constituencies. Changes differ greatly by region. Regions in the south (especially London and South East) had declining crime risks during the 1980s, because of reductions in victim concentration. Northern regions saw increases in both prevalence and concentration, which is fuel by increase in victim concentration.

Farrell et al. (1995) argue in their work that preventing repeat victimization would prevent a large proportion of crime. Hence scarce resource may be more efficiently allocated to individual victim. Sparks (1981) offered a general victim-oriented reason why repeat victimization occurs.

FitzGerald and Hale (1996) in their findings from 1988 and 1992 BCS concluded that comparisons cannot be made with whites since in these years only minority respondents were asked whether they thought racial motivation was involved in the crimes and threats against them. There is a relationship between victimisation and ethnic group, the type of offence. The most vulnerable overall were Pakistanis.

Ellingworth and Pease (1998) analyse the BCS data and conclude that moving home is associated with higher levels of household crime victimization, both before and after the move. Risk after a move is higher than before but are least for owner-occupier. The incidence of property crime in the homes of movers is 52% higher than in the homes of non-movers. In the pre-move homes it is 79% higher than in the homes of non-movers and in the post-move homes, it is 25% higher. The reasons for this are; people who move have lifestyles that make them at greater risk of suffering household property crime. Also, before people move, the house from which they move becomes more vulnerable because of the fact of moving which results in reduced property guardianship. After a move, new residents of an area will not be recognised by others, hence not be in a position to exercise formal or informal guardianship.

Koppen and Jansen (1998) study travel patterns related to commercial robberies in the Netherlands. They adopt the routine activity approach; "to commit a crime a motivated criminal must come into contact in time and space with a victim without the benefit of adequate guardianship". In the same approach criminals are taught to prefer to operating in areas with which they are familiar (Brantingham and Brantingham 1984). Thus, travelling into unknown territories to locate crime sites is very rear (Reppetto 1974). This is usually explained by the cost in time, money and energy that is necessary to overcome distance and unfamiliarity (Bullocks 1955; Turner 1969; Baldwin and Bottoms 1976; Capone and Nichols 1976).

Clancy et al (2001) presented findings from 2000 BCS, that the ethnic minorities run greater risks of victimization than white people, though this largely reflect the fact that minority populations are concentrated in large cities and in particular in those parts of conurbations where the crime risks are high for everyone, regardless of ethnicity. They argue further that the higher crime risks among minority ethnic groups may be thought of quite largely as a consequence of the economic disadvantage experienced by many minority groups. The implications of this are less for criminal policy rather for broader social policy; in assessing the need for action to address the economic disadvantage experienced by some minority ethnic groups, account needs to be taken not only of the direct impact of low income, but also of the indirect consequences such as higher crime risks.

The role of distance travelled to commit crime is widely supported in the literature with numerous studies. A distance-decay function (Cappone and Nichols 1976; Rengert 1989). Cappone and Nichols (1976) for instance found that 33 per cent

robberies were committed within one mile of the criminal home. The distance-decay function does not decline monotonically. Very close to home, criminals commit few crimes, apparently because there, the risk of recognition and apprehension is much higher (Brantingham and Brantingham 1984).

Furthermore, if potential targets are dispersed, then obviously the criminal has to travel further. Thus criminals committing armed robberies on fixed targets travel further than other kinds of crime (Cappone and Nichols 1976; Rengert 1989), while rapists stay closer to home (Rhodes and Couly 1981, LeBeau 1987). Cappone and Nichols (1976) for instance, found that the average distance travelled by the older offenders is 4.98 miles and for the younger offenders it is 2.02 miles while white people travel further than blacks people. Robbers of commercial targets in general travel more than other kinds of criminals.

One can say distance travelled to commit crime is related to how attractive and profitable crimes such as attacking a strongly protected bank could involve greater distances and careful planning. The distance travelled varies with the characteristics of the offender, choose targets close to home provided they are available resulting in a distance-decay function: many crimes occur close to the criminals' homes and the further away from home, the fewer crimes are committed (Rhodes and Couly 1981, LeBeau 1987). However, the major determinant of the distance travel led is the availability of suitable targets. But drug addicts need quick and easy money to sustain their addiction (Akerstrom 1985). As a result, they choose easy targets, such as cafeterias and shops that have few security measures.

(b) VULNERABILITY

The purpose of this sub-section is to review previous studies explaining why humans and materials are exposed to an attack or possible damage under circumstances. The discussion centres on social and physical factors that have been identified as enhancing people vulnerability to crime.

Cohen and Felson (1979) postulate that a crime occurs upon the convergence of three elements: a motivated offender; a suitable victim and the absence of a capable guardian. They account for crime rate movements in terms of social and physical changes influencing the number of interactions, in which these three elements are present. When motivated by greed for goods or money it is rational for offenders to target property items that are portable like television and video equipment. Vulnerability in such a situation increases where there is no sign of occupancy. The chance of reward on the part of criminal is increased as its of vulnerability on the part of the victim.

The argument of Cohen and Felson (1979's) is supported by Brantingham and Brantingham (1981) that a crime occurs when a law, an offender, a target and a place are concurrent. The common features to the two studies are that for crime to occur; there must be both an offender and vulnerable victim. The absence of a capable guardian will enhance the chances of the offender to attack the victim, by increasing the victim's vulnerability.

Spelman (1995) too argued vulnerability is concentrated among few people. Victimization surveys show that 10 per cent of victims account for about 40 per cent of crime committed in any given year, both in the United States (Nelson, 1984) and Great Britain (Farrell and Pease 1993). Self-report studies show that about 10 per cent of offenders account for most criminal offences over a two-year period (Spelman, 1994), while police dispatch records suggest a similar picture with 10 per cent of addresses in American cities account for over 60 per cent of calls for police service each year (Pierce et al. 1986, Sherman et al. 1989). These concentrations can help to structure crime control efforts, resource allocation and focus on offenders, victims and locations at greatest risk. The general belief in theory is that if something can be done about the frequent offenders, vulnerable victims and places at high risk, crime rate could be reduced. This belief led to calls for selective incapacitations of frequent offenders (Greenwood; 1982), police efforts to solve problems in high-risk locations (Sherman et al. 1989) and situational crime prevention efforts (Clarke and Cornish 1985). The current study aim to use mathematical and statistical methods to estimate risk of victimization, which can aid policing operation, monetary policy and decision making.

Clerigi and Killias (2000) conducted empirical tests on the validity of objective and subjective measures of personal vulnerability, to establish their impact on risk of victimization in Switzerland. For these purposes 726 Swiss nationals were randomly interviewed in November 1997. Vulnerability turned out to be a very important factor in the explanation of personal feelings unsafe.

Pantazis (2000) analysed the British Crime Survey, 1994 which was based on interviews with 14,500 people aged 16 and over to explore perceptions of safety among people living in poverty. The fear of crime among people living in poverty should not be seen in isolation from other insecurities such as job loss, debts and mortgage repossession. There have been fewer studies examining poverty as a dimension of vulnerability compared with gender and age. The available evidence suggests that poor people are much more fearful than the rest of the population (Pantazis and Godon 1997; 1998; Borooah and Carcach 1997). Pantazis and Gordon (1997) conclude that 'multiply deprived' households were three times more likely to feel unsafe in their local neighbourhood compared with people in 'comfortable' households. This aspect of vulnerability raises a number of issues. Firstly, people living in poverty may feel less able to protect their property from threat of victimization because of expense, rather than choice. Secondly, where criminal victimization entails the loss of property, the impact of crime may be more significant for people without home contents insurance.

Thirdly, poor people may be exposed to potentially more threatening situations due to their greater reliance on public transport. Fourthly, poor people may live in an area suffering from a higher degree of crime and 'incivility', both of which enhance their perceptions of feeling unsafe (Hope 1995). Finally, people living in poverty may lack the social networks enjoyed by others in ameliorating the effects of victimization. Hale (1996:103) makes the point that: "*the lack of material and social resources may mean that they are less able to cope with victimization at an individual level and at a community level lack the contacts, organizational ability and political networks*

available to higher stature neighbourhoods". This may increase the sense of lack of control.

The result from this study Hope (1995) shows that one in three people in England and Wales feel unsafe when walking alone in their neighbourhood after dark. Half of the female population worries about rape while one in two people worry about being mugged or robbed, Substantial sections of the population worry about becoming a victim of crime in relation to burglary and vehicle related thefts.

People living in poor households are more than twice as likely as rich people to feel un-safety when alone on the streets after dark (54 per cent compared with 25 per cent). Poor people report they feel unsafe when alone in their own home at night (18 per cent compared with 8 per cent for the rich). Over two thirds of women in poor households feel unsafe (67 per cent) compared with only 34 per cent of poor men. Similarly, a higher proportion of women in rich households feel unsafe compared with their male counterparts (45 per cent compared with 12 per cent). Poor women are twice as likely as poor men to feel unsafe when they are alone at home (22 per cent compared with 11 per cent) Roughly equal proportions of younger people (aged between 16 and 24) and older people (aged 65 and over) in rich households report that they feel unsafe (34 per cent and 32 per cent respectively). Poor older people are more prone than younger people to express that they feel unsafe when alone on the streets after dark (62 per cent compared with 46 per cent). Thus, the extent to which age plays a role in shaping people's experience of feeling unsafe appears to be dependent on income and poverty level.

Brunschot and Kennedy (2004) analysed the case of Jane Doe's lawsuit against Metropolitan Toronto Police Force, failing to warn the public of a rapist in Doe's community. This is a demonstration of the disparities between the provision of information to the public, the organizational goals of crime control and individual goals of personal safety which affect the level of risk identification. Individual perception of risk and hazard varies from that of an organization such as police force. It is within the capacity of the police to provide information to individuals regarding identified risks whom many or otherwise be unable to detect the hazards for themselves. When experts such as the police force, issues of liability and responsibility also emerge. For instance, problems occur when informing, failing to inform or correctly defining certain elements or conditions as hazardous and or beneficial. It is in the provision or withholding of information that the police may be view as 'knowledge brokers' (Ericson 1994). "It is knowledge for security that constitutes their trade. The police officer produces and distributes knowledge for the risk management activities of security operatives in other organization (Ericson 1994 p.151). If the member of the public has information on risk identification in their locality, it will aid decision making at individual and organization level. This could be in term of judgement regarding where to live, locate business or increase the number of police beat officers and patrol.

The issue of vulnerability can be related to the use of socio-economic variables such as lone parent, car, economic position of household resident (employed and unemployed), tenure and amenities (exclusive use of bath/showers and inside WC; lacking or sharing use of bath/shower and or inside WC and no central heating), age, and ethnicity as variables to estimate the risk of victimization, explored further in this

study within chapter six. The use of socio-economic variables to estimate risk of victimization in the current study will show the spatial variation in victimization across the city of Leicester.

(c) ECONOMIC REASONS

The purpose of this sub-section is to review previous studies of the motive behind the committing of crime. In the studies reviewed, crime is committed because of financial gain, to settle old scores, act of a revenge and power display among the rival gangs. The various measures taken at national level to reduce the opportunities for criminal acts are discussed.

Van Dijk (1994) showed that the interactions at the macro level between the potential offenders who commit the crimes and the potential victims' gives a predictive model allowing the later to protect themselves in Netherlands. Van Dijk (1994) refers to the offender as the 'consumers' who seeks financial gain greater than the cost involved. The gains are determined by the price paid for stolen goods whereas costs include investment in time and energy. Wilson and Abrahamse (1992) point out that due to a lack of self discipline, persistent offenders are thought not to maximise their financial and social yield in the long term. Their cost-benefit assessments will often be distorted by a preference for immediate gains. The individual decision-making by potential offenders is greatly influenced by the advice given and examples set by peers and role models, success stories and the spending patterns of experienced offenders.

Hence, as the potential victims respond to increased risks with extra protection and such protection potentially reduces the volume of crime, then the potential offender and victim influence each other's decision making. For instance, the security measures of households increases with the average victimization rate per area (Clotfeiter, 1977; Schneider, 1987). Behavioural measures to avoid crime such as avoiding certain places or not going out on one's own are common among ex-victims (Kury and Wurger, 1993) and generally among the inhabitants of areas with high levels of street crime (Van Dijk, 1993). If the potential offender focused on easy target for economic returns, the potential victim may take extra measure to secure themselves.

(d) AGE

The purpose of this sub-section is to review previous studies on the relationship between age and victimization. Sampson and Castellano (1982) identified age as an important antecedent variable highly correlated with victimization. There is a positive relationship between urban rates of personal victimization and age. This relationship is stronger for the victimization of 18 to 20 year olds These relationships tend to be more pronounced for theft offences than violent offences.

Mawby (1988) stresses that greater seriousness of crime for elderly people, which Kosberg (1983) refers to as the impact of their 'diffused' as opposed to 'actual' victimization. The low social status and generalized feelings of insecurity which elderly people experience in western society may heighten their concern about victimization (Maxfield, 1987).

Age can be related to fear of crime. For example, Hough and Mayhew (1983) in their analysis of the British crime survey concluded that although elderly people are more likely to feel unsafe on the streets after dark, they are no more worried about burglary or assault than younger people. The principle concern expressed by the elderly is "being mugged". This specific fear, the concern about mugging makes them appear to feel unsafe outside at night (Mawby, 1988).

Pain (1995) argues that gender composition has an adverse effect on fear of crime. Gender is the strongest predictor of fear of crime in old age (Clarke and Lewis 1982; Smith, 1989). Two thirds of elderly people in the United Kingdom are women (Equal Opportunities Commission, 1993). Women are far more concerned about crime, particularly interpersonal violence than men.

Pain (1995) assesses the relationship between the risk and fear of crime amongst the elderly. His study shows the levels of fears, the chances of victimization, the temporal and spatial parameters to conceptualisation of risk. Cook et al. (1978) Todd (1981) Feinburg (1981) and Yin (1980) asserted that crime has a greater impact on elderly people and it can have a severe effect on their quality of life. On the other hand, Clarke and Lewis 1982, Cutler (1980), Hough and Mayhew (1983) and Mayhew et al. (1993) argued that while elderly people seem to suffer as much or more from the fear of crime as young people, they appear to be the least likely of all groups to be victimized. In the Islington crime survey, for example, only 15 per cent of those who reported having been victims of violence are aged over 45 years (Jones et al 1986). On this basis Hough and Mayhew (1983) describe fear among elderly people as an

irrational phenomenon which ought to be tackled on a separate footing to the actual crime occurrence.

(e) POPULATION DENSITY

The purpose of this sub-section is to report the literature regarding crime in relation to population density. Population density is the number of people in relation to the space that they occupy (Johnston et al 2001).

In this study 'crime rate' is expressed as the number of acts counted as crime as a ratio to the number of persons in a population. Conversely, criminologists measure rate of crime by the reporting and recording of crime counts not as a proportion of population (Trickett et al (1992). Less attention has been paid to the meaning of 'ratio' itself and the nature of denominator. The latter serves two purposes: first, to standardize changes, Secondly, as a probabilistic expression of risk. As Bottomley and Pease (1986 p 45) remark 'we should beware of easily reaching the conclusion that "people commit crime therefore more people can be expected to commit more crime". If the ratio between crime and population is unchanged there can be nothing that requires explanations. This remark illustrates the beginnings of an alternative 'emergent theory' about rates of victimization.

Trickett et al. (1995) argued that if area differences turned out to be a function exclusively of victim prevalence, crime control activity would need to be spread throughout the communities suffering much crime, since people who had not yet been victimized in those areas would be at substantial risk of falling victim. Whereas, if area differences are to be purely a function of the number of victimizations per victim,

crime control should concentrate upon the victimized population, since they are the only group at heighten risk in high crime areas

The differences in incidence and prevalence of victimization rate between the British crime survey regional constituencies have been found to correlate with differences in their social, economic and demographic characteristics (Osborn et al. 1992). Smith (1986) observes regional differences in the 1992 British Crime Survey which he suggests a reflection of different degrees of urbanization, the possible role of crime as an externality to regional development and impact of economic change. In England and Wales between 1982 and 1988 property crime and personal crime became even in their distribution across constituencies. He argued that changes differ greatly by region within regions in the south (especially London and South East) having declining crime risks during the 1980s, because of reductions in victim concentration. Northern regions, on the other hand, saw increases in both prevalence and concentration, fuel by increase in number of victim availability. When making decision based of crime risk estimate the variable used in normalization should be considered.

Trickett et al. (1995) identify three related observations about the distribution of crime in a comparison analysis of British Crime Survey of 1982 and 1988; among which was that, a small number of areas host an unequal amount of crime events. The city centres, entertainment, shopping and industrial areas have high rates of crime due to high resident populations and more opportunities for criminal incidents. For instance, stores and warehouses have goods that attract the attention of some criminals, but nevertheless the residents of some high density residential areas are still victimized

disproportionately relative to those living in other areas. The inequalities in crime can be attributed to the differences in area crime incidence rates (the amount of crime per head of population) and may be a function of area prevalence rate (i.e. the proportion of victims amongst the population) and the area crime concentration rate (the number of victimizations per victim). This justifies the rationale for variation in the risk map when normalized against area or population density.

Ellingworth et al (1995) demonstrate the degree of inequality among the population of England and Wales as the extent to which individuals and households are victimized. For example, the British Crime Survey 1984 shows that only 12 per cent of the population, living in various types of social area, are identified as having high burglary prevalence rates and accounted for over a third of all the burglary incidents (Hope and Hough 1988). The need for conceptual and measurement tools to assist in analysis and amelioration of repeat victimization was advocated by Hope (1995). This can help in the development of crime-risk measurement; which provides an additional valuation criterion for social programmes at policy level. The trade-off between increase or reduction of harm and distribution can be better examined.

Furthermore, crime flux can be a basis for the criminological explanation concerning tax theory such as the integration of the spatial and temporal distribution of offending and victimization, which Bottoms (1994) sees as the subject of environmental criminology. While Gidden's (1984) 'theory of structuration' places considerations on time and space.

(f) ETHNICITY

Ethnicity and neighbourhood are interwoven. In a settlement pattern, the probability of Asian or Chinese living close together is very high. A good example is the Asian community in Evington, Leicester. People of similar race tend to live close to one another.

MacLean (1986) suggests "crime is not an event or 'social fact' but a social process, which includes a number of social events each of which is inextricably bound up with the other. The process of racial victimization involves a number of social actors, each of whom has a dynamic relationship with others. Firstly, (the victim and offender), the relationship between should be examined. The notion of process applies to all forms of crime. Car theft is no less dynamic and bound up with wider social processes than racial violence. However, Sampson and Phillips (1992) point to racial violence often taking the form of multiple victimization (Home Office, 1981), forming an unrelenting barrage of harassment (Tompson, 1988). As Stanko (1990 p 35) suggests racial violence creates a climate of un-safety which transcends individual instances of violence.

Ethnicity can be related to victimization. For instance, in the United States Afro-Carribeans population tend to live in high unemployment neighbourhoods in greater proportions than whites (Hindelang, 1978). A higher victimization rate for blacks may create a spurious relationship between unemployment and victimization. The study shows that the rates of both theft and violent victimization are substantially higher in neighbourhoods characterised by relatively high unemployment rates than in

neighbourhoods having lower unemployment rates. The relationship with neighbourhood unemployment is stronger for theft than for violent victimization.

Smith (1982) studied the victims of crime in North Central Birmingham of England. About 531 residents of an ethnically mixed community were randomly sampled within an area which is part of a ring of late Victorian and Edwardian housing which surrounds the city's re-development inner core. This area supports a relatively high proportion of low-income households, high rates of unemployment and overcrowding. Among the residents are British Whites, an Irish community, a West Indian population, East Africans and British born Asians. Smith's (1982) study buttresses the assertion that when race (ethnicity) is related to risk of victimization, it is linked with other socio-economic variables, such as unemployment, income and neighbourhood quality.

Bowling (1993) review the British Home Office survey of racial violence in 1989 as part of the North Plaistow racial harassment project. The nature, frequency of attacks and harassment were analyses as well as how statutory and voluntary agencies responded. The analysis shows that Afro-Caribbeans and Asians were mostly victimized. The white men were identified as the aggressors. Incidents occurred most frequently in the vicinity of the victim's home and very few people reported their victimization to police or any other agency and when they did, they were rarely satisfied with the outcome.

Although some authors (Gordon, 1984; Fryer, 1984) argued that racial violence has for centuries formed an integral part of the experience of black and brown skinned

people living in Britain. Other studies such as Klug (1982) and Layton-Henry (1984) point out that violence directed specifically against ethnic minority and communities in Britain has increased since the 1950s. However, the outbreaks of racial violence in various parts of England in the 1950s and 1960s such as 'anti-black' riots in Nottingham and London in 1958 (Layton-Henry, 1984; Fryer, 1984; Solomons, 1989) and in Midland and Northern towns such as Dudley, Smethwick, Wolverhampton, Middlesborough, Accrington and Leeds in other years (Pearson, 1976; Reeves, 1989) involved large gangs of white men targeting isolated black families and individuals. During the 1970s what became known as 'Paki-bashing' was increasingly reported in numerous locations across the country (Layton-Henry, 1984; Reeves 1989; Gordon, 1990). Gangs of white men targeted Afro-Caribbean, Asians and others who 'looked foreign'.

In conclusion regarding the risk of victimization, the studies reviewed in this subsection, argued that the chances of victimization vary across different age and ethnicity. The current study will draw on these issues behind the incidence of victimization to analyse risk of victimization in Leicester.

2:3 VICTIMIZATION AND THE BUILT ENVIRONMENT

Previous studies conducted on the impact of the built and physical environment on crime rates shows that the physical environment influences criminal activities. Cozens et al. (2001) argued that 'defensible space' plans obstruct the opportunity to commit crime by reducing the access to an area and the street design may affect both offenders' perceptions of targets and unplanned 'opportunistic' crime against

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residential and non-residential properties. Rates of offending are also shown to be related to neighbourhood quality and the extent of urbanization.

(a) ENVIRONMENTAL IMPROVEMENT

Brantingham and Brantingham (1981) and Evans and Herbert (1989) in their studies established the relationship between crime and environment. On this basis attempt is made to show the relationship between environmental improvement and crime. Previous studies such as (Topping and Pascoe 2000) examined the relationship between the physical environment and crime occurrence in an area suggests that they are often interrelated. This is why property developers resort to the use of crime coping mechanisms in the construction of properties. This may be attempting to reduce fear of crime. In the current study environmental improvement refers to the physical security measures taken to reduce the risk of victimization in an area. Examples are the provision of street lighting (Clarke 1992; Painter and Farrington 1999), the building design and layout (Newman, M.C and Strojan, C.L 1998).

Painter and Farrington (1999) assess the effect and cost-benefits of street lighting on crime in Dudly and Stoke-on-Trent and concluded that street lighting reduces crime. To buttress this argument, Clarke (1992) states that street lighting improvement can prevent crime, by reducing opportunity and risk through modification of the physical environment. Jacob (1961) drew attention to the role of good visibility combined with natural surveillance as a deterrent to crime.

Using a victim survey, Painter and Farrington (1999) measured the prevalence and incidence of crime 12 months before and after the installation of improved lighting in

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an experimental area and the adjacent, control areas where the street lighting remained unchanged. In the Dudley experimental area, the total number of burglaries before (including attempts) of 65 reported by 431 respondents was scaled up to estimate of 181.4 for the 1,203 occupied houses. Similarly, the total number of burglaries of 36 reported by 372 respondents was scaled up to an estimate of 116.4. This led to the estimate that 65 burglaries, were prevented in those particular areas by the improved street lighting. From the ongoing argument one can say that environmental improvement such as provision of street light, installation of closed circuit television and street warden (as introduced in London and other cities in England) can serve as a deterrent to the potential criminal. Also, people will fill more secure in working on the street with light.

The argument of Farrington and Brandon (2001) is related to Painter and Farrington (1999) who in their international comparison of American and British cities concluded that lighting may reduce crime by improving visibility, encouraging increase street usage which in town intensifies social surveillance as well as improving community confidence.

Topping and Pascoe (2000) examined the success of the Secure By Design Scheme (SBD) in countering household burglary. The SBD scheme was devised in 1989 by police forces in the South East of England. The aim was to influence the layout of estates or groupings of houses, to increase ability to withstand crime. SBD *"involves..... a cul de sac template for estate designs, intended to reduce access and anonymity"* (Topping and Pascoe 2000). Within this enclosure houses were inwardly oriented in a circular fashion to maximise natural surveillance and provide the

opportunities for neighbours to recognize and relate to each other. Symbolic and actual barriers were used to define ownership of space and 'target hardening' measures are put in place over the building envelope.

By 1996 SBD had become widely adopted across Britain, 35,000 homes on nearly 3,700 estates had been built to SBD standards. In Britain there is evidence of reduction in the incidence of burglary, the fear of crime and an increase in residents' perceived quality of life in SBD scheme area.

In 1998, Van Dijk et al. were commissioned by the Dutch government to review their 'veiling Wonen' scheme over the 1990s. This Dutch scheme was based on the SBD initiative. Van Dijk et al (1998) reported that in Utrecht, between 1993 and 1995, those houses which took part fully in a local scheme saw a drop in their burglary rate to 0.125 per cent, 30 times better than the 1993 average of 3.5 per cent. In Rotterdam for houses in the scheme burglary rate dropped to 3.5 per cent by 1995. By 1996 the rate in the scheme areas had dropped to 1.5 per cent.

One can come to the conclusion based on these two cases, that improvement in building design with aim of reducing the easy of accessibility to the house by the potential criminal will reduce the chances of domestic burglary. For instance, the installation of double entrance doors into a house, the first is positioned perpendicularly to the second door (as for some residential houses in New York) the easy of accessibility to the potential criminal is drastically reduced therefore, the resident risk of victimization is reduced.

Cozens et al. (2001) use five housing designs most commonly built in the Britain to assess Newman's theory of 'defensible space' and questions the utility of these ideas in contemporary crime prevention initiatives such as 'secured by design' (SBD). Two groups namely, convicted burglars and police officers were interviewed. The designs were presented to respondents in the form of slide projectors. The police perceived three designs as neutral but the burglars regarded them more negative terms. These were 'Low-rise/walk-up flats', 'High-rise flats' and Terraced housing'.

Ten police officers and ten convicted burglars were asked seventeen questions designed to probe 'defensible space', crime and the fear of crime. From the burglars view the image of 'semi-detached housing A' is perceived as the most 'defensible' design with a rating of 630 out of 700

One can say that the hierarchy in-terms of defensibility closely resemble the hierarchy of opportunity to commit crime. Hence, 'defensible space' qualities are important elements in determining the overall image and vulnerability perceived for each design. The Newman's theory can be said to reduce the risk of victimization from the potential criminal perspective. Also the use of window locks, deadlocks, door chains, alarm, double-locks, a dog, and sensor lights improve household security which will in turn reduces the risk of victimization.

Dewberry (2003) analysed crime from social, environmental and ecodesign perspectives. The concept of ecodesign is central to the escalating concern about the unsuitable current modes of global property design. One way of viewing unsustainable development is ecodesign. Home office (1999) report on reducing

crime and tackling its causes, crime is linked to sustainable development. For instance, sustainable development issues linked directly and indirectly to crime by focusing on consumption and owning the latest style or brand related to criminal theft. The relationship between the focus on status rather than on internal well-being relates to the drivers behind the committing of crime and the existence of global and local socio-economic environmental injustice relates to issues (Dewberry 2003).

Dewberry (2003) argued further that the level of crime activity directly affects the degree to which we can move towards a more equitable and just society (a component of sustainability). Hence, reducing crime is a component of sustainability. Establishing this connection provides a common base between design that addresses sustainability through ecodesign and design against crime (Dewberry 2003). One can liken the concept of ecodesign to the broad relationship between design, the environment and society. Design against crime is related to new product innovations, new technological implementation and competitive advantage.

Design against crime can at one level make products and buildings more crime resistant. The longer term view of ecodesign suggests major improvement in reducing environmental degradation. This involves change in people's attitudes, behaviour and understanding resulting in different and less consumption based activity. The long term view of ecodesign against crime in providing effective reductions in crime events will depend upon changes in attitude and behaviour among the stakeholders group involved in the process of crime and fighting crime which will result in risk minimization. These include offenders, victims, communities, policymakers, educators and the criminal justice system. With regards to some crimes, more

attention has been paid to the type of housing than what is actually stolen (Wellsmith and Burrell, 2005). The house appearance may either attract or repel a potential offender they concluded.

(b) NEIGHBOURHOOD

The purpose of this sub-section is to the relationship between neighbourhood and victimization. A neighbourhood can be define as an area within which there is an identifiable subculture to which the majority of its residents conform (Johnston et al 2001). In the criminology literature it is argued that neighbourhood effect can be used to account for spatial pattern of crime. When crime takes place in an area and security measures are not put in place to forestall reoccurrence, the probability of repeat victimization is very high in most cases. A weak financial situation indicates that people live in less attractive neighbourhood, which are in turn more likely to be characterized by higher levels of social problems, leading to relatively high levels of victimization (Dolmen, 2002)

Neighbourhood characteristics, such as signs of decay graffiti, litter, and 'strange' people hanging around reflect the characteristic of a neighbourhood. Thus noisy neighbours and loud parties, graffiti, teenagers hanging around the streets corners, drunks and tramps on the street, rubbish and litter lying around, boarded-up houses and flats with broken windows may all signify to some individuals that the neighbourhood is declining, disorderly, unpredictable and threatening (Hunter and Banmer 1982: Lewis and Maxfield. 1980: Maxfield. 1984: Taylor and Hale. 1986: Wilson and Kelling. 1982). A feeling that the immediate neighbourhood is in economic decline and the community's changing for the worst may produce not only

a generalized anxiety but also, a risk of victimization (Eve and Eve, 1984). Eve and Eve study demonstrate the relationship between crime and neighbourhood.

Winchester and Jackson (1982) identify four various distinguishing features between victimized and non-victimized households namely; distance from nearest house, distance from the road on which the house stands, the of sides of house not visible from public areas and houses that are accessible from sides, front and rear. Nee and Taylor (1988) in their behavioural study of Irish burglars found that lack of visibility by passer-by and the presence of vegetation cover were rated very important by 55 per cent of the burglars interviewed. Also, Cromwell et al (1991) say most burglars in the United States, assessed cues relating to surveillability, occupancy and accessibility in their choice of target.

From the ongoing argument, the neighbourhood characteristic may affect the choice of target of the criminal. For instance, in a neighbourhood a property that is accessible as a result of obscured and invisible entrance that cannot be over look by other residents or passer-by is argued to be a good potential target. Wright (1984) point out that surveillance, which may be defined as the ability of neighbours and passers-by to casually survey approaches to neighbours is an important cue influencing their choice of property burgled.

In conclusion the studies reviewed in this subsection show the relationship between environmental improvement, neighbourhood and crime. Knox and Pinch (2006) argued that neighbourhoods with high proportion of youths (the teens and early 20s) can be expected to exhibit high levels of criminality, especially if the neighbourhood

is caught in a spiral of economic decline and physical decay that heighten youths' feelings of relative deprivation. The Newman's concept of secure by design, ecodesign, introduction of street warden, increased visibility of patrol of beat officers, street lighting and the installation of closed circuit television at the towns and city centres by local authorities are measures to taken to reassure the public that the government is improving safety on our street.

2:4 GIS AND CRIME ANALYSIS

The purpose of this section is to provide a general overview of the application of GIS in various areas of crime analysis. The crimes reviewed can belong to any category on risk of victimization, victimization and the built environment discussed in the previous sections. The central theme is the use of GIS and not the socioeconomic or demographic variables used. This includes hotspot mapping, repeat victimization analysis, the use of map to search for crime suspects and spatial analysis of crime.

Hotspot mapping shows places where features of interest are located or 'clustered'. Hotspot mapping can be regarded as an improved means of analysing crime information showing some examples of spatial clustering. The location of points in a pattern may be analysed and the dispersion of points within an area. The changes of crime and calls for police service across time and space can also be visualized.

Johnson et al. (1997) combined a grid reference with text-based search to identify risk of victimization using MapInfo. The crime data include vehicles availability, burglary methods, and points of entry, plus victim data such as ethnicity, age and gender. Their

GIS allow searches of the data to be done using a standard query language input and proprietary programming languages (e.g. MapBasic) allowing many of the queries and functions. The first search found every location where there more than one burglary report had been recorded by selecting all records where there was at least one other record with an identical geographical location. Crime that happens in the street such as assaults and personal robberies are allocated the grid reference via address-point of the nearest building known to the system. The advantages of using a GIS over a standard database package is the ability to plot graphically the locations selected on a map for visualization of the problem, combined with the ability to select repeats around a particular geographical feature such as a road junction or town centre.

Ratcliff and McCucllagh (1998) employ GIS to undertake repeat victimization identification within Nottingham, United Kingdom. This is an attempt to overcome the problems encountered when extracting repeat victimization records from a non-geographic database. A geographical reference greatly improves the chances of an accurate 'hits' when searching for incidents of repeat victimizations, although it does depends on the accuracy of the geo-reference and how often the system is updated to cope with new addresses. Hirshfield et al. (1995) analyse crime incident data using the Merseyside Address Referencing System (MARS) which form the basis for the command, control and crime incident reporting system used by Merseyside Police.

Ratcliff and McCullagh (1998) also use MapInfo to analyze the perception of crime hotspot in South Nottingham, England. The hotspot identification survey data was combined with the police investigation officer's perceptions of crime hotspots. Crime hotspots were plotted, covering domestic burglary, non-domestic burglary and motor

vehicle theft. Each officer was asked to indicate the location of any crime hotspots based on their knowledge of crime in South Nottingham. These estimates were mapped. The result shows that police achieved a fair degree of accuracy in identifying the areas of domestic and non domestic burglary, but were less accurate in motor vehicle crime hotspots. The result of the analysis was used to review the local crime recording practices and local crime information dissemination.

The Johnson et al. (1997) and Ratcliff and McCcllagh (1998) studies also show how GIS can be used in victimization and rape victimization mapping. The use of GIS to map victimisation can be linked to vulnerability discussed in sub-section one. Vulnerability across various age - group in a given population can be identified. For instance, age group may be regressed against crime to show the must vulnerable age bracket and standardized against population density. Such map will show the spatial variation of risk in various wards in a city.

Reno (1998) analyses the residential burglaries in (District 4 of the Police Department) Shreveport, La, United States. Fifty-eight burglaries were reported from January 1998. It was stated that crime analysis was required to ensure the best deployment of police officers, tactical plan to decrease burglary activity and to determine if there was a geographic concentration of burglaries and determine if the occurred more frequently during the day or night. The map analysis, using MapInfor encompased total burglaries, day and night time residential burglaries, the report time frequency, address, date, time of day and information bulletin containing information about suspects property stolen and method of entry.

From this map information, an operational plan was developed, using the Shreveport police directed patrol unit, the district 4 patrol personnel and the district's community liaison officers. The intelligence and detective units also forwarded information to the patrol captain and worked with officers on burglary suspects. The maps identified a possible juvenile truancy problem by clearly illustrating that the main concentration of burglaries was close proximity to a high school. Resources were mobilized to this target. The truancy problem in this area was corrected, burglary suspects were arrested and intelligence was gathered for further use.

Craglia et al. (2000) studied the pattern of domestic burglary using police crime data in Sheffield, United Kingdom. They have a higher rate of reporting to the police (about 10,000 residential burglaries) and are more accurately geo-coded, since the records contain full details of postal address. For this evaluation, both Space and Temporal Analysis of Crime (STAC) and a Nearest Neighbour Analysis (NNA) routines that checks for the significant of clustering were used. Also, employed was the Getisord technique, which allows the user to test for clustering of values at a range of distances (for the presence of local clustering) was used.

The result of STAC in Craglia's study show that 85 per cent of all domestic burglaries in the city took place within 100 square kilometres covering the city centre. There were two main areas of crime clustering activity were identified; one to the north of the city centre associated with a number of council estates, that were traditionally affected by high crime rates (Bottoms and Wiles; Bottoms et al. 1992), and the other a newer area of criminal activity to the south of the city centre which has a large student

population and has become over the past ten years one of the main night-life attractions in the city

Bowers et al. (2001) use grants allocation application written in Visual Basic, Access Basic and built on a Microsoft Access database. This is a development of a GIS-based database application set up to assist in the identification of vulnerable targets for a domestic dwelling target hardening scheme run by the Safer Merseyside Partnership (SMP) in the Merseyside area. The data is analyse and cross-referenced to establish whether or not the burgled property is located within the deprived areas, whether or not the incident is a repeat, whether or not the occupants of the property fall into defined vulnerable groups and whether the burglary occurred in an area of high criminal activity (a 'hotspot').

Brimicombe et al. (2001) use a Geographic Information System and statistical techniques to examine the racial differences in the inner London Borough of Newham. The crime statistics include a comprehensive set of all of the allegations of racial violence and harassment reported to the police between July 1996 and June 1997. Demographic data on ethnic composition and socio-economic standing was used, but modified into four ethnic groupings namely white, black, Southern Asian and Chinese.

The racially motivated incidents vary across the borough for residents from the same ethnic group. For example, Asians living in Canning Town and Grange (in the south west of the borough) reported the highest number of racially motivated incidents whilst the rate for Asians living in Manor Park (in the north east of the borough) was

much lower. The rate of incidents for blacks was also found to be highest in Canning Town and Grange. The highest rate of allegations by whites was reported in St. Stephens where whites are a minority population. Within the borough the linkage between deprivation and crime rates do not appear to account systematically for difference in victimization rates between groups.

Catalano et al. (2001) apply GIS to predict where future crime might occur and determine where the offenders are likely to live in Phoenix, Arizona. Between October 1997 and June1998 Phoenix recorded a series of armed robberies of convenience stores, supermarket and fast food outlets. A gang of black males conducted these crimes in their early twenties, dubbed as the 'Blue Bandits' because of their habit of wearing blue-coloured bandannas. The robbery detail required information that would allow the police to make decisions about how to apply their resources to investigating these crimes.

Costello and Paul (2001) use GIS to analyse the journey to crime in South Yorkshire, United Kingdom. The geo-coded crime data enables us to view the patterns by analysing the location of the offences, residential addresses of the offenders and the victims. Hence, data were available to establish the relationships between the locations. Data were collected from Police National Computer (PNC) records, the national DNA database and victimization surveys of two Sheffield council estates and interviewed a stratified sample of prolific Sheffield-based offenders. Costello and Paul (2001) study show other capability of GIS, that it is not only issues about probability of victimization that can be addressed but the analysis and mapping of the offenders related to the victim can be carried out.

Craglia et al. (2001) demonstrate modelling high-intensity crime in Greater Manchester, Merseyside and Northumbria, United Kingdom. A sample of the Metropolitan Police Force was asked to identify the location of their High Intensity Crime (HIAs) and compared to the result of a GIS-based spatial analysis for modelling the allocation of these areas using census data. The important characteristics of HIAs are the type of crime found within them that is drug-related and extremely violent crime, involving use of firearms. Secondly, the resident populations of these areas are unwilling to cooperate with the police, because of the nature of crime and criminal behaviours in the area.

In Craglia et al's (2001) study, the spatial database within a GIS was used to integrate data on the HIAs with socio-economic data recorded by enumeration districts. Statistical analysis was undertaken using SPSS, but those elements requiring the methods of spatial analysis were undertaken separately using specialist software including the SAGE software system (Haining et al. 2000). The model suggests that HIAs are characterised by populations that are deprived and live at high density and by higher levels of population turnover.

Murray et al. (2001) uses GIS and quantitative techniques in the analyses of the occurrence of crime and its relationship to urban change in Brisbane, southeast Queensland, Australia. Combinations of socio-demographic information with geographic features were employed in this study. Their result shows that GIS and spatial analysis techniques are increasing what we know about criminal activities.

Charmard (2004) explores the diffusion of computerized crime mapping among the municipal police department in the United States. A mail survey was sent to the chiefs of all 484 municipal police and titled 'crime mapping and communication survey' in November 2002. About 247 police department responded, representing 72 per cent.

The result of the analyses showed that only 10 per cent of the departments in the survey indicated that they used computerizing crime mapping innovations at some point and only three – quarters of those had continued to use it. Of the 90 per cent who had never adopted crime mapping, 30 per cent did indicate that they planned to do so in the near future with some two thirds of this group stating that they expected to adopt the innovation within one year.

The research findings provide some support to the innovation diffusion. Though, the current study is not for Leicestershire constabulary, but they provided the crime data. On request the research result can be made available. This can be regarded as part of diffusion of computerized mapping, not necessarily the police establishment alone but academic as well.

The studies reviewed shows hotspots clustering and how crime move (observe trends) or relocate over a period of time. The current study estimates the risk of victimization from the historic crime data by using mathematic methods. The result of the risk estimate is mapped and the spatial variation in risk of victimization can assist to predict of future risk of victimization and assist in policing resource allocation and decision making. Beyond risk mapping, the two risks derived (observed and

objective) is combined to develop models of overall risk assessment in a GIS environment.

Similarly, the intention is that the maps from the current study might be used by the Leicester Police to distinguish between the risk map and crime count map in policing resource allocation. Risk mapping is another dimension to crime analysis from which qualitative decisions can be made particularly in the area of police operation.

The current study use GIS create a range of map visualizations of estimate risk of victimisation by normalizing crime against beat population density and area. Such maps show the spatial pattern of risk in the city. At police beat level, information about risk may suggest for instance, that belonging to a particular ethnic group or age group may increase vulnerability. The current study is similar to Craglia et al. (2001) and Murray et al. (2001) studies in that census variables and mathematical methods are to be used to arrive at the estimated result. This is to demonstrate the ability to integrate various variables for instance, crime and socio-economic variables to estimate risk of victimization.

In conclusion, the use of socio-economic variables in previous studies, such as Craglia et al. (2000) and Bowers et al. (2001) shows that crime can be related to socio-economic variables. However, the wide gap that is identified in the literature is risk analysis and mapping. The aim of the current study is to fill this identified gap in knowledge. This will involve the use of socio-economic variables such as lone parent, car, economic position, tenure amenities and ethnic group. For instance, car is a surrogate measure of wealth, crime against cars has a monetary effect on the owner.

This study shows the probability of risk of criminal damage to car in Leicester. Members of the public can be assisted by informing them were to avoid and take extra precaution why packing their cars based on such risk map.

2:5 CONCEPTUAL FRAMEWORK

Theories of crime from the positivist school (Lambroso 1876), spiritualism (Tannenbaum 1938), control theory (Durkheim1951), strain theory (Merton 1957), naturalistic (Vold 1958), classical school (Beccaria 1963), labelling theory (Becker 1963), control learning and strain theories (Matza 1969), routine activity theory (Cohen and Felson 1979), environmental criminology (Brantingham and Brantingham 1981), the Chicago School (Bulmer 1984), Peacemaking theory (Pepinsky and Quinney 1991), Marx and Engel (1992), postmodern social thought (Milovanovic 1995) and crime pattern theory (Hirshfield 2005) provides useful explanations of crime and criminal behaviours. But, this current study, in the GIS environment to account for the spatial pattern of crime in Leicester, with emphasis on location, time of occurrence and policing resource allocation, some theories that explain the rationale for criminal's behaviours and activities in space will be adapted.

Hirschfield (2005) argued that understanding crime patterns and the mechanisms that generate them is a good starting point. Therefore theories of crime can help us to make sense as why crimes do not occur randomly. These can be used not only to explain why crimes occur, where they occur and when (as pointed out by Brantingham and Brantingham 1995) but also to indicate how to intervene to prevent. He further argues that successful crime prevention needs to be based on sound theory and theory needs to be constructed from empirical evidence. Theories are helpful

because they explain what puts people, property and places at risk. Among the main theories that have been advanced to explain crime patterns are: routine activity theory, rational choice theory, crime pattern theory.

2:5.1 ECONOMIC MODEL

The applications of economic analysis to the problem of criminal behaviours in both economics and criminology literature can be traced to the work of Stigler (1970), Ehrlich (1972) and Palmer (1977). This is a development from Becker's (1968) work on the analysis of the rational behind individual to commit crime. Becker stated that a rational person commit crime when pecuniary income and non-pecuniary satisfaction generated from the criminal act exceed the expected costs. This approach was exemplified by Hakim's (1980) research in the 'New Jersey portion of the Philadelphia metropolitan area'. He argue that *property crime are "Imported", or attracted to the community in direction relation to its relative wealth; and in inverse relation to both the effectiveness of its local police force and its distance from the area containing the greatest concentration of potential criminal'*.

The offender chooses not only the number of crimes he commits, based upon the economic incentives and costs inherent in his situation, but also where to carry out the crime within a multi-community region. Costs and benefits vary among communities within a metropolitan area. He executes a given crime in that community where the net benefits are maximized. Also the police expenditure decision is based on resource availability i.e. the tax base and not in relation to citizens' demands to reduce criminal activity.

2:5.2 TRANSIT ROUTE MODEL

In this model, ease of travel and familiarity with the physical environment is very important Brantingham and Brantingham (1984) argued that the offender's daily life patterns might influence the location for potential targets. Hence crime will be committed in the parts of the city with which the criminals are familiar at the least opportunity.

The transit route can be related to 'economic man' but sees ease of access as vital to explaining offence patterns. This model argued that it may not be easy to travel but familiarity to the environment the crime is committed is very important. Hence, the cognitive maps of the city play an important role; this can be related to route to work places, near home, shopping and leisure facilities. It is argued elsewhere that offending will tend to take place where criminal opportunities intersect with cognitively well known areas. Brantingham and Bratingham (1984) argued that certain types of location within these areas (city) are particularly vulnerable, in terms of being seen as an attractive target to offenders.

Brantingham and Brantingham (1995) argued that places can generate crime as well as attract crime. 'Crime generators' are places that create opportunities for crimes to that place because they bring large numbers of people together. There are opportunities to commit crimes in these areas such as shopping centres, bus stations, schools, venue for sporting events and concerts whereas crime attractors are locations, sites and properties that are well known to offenders and as such are specifically targeted by them. For instance, the red-light district, drug-dealing areas and run-down housing estates. A crime detractor refers to a location that discourages offenders and

offending. A stable business, the presence of middle-aged women, mixes of activities or easy natural surveillance can have such a positive consequences. Urban area can be viewed as a 'patchwork of crime generators, crime attractors, crime detractors and neutral areas'.

2:5.3 LEISURE ACTIVITY/ ILLICIT GOODS AND SERVICES MODEL

Shaw and Mackay (1969) identify the high rate of crime in the central business district (CBD) and adjoining areas, where both leisure and illicit services are concentrated. Rengert (1989.557) notes 'If residential burglars travel outside their home neighbourhoods for criminal or non-criminal reasons, they are most likely to go to or towards the centre of the city.

Furthermore, Rengert (1992) and Cromwell et al. (1991) argued that locations of drug sales are very important 'anchor points' for drug-dependent property criminals who fund their purchases of drug through property crime. Offence locations of these offenders tend to cluster around drug sale points rather than a route model in that offending takes place in cognitively known areas, in some cases far away from home. Research in the United States, has tended to show that offenders offend in areas dominated by the same ethnic group as the offender (Carter and Hill 1979). In Britain, the issue of class is more significant than race. Davidson (1984) in his study of domestic burglary in Hull found that 60 per cent of offenders confined their activities to the same sort of areas as those they resided in.

Costello and Wiles (2001) argued that restricting offending to areas the offender lives or areas of similar make-up can have two basic causes: first, the offender knows the

area well (including available opportunities) and therefore feels confident in his ability to offend; or second, the offender feels 'ontologically secure' in an area when he comes from familiar ethnic or class background to the residents, because he does not stand out as an obvious 'outsider'.

2:5.4 ROUTINE ACTIVITY THEORY

Cohen and Felson (1979) explains crime in terms of convergence, in time and space, of a motivated offender, a suitable target for the offender (vulnerable person or unprotected property) and the absence of capable guardians against crime. Suitable targets for crime may be a person or an item of property whose position in space or time puts that person or object at more or less risk of criminal attack. Capable guardians generally refer to anyone whose presence may discourage a crime from happening. This theory implies that the solution would be to protect targets such as use of window locks, improving surveillance through CCTV and by raising the effort and risk for the offender in carrying out a crime (Clarke 1997; Felson and Clarke 1998). The important of time and location should not be overemphasised rather the context in which an offence take place in terms of natural surveillance, presence of people and other crime prevention measures. One important question that the issue of context raise is that understanding crime pattern requires more that crime data. Rational choice theory looks at the offender's decision in target selection based on his/her perceptions of the cost and benefits of committing a crime and how these compare against the chances of apprehension, journey time and the expected reward. The implication of this theory on crime analysis is to look at the modus operandi. According to Hirschfield (2005) unlike information on guardianship or the prevalence of existing levels of protection against crime, data on MO can be obtained from

recorded crime incidents available to the analyst. Hirschfield (2005) argued further that the identification of how crimes have been committed can be an important step in ensuring that appropriate interventions are deployed. For instance if the majority of burglaries to terraced houses are a result of offenders gaining entry to the rear of properties, then this is where protective measures are needed.

2:5.5 LAND USE MODEL OR PHYSICAL ENVIRONMENT MODEL

Donnelly and Kimble (1997) pointed out that the physical environment might have impact on crime due to opportunity or informal social control. The opportunity model can be related to the concept of 'defensible space'. The defensible space concept argued that plans to reduce access to an area can impact upon potential offenders' opportunity to commit crime in three ways: first, by reducing access to an area (i.e reducing its 'permeability') they can affect potential offenders' knowledge of the area; second, street design may affect potential offenders' perceptions and evaluations of risk of being observed and apprehended, criminals may be less likely to enter communities where entry and exist routes are limited by the physical environment; third, reducing access to an area may reduce unplanned 'opportunistic' crime.

However, two assumptions are basic to the view above: first, much of the crime in a neighbourhood is committed by 'outsiders'; second, that criminals are rational actors. Donnelly and Kimble (1997) examined the impact of defensible space change to the Five Oaks neighbourhood of Dayton, (Ohio, USA) and found general support for the opportunity rather than informal social control thesis. It is important to point out that the impact of various measures such as road closures, community policing and

neighbourhood partnership can not be underestimated and have a greater impact on offending by outsiders rather than insiders.

2:5.6 CRIME PATTERN THEORY

According to Hirschfield (2005) crime pattern theory explains how people involved in crime move about in space and time. He pointed out that central to the theory are notions of 'nodes', 'paths' and 'edges'. Nodes are departure and arrival points (bus stops, stations, schools, homes or recreation centres). Paths are the journeys between nodes while edges are boundaries of areas where people live, work, and shop or seek entertainment. Some crimes are more likely to occur at the edges such as racial attacks, robberies or shop lifting, because people from different neighbourhoods who do not know each other come together there. These mechanisms such as crime attractors, crime generators, nodes, paths and edges are to be considered when conducting analyses for intervention. Knowing how to intervene also means understanding the distribution of crime opportunities and how they arise as well as familiarizing oneself with crime patterns. It is important to point out that crime theories tell us a great deal about crime opportunities, analyses for intervention normally focus upon historic patterns of crime – identifying 'hotspots' and concentrating on what has already taken place.

2:5.7 APPLICATION OF CRIME OCCURRENCE MODELS

The Economic model, transit route model, Leisure activity and service model, Land use model/physical environmental model explain that offender's life pattern might influence the potential target. The mental or cognitive maps of the city, and areas the offenders knows very well, offending will tend to take place in familiar areas and

where criminal opportunities intersect with cognitive well known area in the city. These theories offer explanations for offenders' mobility pattern and also hold out the possibility of providing models victim mobility which can be used for crime pattern analysis.

2:6 STUDY AREA

The city of Leicester is situated in the centre of Leicestershire in East Midlands of England. The area of Leicester is about 73.09 square kilometres. The city has a population of about 290,000 of whom over one quarter are of ethnic minority origin. Among the educational institutions in the city are: two universities, a teaching hospital, school of nursing and Leicester college. The National Space Centre and the city centre is the hub of social, financial and commercial activities.

The city council is one of the unitary authorities formed following a review of local government administration carried out in the early mid 1990. With effect from 1st April, 1997, Leicester City Council became responsible for all local government services within the city boundaries. Leicester city comprises of 28 wards and occurrence of crime is recorded by beat area. These vary in size and shape. There are almost two hundred such beat areas for the county of Leicestershire. The London to Sheffield railway line and the Grand Union Canal traverse the city. Leicester is in close proximity to the M1 motorway.

2:7 CHAPTER SUMMARY

In this chapter the various studies reviewed were classified into three broad categories and sub-sections for easy reading and understanding. In section one, issues relating to social and physical factors such as target and location, vulnerability, age and ethnicity are discussed. In section two, the relationship between the built environment and crime occurrence is discussed. Previous studies that show the impact of environmental improvement, design and neighbourhood are reviewed. Also some of the theories that offer explanations on patterns of crime occurrence in the city are discussed in this chapter.

The literature on crime mapping is very scanty. This is a reflection of the number of previous studies carried out in this area. The present study will contribute not only to research on crime mapping alone, but to the risk assessment theory that is at infant stage. Some crime theories are reviewed and their application to the crime pattern in the city is examined. In the next chapter risk analysis will be discussed.

CHAPTER THREE

RISK ASSESSMENT

3:1 INTRODUCTION

The purpose of this chapter is to examine the various views to the concept of risk. The factors that are associated with risk categories will be discussed. Also how the current study demonstrates how risk of crime can be communicated to the general public is proposed. This chapter relate the current study to the wider body of academic literature of risk analysis.

Risk assessment is defined as the integrated analysis of risks inherent in a product, system or plant and there significance in an appropriate context (Royal Society 1992 p 4). Risk assessment can be described as a process of analyzing potential losses from a given hazard. In the current study crime risk assessment can be achieved using a combination of known information historic crime data and socio-economic variables to estimate probability of victimization. The goals of risk assessment include the identification of the potentially hazardous situations, provide information to base a risk management decision and estimate the uncertainty associated with risk.

There are many applications of GIS in risk assessment in physical sciences for instance, Akcakaya (1996) use GIS to model ecological risk for endangered species, Bocco et al (1992) GIS and flooding, Emmi and Horton (1995) use monte carlo stimulation of error in a GIS-based assessment of seismic risk, Bouma and Groenigen (1995) apply GIS for environmental risk assessment. The current study shows how GIS can be used in risk assessment in social science in general and crime in particular.

Combining observed risk with objective risk to build a model of overall risk assessment does this.

3:2 RISK

There are many views to risk first; the German sociologist Beck (1992a) argued we live in a 'Risk Society' which has two characteristics. First, it is a society in which a 'post-materialist' public is becoming more and more aware of the risks and hazards of modern life. Secondly, it is a society in which scientific and technological hazards are both multiplying and spreading.

Beck's view of risk can be regarded as the sociological or human view to the concept of risk. This will also embrace psychological explanations and interdisciplinary approaches to analyze human response to hazards. For example, this may involve the use of questionnaire to investigate what people say risk means or how they perceive risk. Kahneman et al (1982) regarded this as risk evaluations in terms of the intuitive mental rules-of-thumb or cognitive heuristic that people often use when judging the likelihood of occurrence of events. This may be useful in subjective risk analysis.

Another view of risk is that it is the probability that a particular adverse event occurs during a stated period of time (Royal Society 1992). Adams (1985) defined risk as a systematic way of dealing with hazards and insecurities induced and introduced by modernization itself. The Royal Society and Adam's view of risk express risk in statistical terms. Risks, as opposed to the concept of dangers, are consequences which relate to the threatening force of modernization and to its globalization of doubt. As a probability in the sense of statistical theory, risk obeys all the formal laws of

combining probabilities. Risk often relates to a specific event or set of events and the associated hazard. The Royal Society argue that the general concept of risk is the chance, in quantitative terms of a defined hazard occurring. The current study will analyze risk of crime as a probability in the sense of statistical theory.

Individual risk is the frequency with which an individual may be expected to sustain a given level of harm from the realization of a specified hazard while societal risk is the relation between frequency of occurrence and the number of people in a given population suffering from a specified level of harm from the realization of specified hazards (Royal Society 1992).

In the current study, within the context of crime and criminal justice, personal or individual risk can be defined as the fraction of and the rate at which the number of individuals are exposed to the risk of crime either in terms of personal or property crime, loss or damage and injury. Hence, individual risk of crime can be expressed as the proportion of a given population at risk of victimization per unit area. This is deduce from the work of Grist (1978), who defines mortality data as the fraction of the population at risk or that does suffer death per unit area.

The Royal Society also classified risk into three dimensions; firstly, risks for which statistics of identified casualties are available; secondly, risks for which there may be some evidence, but where the connection between suspected cause and injury to any one individual cannot be traced (for instance, cancer long after exposure to radiation or a chemical); and thirdly the experts' best estimate of probabilities of events that has

not happened. The current study estimated and maps the probability of risk of victimization of lone parent, age, race and car from four years crime data.

Social scientist, consider risk to be multidimentional, social and personal, with a particular risk or hazard meaning different things to different people and different things in different contexts (Royal Society 1992). One view of risk perception is the use of mathematical modelling to analyze risk, such as the product of the probabilities and consequences of an event.

3:3 CONCEPTUAL RISK

The purpose of this conceptual risk is to explain the relationship between various concepts in relation to hazard, safety and risk. In the risk literature the concept of hazard can be classified according to severity of their potential effects, either in terms of safety, economics or other consequences. According to Royal Society (2001) hazard is a situation that could occur during the lifetime of a product, system or plant that has the potential for human injury, damage to property, damage to the environment or economic loss.

This concept of hazard can be related to the current study (crime) either in respect to potential human injury suffer from crime occurrence such as assault or inform of criminal damage if property is the object of focus. Both instances may result in either bodily harm or economic loss. Furthermore, a general concept of hazard may be applied to an industrial process or commercial organization. This may be as a result of adverse consequences of some event or combination of circumstances.

Second, the concept of safety relates to the freedom from risks that are harmful to a person, or group of persons, either local to the hazard, nationally or worldwide (Royal Society 2001). This implied that for the consequences of an event to be defined as a hazard, i.e. a potential for causing harm. For instance there are some risks to human population and therefore safety could not be guaranteed. A good example is the recent murder of five prostitutes in Ipswich (England) in the mouth of December 2006. Women were strongly advised by the police to keep off 'the red district' of the town in the interest of their personal safety.

Relating safety to crime, individual are expected to maintain some level of personal safety or provide some reasonable guidance to protect their properties. Safety in this sense is the freedom from unacceptable risks of personal harm. For instance, women are advised to avoid going out alone on a lonely and dark road or avoid boarding (alone) an illegal cabs on their way home after a night out especially under influence of alcohol. This is a way of encouraging personal safety decision making in avoiding been a crime victim.

Third, a general concept of risk is the chance, in quantitative terms, of a defined hazard occurring (Royal Society 2001). It is a combination of a probability measure of the occurrence of the primary events with a measure of the consequences of those events. There could be a set out criteria's for acceptability of some predicted risk or measured risk can be set by the appropriate or mandatory organization.

The concept of risk can be related to the likelihood of been a crime victim. In the current study, the proposed use of 'Colour Code' of green to red can show the level of

risk. This can be adjusted to reflect the level of risk of victimisation accordingly. For instance, in Ipswich (England) the risk level may be adjusted to colour red to reflect the extreme condition as a result of the murder of five prostitutes in the 'red light district'. In most cases such directive are often issued by the police service or if in case of modern day terrorism it may be issued by the home office.

3:4 RISK FACTORS

In the literature three categories of risk are identified namely, personal, general and cooperate risk. Personal risk is related to 'oneself'. Drottz- Sjoberg (1993) study that personal risks are judge as smaller than general risk, especially so-called lifestyle risks such as the risk of smoking or drinking alcohol. Personal risk is related to economic vulnerability and lifestyle as demonstrated in the work of Davidson and Freudenburg (1996), Tollgh (2000) and Potter (2001) that when it comes to crime, women perceive themselves to be at greater risks than men do. Flynn et al. (1994) analyze differences between white and other racial groups, with the formal being reported to be at lower risk of racial victimization than other groups such as the Black Caribbean, Asian and Chinese. At individual level the personal lifestyle can be linked to risk of victimization or exposure to hazard. In the current study race and other socio-economic indicators are used to estimate the probability of victimization.

General risk is the risk that is related to other people. Sjoberg (2003) study in Sweden considers the perceived ability to protect oneself from hazards by investigating age differences in risk perception, economic vulnerability and risk mitigation. The study shows that average personal risk was judged as smaller than general risk. Age differences in perceived risk were found to be more pronounced for general than for

personal risk. This is more pronounced for hazards where there was a small-perceived capacity of protection while age differences tended to be more constant for general risk. Although economic vulnerability affects both personal and general risk, it has a stronger effect on general risk. Risk mitigation is strongly related to general than personal risk. The individualists, hierarchists, egalitarians and fatalist are prone to general risk of crime especially the modern large scale terrorism, environmental and technological risk. Cooperate risk is related more to security risk. Gibson (2003) sites an example of a multi-national pharmaceutical company setting up a new global research and development facility.

Risk of crime may cut across the three categories. Individual may suffer personal victimization. A particular race may face general racial victimization. At the cooperate level, an organisation may face attack inform of criminal damage to company properties in an environment.

3:5 RISK COMMUNICATION

The Royal Society (1992) in the 1992 report stated that the study of risk communication is a relatively new development. To date few definitive empirical studies are available. Central to public policy, decision making and risk management is risk communication. Fisher (1991) identifies four overlapping conceptual approaches to risk communication. Firstly, risk communication is define within engineering communications in terms of a 'top – down' or one way transmission of some message about a hazard or risk from a particular 'expert' communicator to a 'non – expert' audience. This approach focuses on the characteristic of the source,

channel, message and receiver. This is derived from work in social psychology as reviewed by Lee (1986). One major criticism of this approach is that the communicator relegates the perspectives and knowledge of the risk bearers.

The next approach is the two – way exchange. The approach was the US National Research Council (NRC 1989) also considers risk communication is considered as '*an interactive process of exchange of information, opinion among individuals, groups and institutions. It involves multiple messages about the nature of risk and other messages, not strictly about risk, that express concerns, opinions or reactions to risk messages or legal and institutional arrangements for risk management'* (p.21). The NRC listed four reasons why risk communication is very important in our society. Namely, the desire of the government to inform; the desire to overcome opposition to decisions; desire to share power between government, public and desire to develop effective alternatives to direct regulatory control.

Thirdly, risk communication stresses both the exchange of information between actors and wider institutional and cultural contexts, in which risk message are formulated, transmuted and embedded (Fessenden-Raden et. al (1987); Krimsky et. al (1988). These authors regarded risk communication as a complex 'tangled web' of messages, signs and symbols relevant to hazards. Finally, risk communication is viewed explicitly as part of a wider political process which operates within a democratic society. Communication is regarded as a weapon of empowerment of the risk – bearing group in the society. The important factor here is whether public groups should be granted a right to know about the risks that they face and their role in risk management decision making.

To date, there is no universal mode of risk communication. The current study employs scientific tool (statistics) to analyze and map risk of crime. Also a 'Colour Code' of green to red is used to communication the probability of risk of victimization. It is pleasing, easy to interpret and familiar to lay people. The green to red colour is widely use in the traffic light management across the world. For instance, in the building security lock the green to red colour is used to show the access to a building through the use of the buzzer: when the system is busy it shows yellow, when access is denial it shows red and if access is permitted it shows green. Therefore using the colour code to show the degree of crime in an area can be easily understood by the general public.

Table 3.1: Crime Colour Code

COLOUR ASPECT	CRIME INDICATOR
Green	Minor
Light green	Moderate
Yellow	Intermediate
Orange	Severe
Red	Extreme

The table above is similar to the 1990, UK National Rivers Authority, device warning flood risk in three phases: a yellow warning (flood possibility), an amber warning (flooding likely) and red warning (serious flooding likely). These warning are linked to the description of the resultant risk (NRA 1990).

3:6 RISK QUANTIFICATION

Risk quantification refers to the measurement of risk in numerical terms. It also refers to the estimation of a given risk by statistical and or analytical modelling process (Royal Society 1992). In the current study, statistical inferences from historical crime data derived or recorded by the police are used in modelling, from which future occurrences can be predicted.

Risk estimate can be done in several ways first, by modelling, if no data is available, secondly, by breaking down the system into known subsystem such as event trees or fault trees, thirdly, by analogy with similar situations or by comparison with similar activities, lastly, with trend of historical data (NRC 1989). The current study will analyze the risk of victimization using the historic crime count data.

In the literature, various scales are used in hazard measurement, such as the Beaufort wind scale, for measurement of physical wind speed and associated visible effects (Beaufort 1805); the Richter scale (Richter 1935), a logarithmic scale to measure energy releases from earthquake; the Mercalli scale (Mercalli 1902) which measures the actual effect of an earthquake in an area or specific location, based on visual observation; the Chinese seismic intensity scale (Chen Yong et.al 1988) for measurement and prediction of potential surface damage within earthquake catchments area; the Bradford disaster scale (Keller 1990) for measurement of disaster such as aircraft, rail crashes, crowd disaster and industrial accident; and the International Nuclear Event Scale (INES), a means for promptly communicating to the public in consistent terms the safety significance of events reported at nuclear power plants. These scales are attempts to put events into perspective; scales can

facilitate a common understanding between the scientific community, the media and the public.

To date, no scale exists to measure or communicate the risk of crime. Crime is widespread and affects humans more frequently than the more exceptional hazards cited. The objective risk map based on (statistical) view can be used to estimate probability of being a victim of crime; map may be an aid the policing and decision making.

3:7 RISK MANAGEMENT

Risk quantification is carried out aid in management policy for the type of risk under consideration. Scale and frequency is very important in risk management. In the literature three notable classifications of risks are natural, technological and social hazards. Natural hazards include earthquakes, hurricanes, flood, drought etc. Technological hazards are a by-product of man's technological advancement. This includes nuclear, biological, chemical, earthquake, oil spillage and insecticide.

National Research Council (NRC 1983) argued that risk assessment and risk management are overlapping. But these are different tasks. The Royal Society (1992) states that in public policy, 'risk management' has been commonly used to refer to an analytic technique for quantifying the estimated risk of a course of action and evaluating those benefits. This is an attempt to argue the possibility of a risk free society and the value of cost – benefit analysis to human life. Hence, private and public dimension to crime risk management is not an issue for debate. Unlike other activities of individuals, corporation, associations and insurers, crime is managed at

public, private and individual levels. Crimes are committed against individual, corporate and the society at large. It is crime against individuals that aggregate to that of the general public. Objective risk analysis may aid crime management policy at government, policing and community level.

3:8 RESOURCE ALLOCATION

Horlick-Jones (1990) and Handmer (1992) claimed that safety levels are related to public spending and investment, notably in relation to transport, public utilities and investment in public infrastructure and that resource pressure may contribute to vulnerability to major accidents. Matching costs and benefits is paramount in public expenditures, especially in risk management. Although Adam (1985) argued that it is difficult to show clear links between resources committed and risk outcomes, as a result of the operation of factors such as 'the law of anticipated reactions' and risk compensation in human behaviour.

The Safer Cities Programme inaugurated in 1988; cost about £30 million is an example of study on resource allocation in England. One of the key features of the Safer Cities was meant to be high-crime areas were targeted for action. The programme was seem to have reduced local burglary and was cost – effective (Home Office 1996). By implementing action in a police beat reduced local risks by nearly 10 per cent. Physical security measures against each burglary seemed to work independently. But community-oriented activities (e.g., to increase awareness and promote crime prevention) needed reinforcement with action against other types of crime or against crime in general. The overall cost of each burglary prevented was about £300 in very high-crime areas. The average financial cost of a burglary to the

state and the victim was about £1,100. People's perception of their area's quality improved only where action was most intensive (Home Office 1996 p ix.).

In conclusion the analysis of crime risk may reveal hidden information about risk (spatial pattern) which may be of significance in comparative analysis of various crime prevention measures. Also the map from the analysis may be a useful medium to communicate risk to the local community. The emerged overall risk map may be useful in formulation and implementation of security measures and community safety partnership between the police and the community.

3:9 CHAPTER SUMMARY

The various ranges of concepts of risk is discussed in this chapter. Today there is no universal method for assessment of risk. Different types of risk for instance flooding and earthquakes have different method for assessing their risk and communication to the general public. In health risk assessment for instance, opinions and beliefs about the probable consequences of decisions are expressed as explicit quantitative models of exposure and exposure-response relations (Cox 2002 p. 2). The current study uses green to red colour code for risk of crime communication. From this perspective, qualitative information can be provided about victimization, may support risk management policy and decision making. The methods that are used to achieve the aim and objectives of this study are discussed in the next chapter.

CHAPTER FOUR

METHODOLOGY

4:1 INTRODUCTION

The purpose of this chapter is to discuss how the aims and the objectives of the current study will be achieved. It will start by discussing the collection of the four years historic crime data and then outline how and why the data was normalized by area and population density to become a measure of observed risk. Other sources of crime data are identified.

In chapter three the various views to the concept of risk was discussed. Risk is a complex and exists in aviation, road transportation, insurance, health, environmental management, and many other areas. One important fact that emerges from the risk analysis is that one can use the methods of science and mathematics to estimate risk. The likelihood may be expressed as a probability. This can be achieved using the mathematical and statistical methods, these methods are used in the current study.

4:2 CRIME DATA

Four years crime data was obtained from Leicestershire Police Constabulary for use in this study, namely the historic crime data recorded by the police from 1999 to 2003 financial years. These provide useful information from which accurate on patterns and trends in various offence category can be generated. These are the numbers of crime reported to and recorded by the police. These are inaccuracies in the crime recording process which means is difficult to have complete record of all crimes committed in any locality because some crimes go undetected and unreported. In the literature

criminologist refer to all crime that escapes counting as the 'dark figure of crime' (Evans and Herbert1989). However despite such problem, police statistics provide a good measure of trends in well-reported crimes, are an important indicator of police workloads, and can be used for local crime pattern analysis (BCS 2002 p.1).

The police do have the record of point location of crime, but member of the public (a this researcher) are not generally provided with such information as a result of the 1998 Data Protection Act in which rights of access to personal data is very crucial. The Data Protection Act imposes legal requirements on the collection, storage, processing and disclosure of personal (sensitive) information, held in structured manual (paper) files or electronic/IT based systems (DAP 1998). May be given crime location information may reveal the identity of a criminal if probe further. Therefore, members of the public (this researcher) are provided with the area specific data. This affect the choice of mapping carried out in the current study.

Other methods of collecting crime data not included in the mapping and analysis of this study are the British Crime Survey (BCS) and Self Report Survey (SRS). BCS reports crimes that occurred in the 12 months preceding interviews in a financial year (Simmons et al. 2002). It is primarily a 'victimization' survey; in which respondents are asked about the experience of crimes which they themselves have experience (BCS 1998). The BCS is relevant in the analysis of subjective risk which is not the focus of this study. BCS measures crimes against people living in private households in England and Wales and provide information on crime risks, the picture of the nature of crime, and take up other crime – related issues (BCS 2000 p.1).

The BCS fills the vacuums of unreported crime to the police hence provide vital information on these crimes. Individual members of public above age 16 are interviewed randomly. Such interview is argued elsewhere to give accurate picture of the levels of crime in the country, as some people will be a victim of crime but not want or bother to report the incident to the police. In order to classify incidents the BCS goes beyond collects extensive information about the victim of crime, but include the circumstances in which incidents occur and the behaviour of offenders committing crimes. In this way, the survey provides information to inform crime reduction measures and to gauge their effectiveness (BCS 1998). Additional information in the BCS includes information on the background of the respondents, contact with the police and lifestyle. Areas at risk of different types of crimes are identified. BCS provide forum for people to express their feelings about the fear of crime and opinion on the Criminal Justice System.

According to the BCS (2000 p.55) the following distinctions were made between the police crime data and BCS; firstly, the BCS provides a calendar year count, whereas police figures are now presented on a financial year basis. Secondly, the BCS figures are made for two-years periods, because the BCS has not been run annually. The picture over two years, may simply 'average out' different year –on –year changes. Thirdly, comparisons between the two crime measures are restricted to a sub-set of crimes. The picture of trends from police figures for full set recorded offences may differ from the BCS. Finally, changes introduced in April 1998 to the coverage of offences now counted by the police, as well as changes to how offences are counted, has complicated easy interpretation of the trend in recent police figures.

Fyfe (1997) in his reaction Smith 1989 essay on 'The Challenge of Urban Crime' in the street of Britain are getting better argued that the results of 1988 British Crime Survey indicate that the gap between Scotland and England and Wales is widening, with Scottish victimization rates lower than those south of the border for all categories of crime pointed out that the importance of geographical sensitivity to the uneven distribution of crime should be clear. Fyfe (1997) explains further that the spatial differentiation in crime evident at a national level is more marked at the intra-urban scale. He re-echo the problems of measuring crimes and this may account for variations in police record and public propensity to report offences. This result in distortion of level and distribution crime. In an attempt to overcome these problems there have been proliferations of national and local crime surveys in Britain since early 1980s measuring the incidence and impact of victimization among random sample of the population (Fyfe 1997 p 245). Fyfe (1997) argued that crime surveys do provide a more accurate alternative to police statistics in assessing the dimensions of the problems of urban crime. As a result of underreporting and therefore unrecorded volume of crime by police and greater degree of accuracy provided by crime surveys Fyfe uses both national and local surveys to map the contours of urban crime. Using the Edinburgh Crime Survey (Anderson et al. 1990), covering central Edinburgh Corstorphine (a mainly middle-class, owner-occupied suburb) and Craigmillar (a poor, peripheral council estate), found that the most important factor in determining the level of housebreaking was the area in which people live hence people are more or less likely to be victims of burglary not because of who they are, but because of where they live (Anderson et al. 1990: 22). However, when the spatial scale of analysis is narrowed, the intra-neighbourhood variations in crime become

apparent (Fyfe 1997: 248) this is a pointer to the importance of geographical scale in detecting the clustering of crime within neighbourhood.

The third method to collect crime data is Self Report Survey (SRS). SRS measures of criminal victimization have become widely used social indicators and tools in criminology and criminal justice (Cantor and Lynch 2000). The SRS include events that were reported to the police as well those that were not. This survey provides more details information on victim, the offenders, the nature of the crime, and the context in which it occurred (Cantor and Lynch 2000). Such details were not available in the traditional police records, if they do are not readily accessible.

Cantor and Lynch (2000) argued that prior to the institutionalization of victim surveys; crime information was entirely under the control of the criminal justice system. This raised questions about the accuracy and scientific impartiality of the resulting data. They argued further that the police have immediate and specific interest in the crime problem; there is always the suspicion that they are "cooking the books". It is argued elsewhere that SRS had a profound effect on theories of crime causation. The availability of highly disaggregated information on crime events, including events not known to the police, facilitated the development of a whole new way of looking at crime such as routine activity theory, opportunity theory and rational choice theories flourished in large part because of the availability of victim survey data (Hindelang et al. 1978).

The survey also provided an opportunity to identify and investigate the consequences of crime, by documenting the durable and psychic harm that resulted from

victimization, the survey prompted researchers to investigate why the degree of harm difference across crimes and victims (Resnick et al. 1993). SRS have contributed to the building of criminology theories for instance, the availability of SRS data encouraged the development and testing of victim-centered theories of crime (Hindelang et al. 1978). These theories focused on the occurrence of crime events rather than criminal motivation (Cohen and Felson 1979). They emphasized the routine activities of the victims as sources of opportunity for the motivated offender. The social, structural, and spatial location of victims influenced their routine activities, which in turn affected their risk of criminal victimization Cantor and Lynch (2000).

These three sources of data can be said to compliment one another and provide a clearer and better picture of crime in a particular locality. For instance the BCS which is a cross-sectional survey and police data may not identify sources of repeat victimization whereas SRS Polvic et al. (1990) argued is a better pointed to incidents of repeat victimization. The police source of data meets the aim of the current study. The police crime data are recorded in accordance with financial year, therefore crime occurrence can be analysed against revenue allocation. The police makers can evaluate police performance, level of criminal activities and resources. The police data allow for the spatio temporal analysis to be carried out yearly.

These police crime data for the period under study were pre-processed to comply with use in GIS softwares. Crime occurrence is recorded by police beat area .The crime data were used in the choropleth maps. This is to show the spatial variation in crime

occurrence as represent by each polygon over the period under study. ArcMap 8.3 and ArcView 3.3 are used in choropleth mapping.

4:3 CENSUS DATA

4:3.1 CENSUS GEOGRAPHY

Census data is important in the current study because, information on socio-economic variables used in the analysis can be obtained from the census data. To achieve this goal risk can be objectively defined so that two people can arrives at similar result by combining the same socio-economic variables with the same crime data (for instance from police crime data).

Census is the official count of a population carried out at set intervals. In England census date back to 1801 and since then every 10 years the nation sets aside one day for the census (National Statistic 2002). The aim of the census is to count every members of the population. Census is very important because it provides detailed information about the entire population. The same structured or worded questions are asked from the entire population. An answer to such question makes comparison among various parts of the country easier between different groups across the nation. The information the census provides allows central and local government, health authorities and many other organizations to target their resources more effectively and to plan for housing, education, health and transport services for years to come (National Statistics 2002)

4:3.2 CENSUS VARIABLES

In the United Kingdom the most important single source of socioeconomic information is the decennial Census of Population, which is widely used in both the public and private sectors (Martin1991). The question asked in the household accommodation include, types of accommodation, availability of central heating, ownership of accommodation and types of landlord. Other questions asked from household members include, age and marital status, medical and care establishment, hotels, ethnic group, economic position, address, long-term illness, migrants, tenure and amenities, lone parents, types of accommodation, occupancy, tenure of dwellings, employment status, occupation, social class, family composition and qualified manpower etc. (National Statistics 2002)

For the current study census variables were downloaded from the Manchester Information Datasets and Associated Services (MIDAS). Table 2 shows the list of the variables used with previous studies and the rationale for using the variables. The purpose of the table is to identify the goals and the methods criminologists use to analyze crime. Such analyses show whether there is a relationship between the variables considered. For instance, poverty and risk of victimization; victimization and built environment, these are reflected in the literature review session.

Table 4.1: PREVIOUS STUDIES AND VARIABLES

VARIABLE	AUTHOR	CRIME	RATIONALE
Age (elderly)	Cohen et al. (1979	Burglary from dwelling	Lifestyle. Vulnerability
Age	Sampson et al. (1982)	Burglary from dwelling	Neighbourhood
Age	Mawby (1988)	Burglary from dwelling	Neighbourhood
Age	Pederson (2001)	Burglary from dwelling	Social and Environmental factors
Race	MacLean (1986)	Burglary from other than a dwelling	Car
Race	Stanko (1990)	Other crime	Violence
Race	Hindelarg (1978)	Other crime	Neighbourhood
Race	Smith (1982)	Burglary from dwelling	Neighbourhood
Car	Mayhew et. al	Burglary fro	Steering luck reduces
Car	(1990)	Burglary from dwelling	Car theft
Car	Van A (1992)	Burglary from dwelling	Surveillance
Car	Van Dijk (1994)	Burglary fro dwelling	Surveillance
Lone parent	Sampson et al	Homicide and	Victimization

	(1982)	Assault (1982)	
Lone parent	Box et al (1988)	Sexual Crime	Vulnerability
Area	Johnston et al. (1990)	Burglary from dwelling	Concentration of repeat victimization
Area	BCS (1984)	Homicide and Assault	variables are related to victimization
Environmental cues, accessibility,	Bichler-Robertson et al. (2002)	GIS application	Crime mapping
Enumeration district	Craglia et al.(2001)	GIS application	SPSS analysis
Crime concentration 'hotspot'	Bichler (2004)	GIS application	Repeat victimization
Immigrants, unemployment,	Perderson (2001)	Homicide and Assault	Demographic variables are related to victimization
economic status,	Clerigi et al. (2000)	Homicide and Assault	Validity of objective and subjective
Health condition	Clerigi et al. (2000)	Homicide and Assault	Measure of vulnerability
Lifestyle	Cohen et al. (1980)	Homicide and Assault	Family size
Lifestyle	Dewberry et al. (2003)	Homicide and Assault	Crime reduction

Unemployment	Witt et al.(1999)	Robbery	Reduction in crime
Poverty	Hope (1995)	Sexual crime	Rape, neighbourhood

The choice of variables used in the current study is informed from the list of variables from the previous studies which various authors have used in past studies. These variables were used prominently in the previous criminology research. The selection of the variable in the current study is based on the wide search of the past studies shown in table 4.1.

A result of the result of this initial regression analysis carried out, socio-economic variables that did not predict the value of the dependent variable (crime) they were dropped from the analysis. These variables that were dropped are not significant throughout the four years. Selecting the variables that are significant in the four years will made comparison easier. It appears that the socio-economic variables of age, car, employment status, ethnic group (race), lone parents and tenure amenities appears were the best predict of crime levels and these were therefore selected for use in the risk analysis during the period under study. Some crimes are committed against persons and other crimes are against property. Table 4.2 shows the list of variables that are relevant to the current study.

TABLE 4.2: VARIABLES USE IN THE CURRENT STUDY

VARIABLES	CENSUS CODE (1991)	COMPOSITION
Age	23	18-19 years , 20-25 years, 45-/49 years
Car	21	No car, Total car
Employment status	11	Employed, Unemployed
Ethnic group (Race)	06	White, Black Caribbean, Indian,
Lone parent	40	Total lone parents
Tenure Amenities	35	Exclusive use of shower & inside WC , Lacking share bath, shower & WC, No cental heating

Source : census.ac.uk/casweb

It is important to note that the data analysis was almost completed before the release

of the 2001 census data; hence the 1991 census data was used. These variables are

taken from the 1991 Small Area Statistics, (SAS) dataset at enumeration district level.

Denham and Rhind (1983, p.73) argued that 'in local authorities, SAS form an

important part of information needed for the planning and management of local

services, particularly to study trends and possible future patterns in the population and

the need for housing." The SAS are the largest body of data on population available for academic research in general.

4:3.3 BEAT AREAS WITH ENUMERATION DISTRICTS

Robinson et al. (1995 p. 162) argues that if population were dispersed uniformly, one mosaic of data collection regions would give as representative a picture of the distribution as the next. However population distributions are not uniform, census regions are usually defined by political boundaries, states, provinces, townships, cities and enumeration districts are used for data aggregation.

The current study use data aggregation base on enumeration districts (hereafter referred to as EDs). An ED is a geographic area assigned to a census taker, usually representing a specific portion of a city or county (genealogy.about.com/cs/census). This is the basic unit by which the census returns are arranged. Police crime data are however colleted on using a very set of spatial units, the police beat.

ED's are the smallest measurable area used in census hierarchy in this order, county, district, ward and ED. Martin (1991) argued that the smallest collection zone is the ED, which represents the household visited by a single enumerator at the time of the census. Although crime and census data are collected using different spatial frameworks, it is possible to combine them via use of the lowest level of census data collection, the ED. This is because most ED falls within police beats. Due to amalgamation of smaller beats into a larger beat for the purpose of spatial data management, this raise the question of the basic unit of analysis for crime statistics. It

is related to the problem called the – Modifiable Areal Unit Problem (MAUP). The census variables are collected for ED, therefore they are taken through the weighted overlay process in the ArcView.

The process of weighted overlay was done using the data partitioner dialogue box. There are three stages involved. First, the enumeration district area and police beat area are imported the ArcView. This is referred to as the boundary theme. In the boundary theme the overlapping polygons will be selected using the unique ID (area). The beat – ed overlay is shown in Figure 4.1.

Figure 4.1 An example from ArcView interface

Second is the data theme, the field to be calculated will be selected (police beat). The sample of the shape file is shown in Figure 4.2

Figure 4.2 An example from ArcView interface

Third, the output file is selected and Export to ArcMap. The editing command was used to ensure that cut –cut each other. The final output of beat-ed overlay serve as an input for the choropleth mapping in chapters 5 and 6.

Police beat can be defined as an area of land that officers move across or patrol repeated in order to detect or prevent crime. In Leicestershire a police officer is assigned to be the beat officer will beat officer's name and telephone number being published in print and web media to facilitate contact with members of the public wanting to report crime incidences or suspects. In some case the police beat falls within an ED while in some situations there may be more than one police beats in an ED. To ensure accurate approximation, the process described above (weighted

overlay) was carried out. However, this does not eliminate the MAUP identified and discussed below.

4:3.4 MODIFIABLE AREAL UNIT PROBLEM AND MAPPING

The Modifiable Areal Unit Problem (MAUP) was identified by Gehlke and Biehl (1934), showed that the differences could be observed between results obtained using data for areal units where different sets of zones are used for instance, beat data and socio-economic data (census). MAUP is a problem arising from the artificial imposition of artificial units of spatial reporting on continuous geographical phenomenon resulting in the generation of artificial spatial pattern (Heywood 1998). Taylor (1977) argued that the effect was related to spatial autocorrelation. That is the events that happen in different locations may be related. In a crime 'hotspot' for example, the underlying social and environmental process generate crimes in a small area can be analysed. This means that statistical measures of this condition, known as autocorrelation, can serve as 'hotspot' indicators (Roncek and Montgomery, 1995).

The MAUP states that changing the shape (the aggregation problem) or size (the scale problem) of the units on which the data are mapped can change the resulting models generated from the data (Malczewski 1999). It can be argued that the results of many decision analyses for geographic areas are sensitive to the particular areas in the analysis (number and boundaries). GISs facilitate the concept of user-defined flexible geographic representation. The same set of geographical data can be given a large number of broadly equivalent but different spatial representations (Openshaw 1984).

Wrigley (1995) explored the relationship between scale and zoning effect components and defined 'scale effect' as the tendency, within a system of modifiable areal units, for different statistical results to be obtained from the same set of data when the information is grouped at different levels of spatial resolution (e.g. census block, tracts, districts, counties and regions).

The scale problem affect prediction is that given the same variables analyzed at different levels of aggregation will produce varying results. For instance, the scale problems will address the question such as how many zones should be used (what is the level of aggregation). This has a serious implication on causal analysis. The 'zoning effect' is mathematical model. This is the variability in statistical results obtained within a set of modifiable areal units grouped at a given scale, which is not as a result of the variation in the size of those areas – i.e. the difference in results which follows from merely altering the boundaries or configurations of the zones at a given scale of analysis. The aggregation problems focus on the decision as to which zoning scheme should be chosen at a given level of aggregations. Monmonier (1996) demonstrated this problem by allocating the point locations of Dr. Snow's cholera victims in London during 1854 into three different areal configurations at the same scale. Each configuration yielded a different geographical pattern of cholera problem. It is noted in the literature that GIS mapping software, with its inherent capacity to facilitate rather simplistic analysis of areal uint, have substantially increased the risks associated with scale and zoning effects.

Openshaw and Rao (1995) for instance, demonstrated this graphically by mapping of ethnic minority population in Merseyside, changing the zoning (altering the boundaries) at a given scale alter dramatically the interpretation of the map. In Merseyside study, altering the conventional administrative representation to an approximately 'equal population' representation, the perceived locations of the higher concentrations of ethnic population is shifted·dramatically.

Wrigley et al. (1996) distinguished three kinds of effects which can lead to spatial clustering are: first, a tendency for people with similar attributes to choose to live near each other. Secondly, the effects of other characteristics of the area (which may not be available for analysis) and third, a tendency for people living nearby to interact as a result to develop common characteristics. Openshaw (1996) concluded that traditional spatial statistics and mathematical models are fitted to fixed spatial·data and thus are prone to MAUP effects. In the·current study, MAUP is an inherent problem in the nature of data used.

According to Blalock (1964) the ecological fallacy lies in the fact that there are many possible strategies for a set of individual data. Martin (1991) argued that relationships observed at a particular level of aggregation do not necessarily hold for the individual observations. For example, a high positive correlation between immigrants and crime (robbery) in a given zone does not necessarily mean that the immigrants are criminals. At individual level ·there may be a weak relationship ·between the two variables. However, in a larger aggregation, probability theory suggests that these unknown factors are more likely to cancel each other out; leading to more stable observations. The use of mathematical models to estimate the probability of risk of victimization

will minimize the MUAP in the current study. One way of overcoming this problem ·

in the current study is the conversion between ED and the beats to match through the

process of weighted overlay explained above.

4:4 MAPPING

There are many types of mapping techniques, but three types are discussed in the

current study. First, isarithmic mapping; second, dot (point) mapping; third,

choropleth mapping. Choropleth mapping is used in the current study because; the

. crime data available covers beat area rather than specific crime location. Also, the

range of values in the maps can be associated with enumeration units.

4:4.1 CHOROPLETH MAPPING

Slocum et al. (2004 p.250) point out that choropleth maps should be used for

phenomena ·with spatial variation and can be mapped with the boundaries of

enumeration units. Choropleth maps enable each area (e.g, ward, ED) to be shaded

according to the data, with different colours intensities show different values over

space. However, as Langford and Unwin (1999) note there are problems with using

choropleth maps for population data are; enumeration units hide the data variation that

exists within them. ED unit boundaries are arbitrary and this unlikely to be associated

with actual discontinuities in population density. Choropleth mapping is done due to

the nature of the data (this researcher) have access to from the police. Choropleth map

can convey the relationships in crime intensity in an area.

Generally there is a need for caution in interpretation of all maps. If a small area is

used for crime rate calculation, we may·have areas with crimes but no resident

population, producing an infinite crime rate. It is argued elsewhere that one should bear in mind that the crime rate concept is a loose one and crime rate maps are only an approximation.

4:6 STATISTICAL METHODS

The relationship between crime and the various selected socio-economic variables is analyzed using multiple regression models. A regression line can show us whether there is any causal relationship between variables of interest. The recorded crime data is the dependent variable while the socio-economic variables are the independent variables. The data is transform on the basis of regression models. The procedure is discussed in section 6.1.

4:7 CHAPTER SUMMARY

This chapter discussed the various source of data for crime analysis. A table was generated from the literature review to show how crime analyzed previously and establish a base and justification for the variables used in statistical analysis in the current study. The problem of transforming beat boundary to fit into the enumeration district was identified and how this was resolved by caring out cross estimation in ArcView. The concept of MAUP was discussed and the various attempt made to resolve it in the literature.

Also the various type of mapping techniques are mentioned and the technique used in current study was discussed. The rationale for selecting choropleth mapping was pointed out and the relationship between police beat and enumeration districts was.

examined. The methods used in the data analysis, the multiple regression. The next

chapter is the discussion of the research findings.

CHAPTER FIVE

OBSERVED RISK

5:1 INTRODUCTION

Observed risk is assessed using GIS by hotspot mapping of a number of significant

crimes recorded in Leicester during the period under study (1999/2000 to 2002/2003

financial year). The list of offences in the yearly crime data are; burglary from

dwellings, burglary from buildings other than a dwellings, criminal damage, cycle

theft, homicide and assault, robbery, sexual, theft from crimes, theft other crimes,

theft without consent, total of other crimes and total crime recorded.

This thesis mapped and discussed three types of crimes considering the reliability of

the police recorded crime data in relation to findings from the BCS over the years.

This is used as a basis to identify these three types of crimes: burglary from

dwellings, criminal damage and homicide and assault. According to BCS (2000) these

crimes are committed against individuals and their private properties. FitzGerald and

Hale (1996 p.54) in their review of the 1988 and 1992 BCS pointed out that members

of the general public and particularly people from minority ethnic groups are

encouraged to report crimes especially these (three crimes) to the police. According to

FitzGerald and Hale (1996) people from ethnic minorities especially Afro-

Caribbean's and Pakistanis were actually less likely to report incidents (racial) to the

police and where they had done so, they show a greater dissatisfaction with the police

response.

Clancy et al (2001 p.1) argues that BCS provides an important complement and provides a good yardstick for the estimates of crime reported and recorded by the police. The police made a significant effort to improve their public relations since the publication of the Stephen Lawrence Inquiry (Macpherson, 1999) and bring into spot light the way and manner crimes are recorded (Clancy et al. 2001). Hence police record could be more trusted and seen as a reliable more accurate record that reflect crime occurrence in the society.

To facilitate an easier understanding of the trend of crime over the period under study, polygons are selected from Leicester west, east and central districts to represent high, average and low risk crime areas. The selected polygons are the representation of the spatial distribution of crime count and risk of victimization in Leicester.

5:2 BURGLARIES FROM DWELLINGS

Burglary as an offence generally is recorded by the police if a person enters any building as a trespasser and with intent to commit theft, grievous bodily harm or unlawful damage (Simmons, 2001/2002). In the specific police data sources used here, burglary dwelling includes both burglary in a dwelling and aggravated burglary in a dwelling (Leicestershire Police Headquarters 2003). The total count of burglaries from dwellings is mapped for the

Fig. 5.1   Burglaries dwellings in Leicester City

Number of incidents

- 0 - 15
- 16 - 55
- 56 - 88
- 89 - 155
- 156 - 251

0   2   4   km

Fig. 5.2   **Risk of burglaries from dwellings per 1000 people**

Fig. 5.3

Risk of burglaries from dwellings per sq km

1999 - 2000

2000 - 2001

2001 - 2002

2002 - 2003

W17 E9 C31 C21

Incidents per sq km

1
2
3
4
5
6
7
8
9
10

0   2   4 km
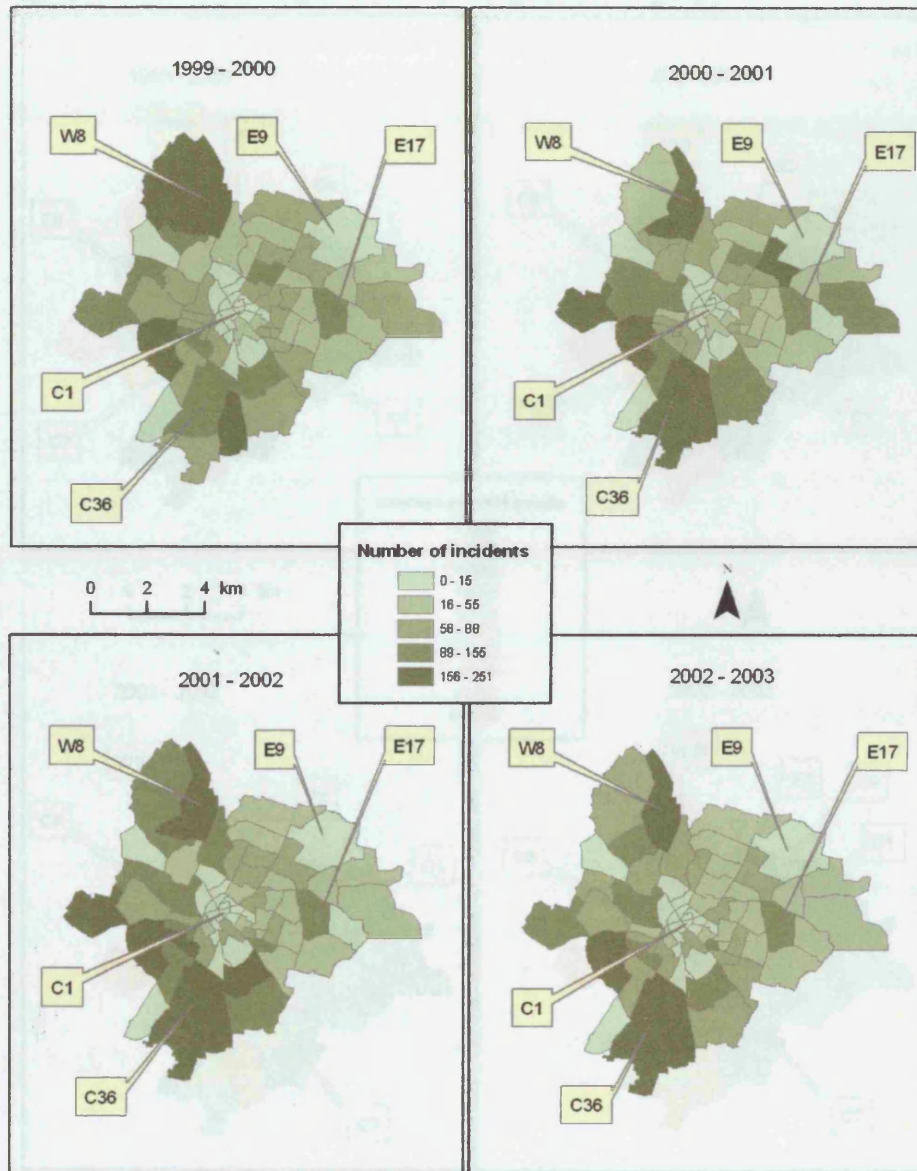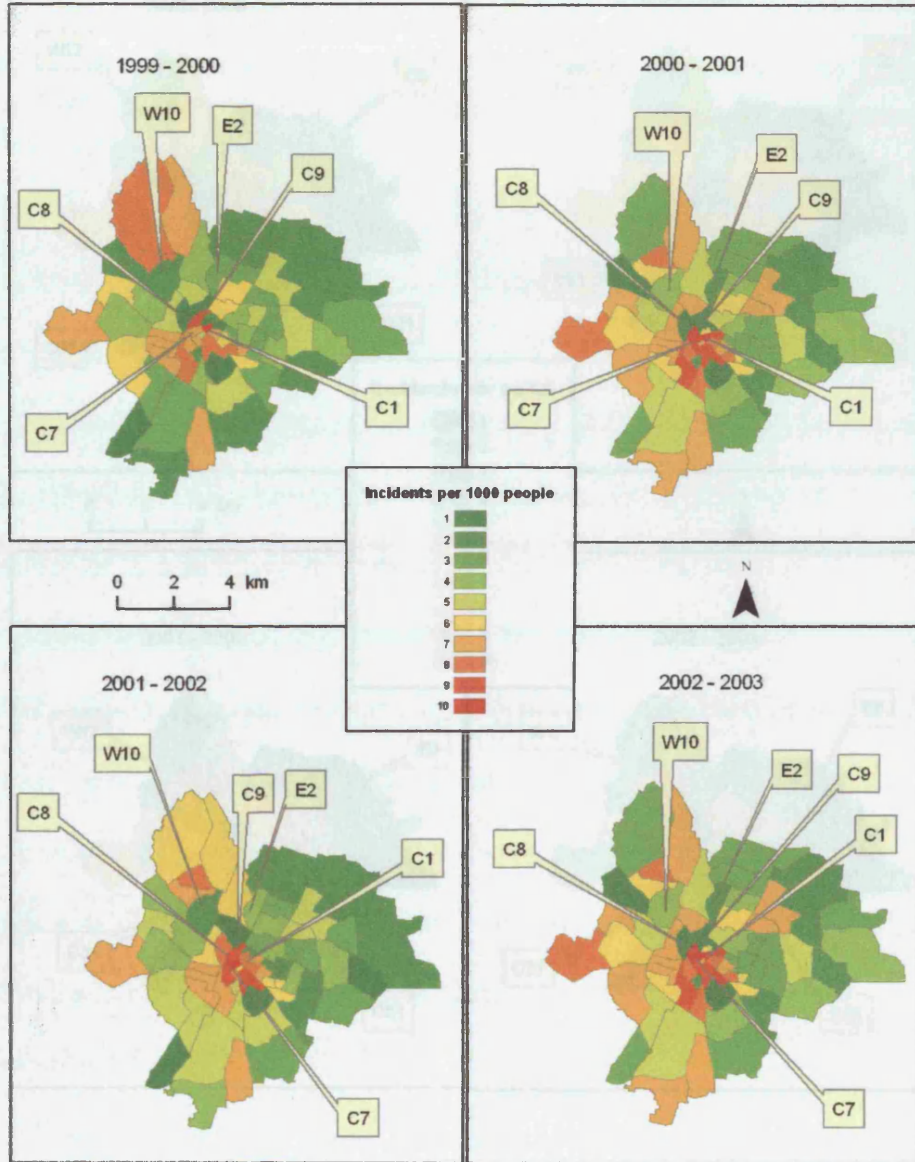
all four years. Figure 5.1 shows the choropleth mapping for this period. In W8 (Mowmace) very high incidents of burglaries from dwellings were recorded from 1999 to 2003 financial year. This makes this polygon a 'hotspot' for burglary crime. In E9 (Hamilton) incidents of burglary are very low during the period under study. In E17 (Rowlatt's) burglary from dwellings incidents are average for the four years. In C1 (City Centre) burglary from dwellings incidents are very low during the period under study. In C36 (Aylestone) the incidents of burglary from dwellings is average in 1999/2000 and very high in 2000/2003.

In Figure 5.2 when risk of burglary from dwellings is normalized against the beat population density, a different scenario emerges. In C1 (City Centre) the risk is extreme except in 2001/2002, when the risk is severe. In C7 (City Centre) the risk is moderate in 1999/2000 and increases to an extreme level during the rest of the study period. In C8 (City Centre) the risk is extreme in all four years. In C9 (City Centre) the risk is extreme in 1999/2000 and reduces to a relatively minor level in 2000/2001. In 2001/2002, the risk increases to an extreme level and reduces to a minor level in 2002/2003. In W10 (Stadium) the risk is minor in 1999/2000 and increases to moderate in 2000/2001. In 2001/2002 the risk reduces to minor and increases to moderate again in 2002/2003. In E2 (Belgrave) the risk is moderate in 1999/2000 and 2001/2002 and minor in 2000/2001 and 2002/2003.

In Figure 5.3 when risk burglary from dwellings is normalized against beat area, the scenario is different from Figure 5.2. when burglary from dwellings is normalized against beat population density. In W17 (Home Farm) the risk is extreme from 1999/2002 and reduces slightly to severe in 2002/2003 financial year. In C21

(Spinney) the risk is extreme in 1999/2001 and reduces to severe in 2001/2002 and further reduces to intermediate in 2002/2003.

The result of this study as shown in Figure 5.2 is similar to that of Tseloni et al (2004) who identified that there is a concentration of burglaries around city centre in England and Wales, United States and Netherlands. But when burglary from dwellings is normalized against beat area, Figure 5.3 reveals other parts of Leicester (city) that may not be at the city centre but nevertheless could be at very high risk. This result may be useful for insurance industry. In C31 (West End) the risks are extreme in 1999/2000 and 2001/2002 and in 2000/2001, 2002/2003 the risks are severe. In E9 (Hamilton) the risk is minor during the period under study.

The incidence of burglary dwellings is low around the city centre (Figure, 5.1) compared to (Figures 5.2 and 5.3) there is a geographical spread in incidents of burglary from dwellings in risk maps. One reason that may account for this spread in risk map may be due to the notion that offenders commit crimes in the neighbourhood they are familiar to. Apart from the city centre there are other parts of the city (Figures 5.2 and 5.3) that the risk burglary from dwellings ranges from intermediate to extreme during the period under study. This shows credence to the postulation of Hakim (1980) that burglary and property crime is 'imported', to wealthy, developed and enriched communities which are located close to one another and in some cases are easily accessible by highways.

Fig. 5.4   Criminal Damage in Leicester City

99

Fig. 5.5 Risk of criminal damage per 1000 people

1999 - 2000

2000 - 2001

2001 - 2002

2002 - 2003

incidents per 1000 people

1
2
3
4
5
6
7
8
9
10

0   2   4 km

100

Fig. 5.6 — Risk of criminal damage per sq km

1999 - 2000

2000 - 2001

2001 - 2002

2002 - 2003

Incidents per sq km

1
2
3
4
5
6
7
8
9
10

0   2   4 km
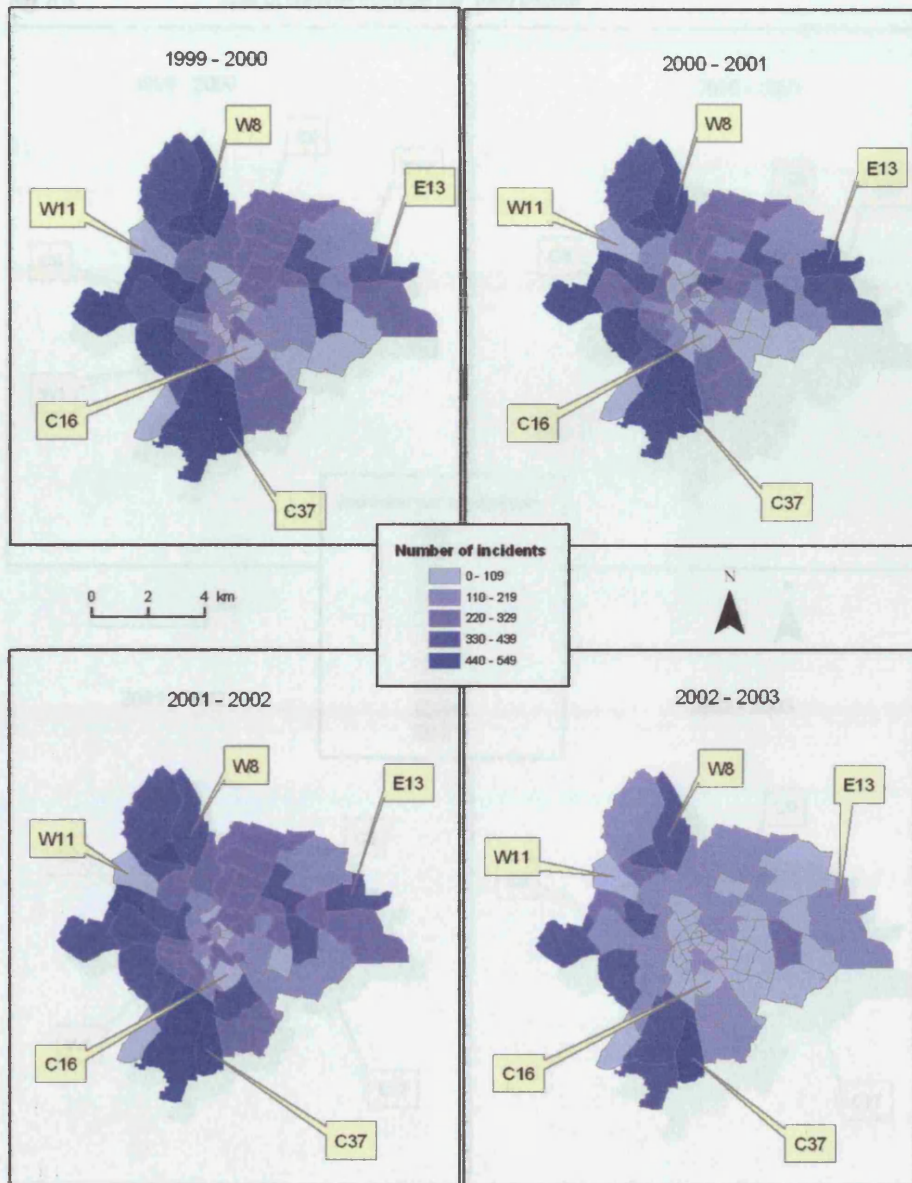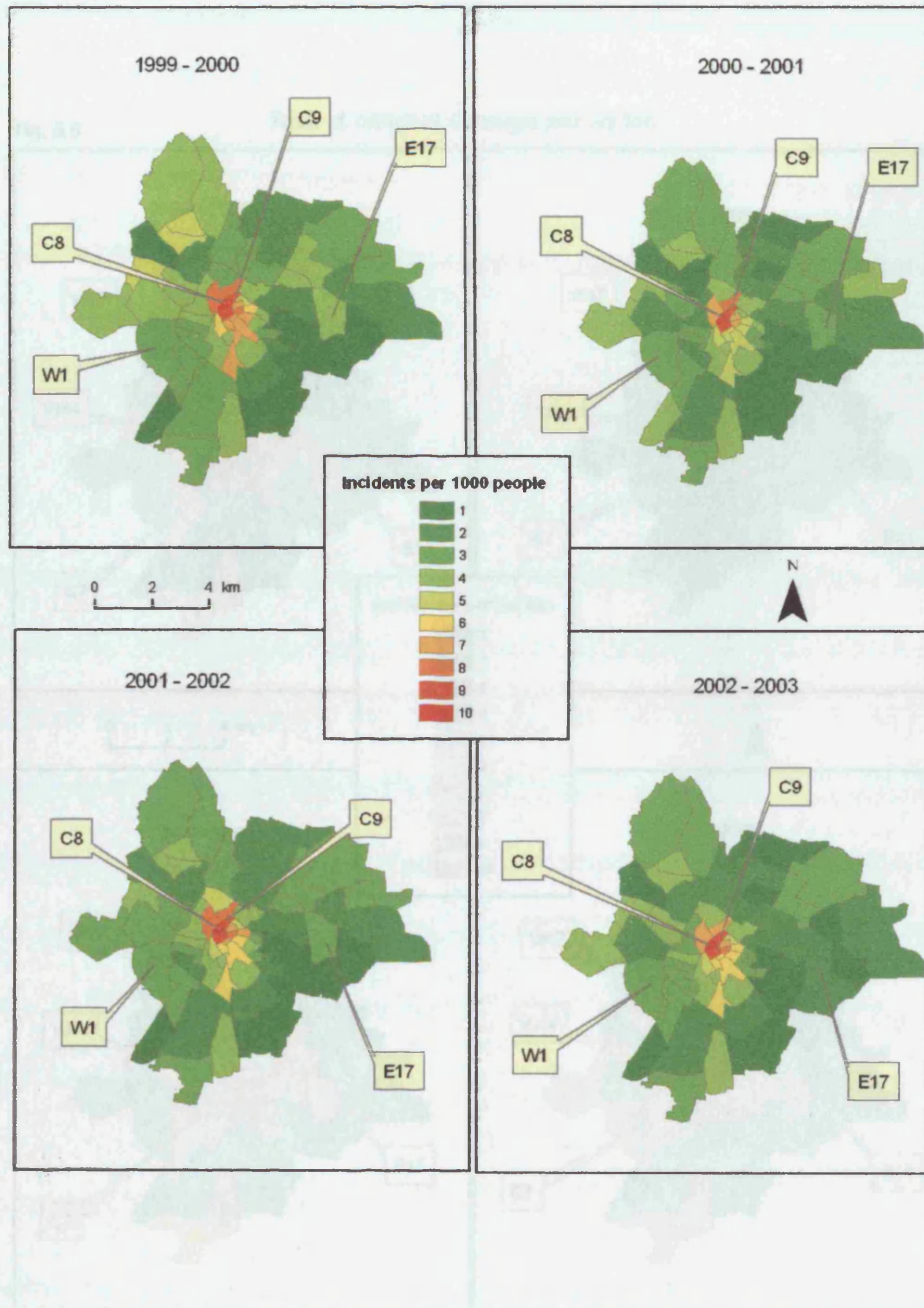
5:3 CRIMINAL DAMAGE

Criminal damage includes damage to a building other than a dwelling, a vehicle, racially or religiously aggravated damage to a dwelling and a building other than a dwelling and threat or possession with intent to commit criminal damage (Leicester Police Headquarters 2003). But according to BCS (2002 p180) criminal damage results from any person who without lawful excuse destroys or damages any property belonging to another, intending to destroy or damage any such property or being reckless as to whether any such property would be destroyed or damaged.

Figure 5.4 shows the criminal damage in the city and polygon W8 (Mowmacre) record very high incidents of criminal damage in 1999/2000 and 2000/2001. There was a reduction in 2001/2002 and slight reduction in 2002/2003. In W11 (Glenfield) the incidents of criminal damage is very low during the period under study. In E13 (Netherall) the level of incident is average in 1999/2000 and very high in 2000/2001. There was a slight reduction to average in 2000/2001 and reduces to low incidents in 2002/2003. In C16 (Victoria) the level of incidence is very low during the period under study. In C37 (Saffron Lane) the number of incidents is very high during the period under study.

When criminal damage is normalized against beat population density, in Figure 5.5, a different pattern emerges. In C8 (City Centre) and C9 (City Centre) the risks of criminal damage are extreme in the four years. In W1 (South Bra) the risk of criminal damage is moderate during the period under study. In E17 (Rowlatt's) the risk of

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criminal damage, is intermediate in 1999/2000 and reduces to moderate in the subsequent years.

When criminal damage is normalized against the beat area, a different scenario emerges. In Figure 5.6, the risk of criminal damage in W17 (Home Farm) is extreme in 1999/2000 and reduces to intermediate in 2000/2001. The risk increases to extreme in the 2001/2003. In W44 (New Parks) the risk of criminal damage, is extreme in 1999/2000 and reduces to moderate in 2000/2001. In 2001/2003 the risk is moderate. In C7 (City Centre) and C9 (City Centre) the risk of criminal damage is extreme in all four years. In E15 (Goodwood) the risk is moderate in 1999/2000 and reduces to minor in 2000/2001. The risk in E15 (Goodwood) increases to moderate from minor in the two preceding two years.

The incidence of criminal damage is very low in the city, but the risk of is very high and concentrated in the city centre when normalized against the beat population density. When risk is normalized against beat area, the risk variation is revealed. Criminal damage accounted for 19% of the property crimes in England and Wales (Home Office, 1999). One reason for this pattern may be due to the geographical spread of properties (personal and landed properties) across the city which may be targets of criminal damage.

Fig. 5.7   Homicide and Assault in Leicester City

Number of incidents

- 0 - 98
- 99 - 196
- 197 - 294
- 295 - 382
- 393 - 490

0   2   4   km

Fig. 5.8   Risk of homicide and assault per 1000 people

1999 - 2000

2000 - 2001

Incidents per 1000 people

1
2
3
4
5
6
7
8
9
10

0   2   4 km

2001 - 2002

2002 - 2003

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Fig. 5.9   Risk of homicide and assault per sq km

1999 – 2000

2000 – 2001

2001 – 2002

2002 – 2003

Incidents per sq km

1
2
3
4
5
6
7
8
9
10

0 2 4 km

N
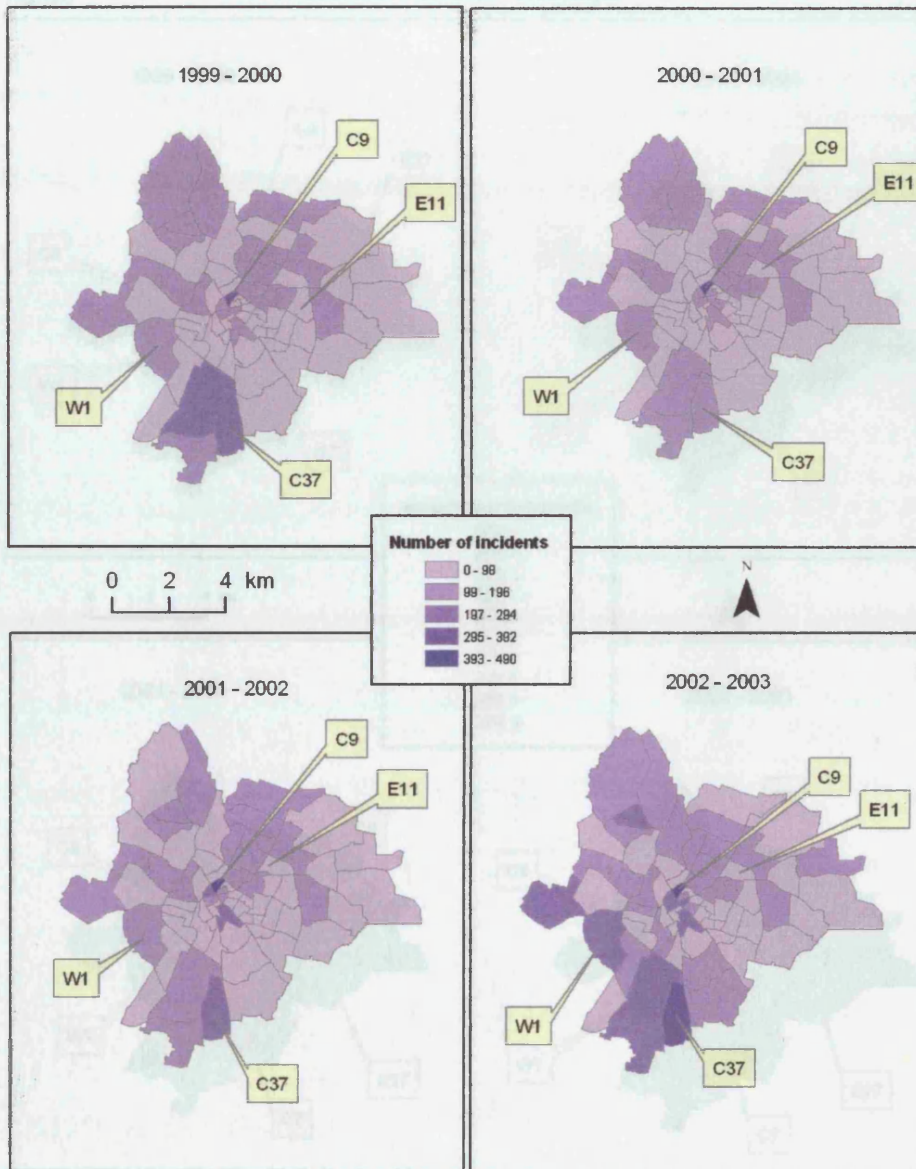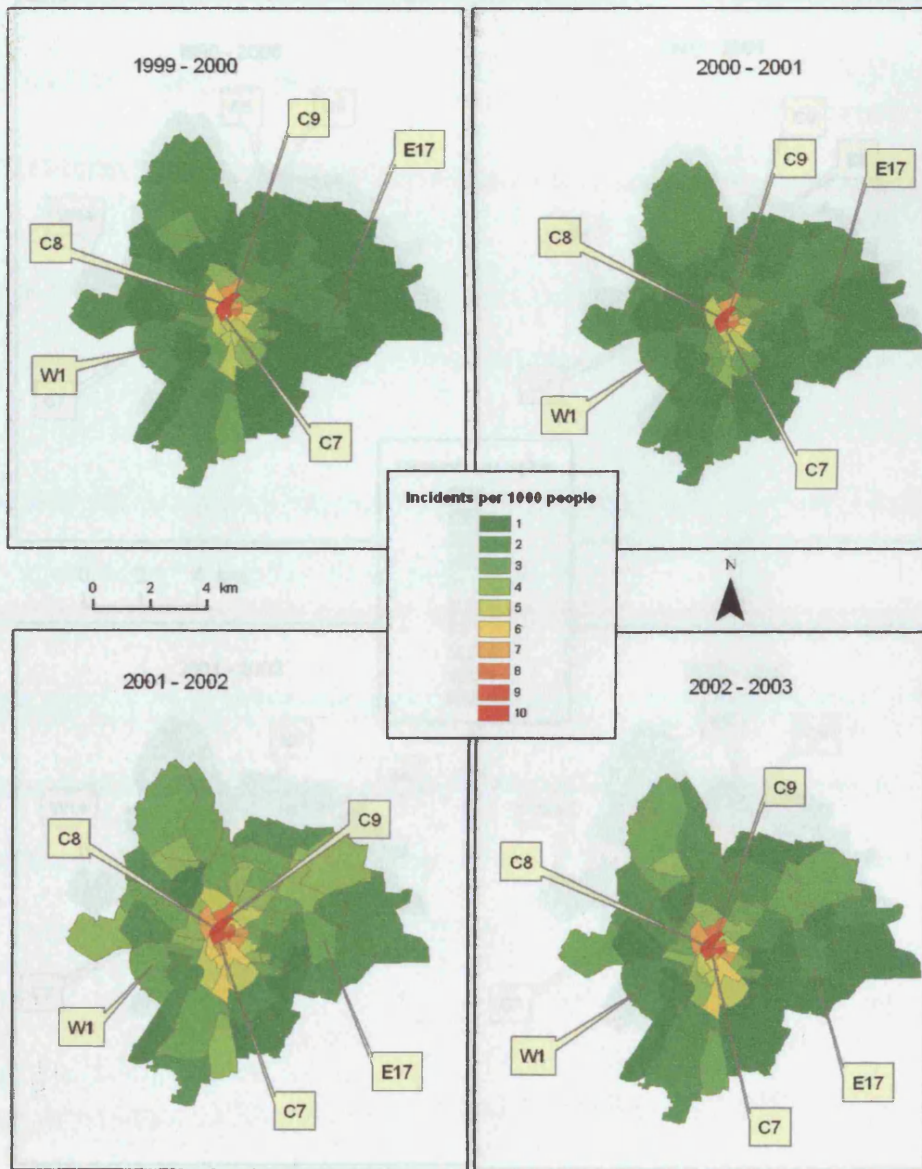
5:4 HOMICIDE AND ASSAULT

Homicide and assaults include various offences such as murder, attempted murder, manslaughter, infanticide, child destruction, causing death by dangerous or careless driving (include under influence), wounding or other act endangering life, possession of weapons etc (Leicestershire Police Headquarters 2003). Other offences classified into this category are shown in table 3.

Figure 5.7 shows the incidence of homicide and assault. In C9 (City Centre) the incidence is very high in all four years. In C37 (Saffron Lane) the incidence of homicide and assault is high in 1999/2000 and reduces to average low in 2002/2001. In 2001/2002 the incidence is average, while this rises to very high in 2002/2003. In W1 (South Bra) the incidence is average in 1999/2002 and high in 2002/2003. In E11 (Morton) the incidence is very low all the four years.

When homicide and assault is normalized against beat population density, Figure 5.8 shows the scenario. In C7 (City Centre), C8 (City Centre) and C9 (City Centre) the risk is extreme during the period under study. In W1 (South Bra) and E17 (Rowlatt's) the risk is moderate during the period under study.

Figure 5.9 shows that when homicide and assault are normalized against beat area, a different pattern emerges. In C7 (City Centre) and C9 (City Centre) the risk is extreme in the four years. In W14 (Braunstone) the risk is moderate during the period

under study. In E5 (Rushey Mead) the risk is moderate in 1999/2002 and minor in 2002/2003.

The concentration of high risk of homicide and assault in the three maps (Figures 5.13, 5.14 and 5.15) in the city centre may be attributed to the fact that the city centre is the hub of social activities with greater number of pubs. The possibility of been assaulted at night by those under the influence of alcohol increased vulnerability on their victim way home after been drunk can be attributed to high risk of homicide and assault. It is important to point out that the loose definition and crimes classified under this heading may influence this concentration in the city centre. The result of this study supports Deeham et al's (2002) findings of the concentration of assault in city centres in the UK.

Stickley and Makinen (2005) argued that lacking the traditional mechanisms of social control and poor living condition or periodic unemployment, a natural corollary of this was increased level of violence, including homicide. Furthermore, Rossow (2001) demonstrated a close link between alcohol and homicide in 14 European Countries.

The concentration of the risk of homicide and assault in the city centre shows credence to the postulation of Rhodes et al (1981) that offenders commit their crimes in areas that are public in nature. The probability is very high that assaults are committed when people are on leaving pubs, cinema or other forms of socializing. Also the risk is high around the city centre (Figures, 5.9 and 5.10) can be attributed to the high population density in the city especially during the day time which could aid indecent assault rather than rape.

5: 5 CHAPTER SUMMARY

In this chapter three types of crimes are mapped to show the spatial variation over four years. In an attempt to explore the data, for instance the crime is normalized against the beat population density and area. When any particular crime is normalized against beat population density there is a remarkable difference from when that crime is normalized against the beat area. This is another way of viewing crime map and could be very useful in policing resources allocation.

Although, various scenarios emerges when crime is normalized against beat population density and area, but polygons such as; C7 (City Centre) and C9 (City Centre) in the city centre feature prominently as hotspot whether crime is normalized against the beat population density or area. It is important to note that the crime incidence may be low in the city for instance; burglary from dwelling (Figure 5.1) but the risk maps show extreme cases even in the city centre (Figures 5.2, 5.6 and 5.9).

The result shows that the risk of being a crime victim is very high in the city centre compare to other parts of the city. The result is in line with past studies such as Brantingham and Brantingham (1981) and Clerigi and Killias (2000). The next chapter is the objective risk and calculated by the relationship of socio-economic factors to crime occurrence. The next chapter is the analysis of objective risk.

CHAPTER SIX

OBJECTIVE RISK

6:1 INTRODUCTION

In the current study, the objective risk is the statistical inference from historical crime data recorded by the police from 1999/2000 to 2002/2003 financial year. The objective risk data are generated using the result of multiple regression models. To assess the objective risk the following socio-economic variables were obtained from the census data: lone parent, car availability, economic position of household resident (employed and unemployed), tenure and amenities (exclusive use of bath/showers and inside WC; lacking or sharing use of bath/shower and or inside WC and No central heating), age group (18 – 19, 25 – 29 and 45 – 49 years) and ethnic group (White, Black Caribbean and India). In order to relate crime data and census variables, cross estimation was done in ArcView as indicated in chapter 4.

These socio-economic variables are interrelated and use as a surrogate measure of risk. The basic assumption underlining the use of multiple regression model is that lumping these surrogate variables together may give a better view of risk. The multiple regression model is a direct extension of the single linear form (Shaw and Wheeler 1997). It attempts to predict and explain the variation of a single dependent variable (crime) from a number of predictor terms otherwise known as the independent variables.

According to Shaw and Wheeler (1997) geographers are now more aware of the difficulties inherent not only in regression analysis but also in the use of powerful statistics packages and their options for data manipulation. Poole and O'Farrell (1971), Mather and Openshaw (1974) and Gould (1970) also identified two problems. First, important assumptions necessary for the validity of regression models may not always be fulfilled. Second, unquestioning dependence on the results of pre-written computer packages can be ill-advised, especially if insufficient attention is given to the substantive suitability of the raw data and the sampling frame within which they were gathered.

Mather and Openshaw (1974) stated that one way of overcoming the difficult in regression analysis is to normalise and transform data. Shaw and Wheeler (1997) argued that even if we harbour reservations about some of our variables, practical impositions may mean that no other data are available and a compromise might be needed between the practical need for data and more purely academic demands of the exercise.

The multiple regression equation can be summarized as:

$$Y = a + b_1 x_1 + b_2 x_2 + b_3 x_3 \ldots\ldots\ldots b_j x_j \qquad \text{(i)}$$

According to Ott (1988), one way to deal with model is to take natural logarithms of both sides of the equation becomes;

$$\text{Log } Y = \log a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3 \ldots b_j \log x_j \ldots\ldots\ldots \text{(ii)}$$

$$Y = 10^{(a + b_1 \log x_1 + b_2 \log x_2 + b_3 \log x_3} \ldots\ldots\ldots\ldots b_j \log x_j \qquad \text{(iii)}$$

Table 6.1

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.974	.667		-1.459	.150
	logaloneparent	.340	.173	.401	1.969	.054
	logacar	.012	.076	.018	.165	.870
	logaemployed	1.382	.767	1.733	1.802	.077
	logaunemployed	-.229	.263	-.282	-.872	.387
	logaeubsiwc	1.533	.887	1.903	1.728	.090
	logalsbswc	-.096	.100	-.123	-.960	.341
	loganch	-.165	.208	-.226	-.791	.432
	logaeighteennineteen	-.051	.369	-.060	-.139	.890
	logatwentytwentynine	-.215	.597	-.275	-.360	.720
	logafortyfivefortynine	-.678	.431	-.860	-1.574	.121
	logablacarib	.456	.287	.554	1.590	.118
	logawhite	-1.242	.627	-1.556	-1.981	.053
	logaindia	-.580	.218	-.895	-2.663	.010

a Dependent Variable: logaburglarydwelling

Table 6.1 shows the unstandardized and standardized coefficients sample result of multiple regression of log of burglary from dwellings (1999/2000) regressed against log of selected socioeconomic variables. The table shows the level of significant of the socioeconomic variables.

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Table 6.2

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.202	.725		-1.657	.103
	logaloneparent	.362	.188	.419	1.926	.059
	logacar	.003	.082	.004	.032	.975
	logaemployed	1.944	.833	2.400	2.333	.023
	logaunemployed	-.215	.286	-.260	-.752	.455
	logaeubsiwc	1.003	.964	1.225	1.040	.303
	logalsbswc	-.108	.109	-.136	-.995	.324
	loganch	-.084	.227	-.114	-.372	.711
	logaeighteennineteen	-.015	.401	-.017	-.038	.970
	logatwentyfivefortynine	-.393	.649	-.495	-.606	.547
	logafortyfivefortynine	-.866	.468	-1.081	-1.850	.070
	logablacarib	.367	.312	.439	1.178	.244
	logawhite	-1.019	.681	-1.256	-1.495	.141
	logaindia	-.583	.237	-.886	-2.464	.017

a Dependent Variable: logaburglarydwelling

Table 6.2 shows the unstandardized and standardized coefficients sample result of multiple regression of log of burglary from dwellings (2000/2001) regressed against log of selected socioeconomic variables. The table shows the level of significant of the socioeconomic variables.

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Table 6.3

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	T	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.575	.749		-2.104	.040
	logaloneparent	.261	.194	.277	1.345	.184
	logacar	.016	.085	.021	.187	.852
	logaemployed	1.308	.860	1.478	1.521	.134
	logaunemployed	-.303	.295	-.336	-1.027	.309
	logaeubsiwc	1.207	.995	1.350	1.213	.230
	logalsbswc	-.153	.112	-.175	-1.360	.179
	loganch	.099	.234	.122	.422	.675
	logaeighteennin eteen	-.137	.414	-.145	-.332	.741
	logatwentyfivetw entynine	-.364	.669	-.419	-.543	.589
	logafortyfiveforty nine	-1.042	.483	-1.189	-2.156	.035
	logablacarib	.613	.322	.670	1.905	.062
	logawhite	-.440	.703	-.496	-.625	.534
	logaindia	-.638	.244	-.887	-2.612	.012

a Dependent Variable: logaburglarydwelling

Table 6.3 shows the unstandardized and standardized coefficients sample result of multiple regression of log of burglary from dwellings (2001/2002) regressed against log of selected socioeconomic variables. The table shows the level of significant of the socioeconomic variables.

Table 6.4

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-1.086	.747		-1.454	.152
	logaloneparent	.306	.193	.322	1.580	.120
	logacar	-.007	.085	-.009	-.083	.934
	logaemployed	1.754	.858	1.971	2.045	.046
	logaunemployed	-.286	.294	-.315	-.971	.336
	logaeubsiwc	.669	.993	.744	.674	.503
	logalsbswc	-.018	.112	-.020	-.157	.876
	loganch	.124	.233	.152	.530	.598
	logaeighteennineteen	-.162	.413	-.170	-.393	.696
	logatwentyfivetwentynine	-.698	.668	-.801	-1.046	.300
	logafortyfivefortynine	-.614	.482	-.698	-1.274	.208
	logablacarib	.673	.321	.732	2.098	.041
	logawhite	-.457	.702	-.512	-.651	.518
	logaindia	-.724	.244	-1.002	-2.972	.004

a Dependent Variable: logaburglarydwelling

Table 6.4 shows the unstandardized and standardized coefficients sample result of multiple regression of log of burglary from dwellings (2002/2003) regressed against log of selected socioeconomic variables. The table shows the level of significant of the socioeconomic variables.

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Fig. 6.1   Multiple regression analysis of risk (burglary from dwellings) per 1000 people

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Fig. 6.2   Multiple regression analysis of risk (burglary from dwellings) per sq km
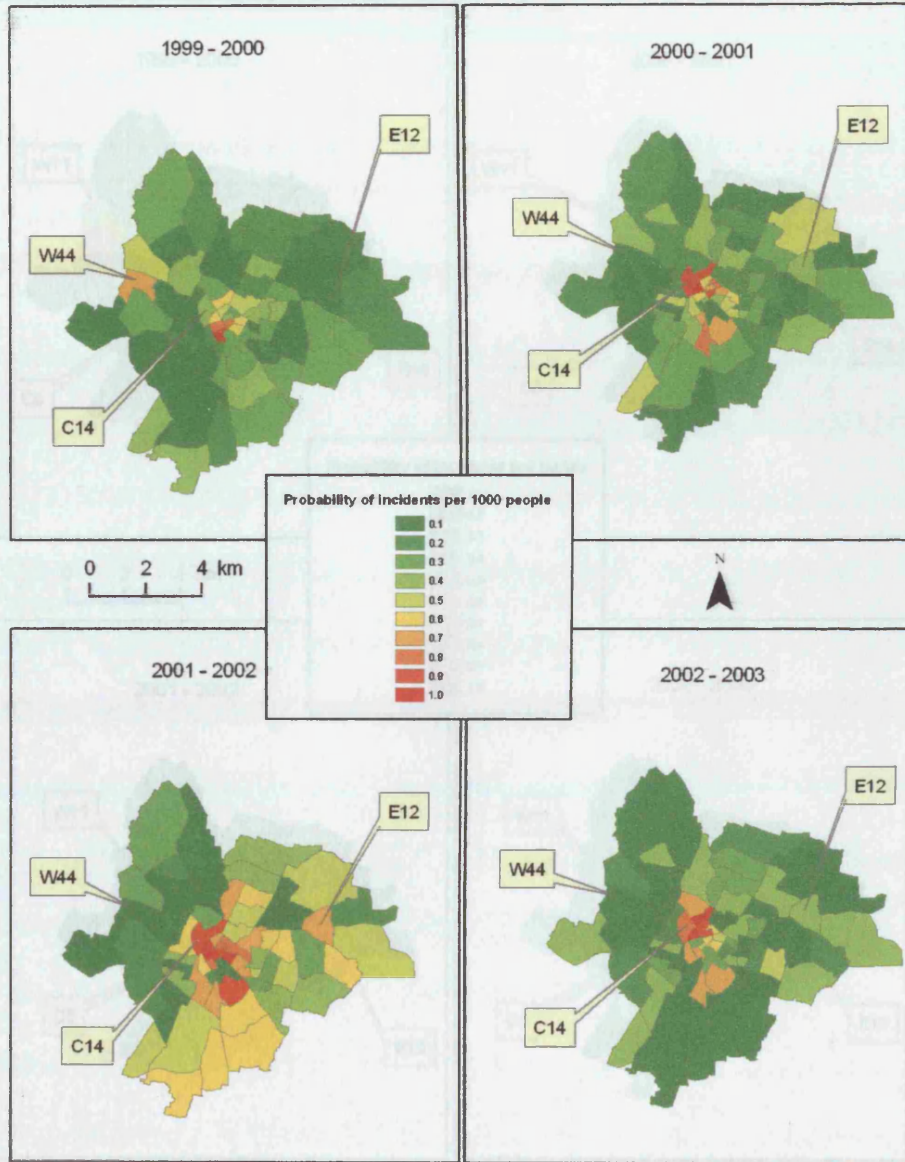
6:2 RISK OF BURGLARIES FROM DWELLING

Appendix 6.1 shows the multiple regression model of burglary from dwelling against the surrogate variables. The Y value (column T) is the likelihood of victimization, which is mapped and display in Figure 6.1 and 6.2. The value Y for other maps is derived following the same procedure. The graduation of the crime colour code in table 1 is used for the map interpretation.

Figure 6.1 shows the mapping of risk of burglary from dwellings normalized against beat population density. In W44 (New Parks) the risk is minor except in 1999/2000 that is severe. In C14 (Woodgate) the risk is moderate in 1999/2000 and increases to extreme in 2000/2002. In 2002/2003 the risk reduces to severe. In E12 (Humberstone) the risk is minor in 1999/2000 and increases to moderate in 2000/2001. In 2001/2002 the risk is severe and further reduces to moderate in 2002/2003.

When the risk of burglary from dwellings is normalized against beat area in Figure 6.2 the scenario is different. In W11 (Glenfield) the risk is moderate except in 1999/2000 that is intermediate. In C5 (New Walk) the risk is extreme except in 2000/2001 that it reduces to minor. In E15 (Goodwood) the risk is moderate in 1999/2000 and 2002/2003. In 2000/2001 the risk reduces to minor and increases to intermediate in 2001/2002.

The high risk of burglary from dwelling needed to be interpreted with caution. Some areas of these areas with negligible residential populations for instance, the city centres with a high population concentration during the day due to the volume of commercial activities. The low risk of residential burglaries in some area of the

Leicester may be due to security measures taken by the various households such the installation of security alarms, surveillance measures and guard dogs. Palmer (2002) examined the selection of targets by burglars in Leicester and concluded that of premises, the presence of thick vegetation and mode of entry all play a significant role in target selection.

Other factors that may aid target selection, as occupancy pointed out by Winchester and Jackson (1982), are a target's distance from the nearest house, distance from the road on which the house stands, visibility of the majority of sides of the house from public areas and the availability of access at both sides of the house from front to rear of the plot.

Hinderlang et al (1978) argued that victimization is affected by exposure factor. It is rational for offenders to targets property items that are portable like mobile phone, cash, television and video equipment especially where there is no sign of occupancy in the house. This reduces the risk of the part of the offender and increases the chance of reward.

The neighbourhood economic status may play a significant role in victimization. For instance, Sampson and Castellano (1989) argued that rates of victimization decrease as neighbourhood economic status increases. Figure 6.12 shows that may be related to robbery may be related to neighbourhood economic status. A low economic status neighbourhood based on the risk maps shows that victimization is related to neighbourhood economic status in Leicester.

Ellingworth and Pease (1998) analyzed the BCS data and concluded that moving home is associated with higher level of victimization, both before and after the move. The reasons for this are; people who move have lifestyles that make them at greater risk of suffering property crime. Also, before people move, the house from which they move becomes more vulnerable because of the fact of moving which results in reduced property guardianship. After a move, new residents of an area will not be recognised by others, hence not be in a position to exercise formal or informal guardianship.

Wellsmith and Burrell (2005) tested the hypotheses that frequently stolen items are 'craved' (Clarke, 1999). Wellsmith and Burrell concluded that the most commonly stolen items are cash, jewellery, mobile telephones, portable stereos and television. One factor that seems to support the stolen of these items may be the desire of the buying public in illegitimate second hand markets. The neighbourhood economic status may play a significant role in victimization. For instance, Sampson and Castellano (1989) argued that rates of victimization decrease as neighbourhood economic status increases. Burglaries may be related to neighbourhood economic status. A low economic status neighbourhood based on the risk maps shows that victimization is related to neighbourhood economic status in Leicester.

Table 6.5

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.446	.678		-.658	.513
	logaloneparent	.046	.176	.056	.264	.793
	logacar	-.012	.077	-.017	-.151	.881
	logaemployed	.688	.778	.882	.884	.381
	logaunemploye d	-.312	.267	-.393	-1.169	.248
	logaeubsiwc	2.528	.901	3.208	2.806	.007
	logalsbswc	-.061	.102	-.080	-.601	.550
	loganch	-.009	.212	-.013	-.044	.965
	logaeighteenni neteen	.116	.375	.139	.309	.759
	logatwentytwen tynine	-.656	.606	-.859	-1.082	.284
	logafortyfivefort ynine	-.340	.438	-.441	-.777	.441
	logablacarib	.632	.291	.784	2.169	.034
	logawhite	-1.436	.637	-1.839	-2.255	.028
	logaindia	-.773	.221	-1.222	-3.499	.001

a Dependent Variable: logacriminaldamage

Table 6.5 shows the unstandardized and standardized coefficients sample result of multiple regression of log of criminal damage (1999/2000) regressed against log of selected socioeconomic variables. The level of significant is also shown.

Table 6.6

<div align="center">Coefficients(a)</div>

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.496	.664		-.747	.458
	logaloneparent	-.126	.172	-.154	-.735	.465
	logacar	-.037	.075	-.056	-.494	.623
	logaemployed	.217	.763	.281	.285	.777
	logaunemployed	-.121	.262	-.153	-.461	.647
	logaeubsiwc	2.526	.883	3.239	2.862	.006
	logalsbswc	.004	.100	.005	.040	.968
	loganch	-.088	.207	-.125	-.425	.672
	logaeighteennineteen	.216	.367	.262	.590	.558
	logatwentytwentynine	-.700	.594	-.926	-1.179	.244
	logafortyfivefortynine	-.311	.429	-.407	-.724	.472
	logablacarib	.634	.286	.795	2.222	.030
	logawhite	-1.097	.624	-1.420	-1.759	.084
	logaindia	-.668	.217	-1.066	-3.085	.003

a Dependent Variable: logacriminaldamage

Table 6.6 shows the unstandardized and standardized coefficients sample result of multiple regression of log of criminal damage (2000/2001) regressed against log of selected socioeconomic variables. The level of significant is also shown.

Table 6.7

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.025	.603		.041	.968
	logaloneparent	.080	.156	.103	.511	.612
	logacar	-.023	.068	-.037	-.339	.736
	logaemployed	.625	.693	.861	.903	.371
	logaunemployed	-.353	.238	-.476	-1.485	.143
	logaeubsiwc	2.344	.805	3.194	2.913	.005
	logalsbswc	-.051	.090	-.072	-.567	.573
	loganch	.035	.188	.053	.186	.853
	logaeighteennineteen	.071	.333	.091	.213	.832
	logatwentytwentynine	-.523	.542	-.735	-.965	.339
	logafortyfivefortynine	-.079	.389	-.109	-.202	.841
	logablacarib	.653	.260	.865	2.515	.015
	logawhite	-1.559	.567	-2.147	-2.748	.008
	logaindia	-.815	.197	-1.378	-4.144	.000

a Dependent Variable: logacriminaldamage

Table 6.7 shows the unstandardized and standardized coefficients sample result of multiple regression of log of criminal damage (2001/2002) regressed against log of selected socioeconomic variables. The level of significant is also shown.

Table 6.8

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.172	.627		-.274	.785
	logaloneparent	.181	.162	.227	1.116	.269
	logacar	.021	.071	.032	.289	.774
	logaemployed	.771	.720	1.029	1.071	.289
	logaunemployed	-.111	.247	-.145	-.448	.656
	logaeubsiwc	1.593	.836	2.105	1.906	.062
	logalsbswc	.008	.094	.011	.084	.933
	loganch	-.434	.196	-.635	-2.216	.031
	logaeighteennineteen	.209	.346	.261	.604	.548
	logatwentytwentynine	-.293	.563	-.399	-.521	.605
	logafortyfivefortynine	-.201	.404	-.271	-.497	.622
	logablacarib	.422	.270	.543	1.566	.123
	logawhite	-.977	.589	-1.305	-1.658	.103
	logaindia	-.704	.204	-1.155	-3.449	.001

a Dependent Variable: logacriminaldamage

Table 6.8 shows the unstandardized and standardized coefficients sample result of multiple regression of log of criminal damage (2002/2003) regressed against log of selected socioeconomic variables. The level of significant is also shown.

Fig. 6.3   Multiple regression analysis of risk (criminal damage) per 1000 people

1999 - 2000

2000 - 2001

2001 - 2002

2002 - 2003

Probability of incidents per 1000 people

0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

0   2   4 km

N

Fig. 6.4   Multiple regression analysis of risk (criminal damage) per unit area

1999 – 2000

2000 – 2001

2001 – 2002

2002 – 2003

W16   E3   C7

Probability of incidents per unit area

0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

0 2 4 km

N

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6:3 RISK OF CRIMINAL DAMAGE

In Figure 6.3 the risk of criminal damage is normalized against beat population density. In W17 (Home farm) the risk is minor in 1999/2001 and increases to moderate in 2001/2003. In C8 (City Centre) the risk is extreme in the four years. In E9 (Hamilton) the risk is moderate in 1999/2001 and increases to intermediate in 2001/2003

Figure 6.4 shows the risk of criminal damage when normalized against beat area. In W16 (Gt Meado) the risk is except in 2001/2002 that is moderate. In C7 (City Centre) the risk is moderate in 1999/2000 and 2001/2002. In 2000/2001 the risk is severe further reduce to intermediate in 2002/2003. In E3 (Belgrave) the risk is intermediate in 1999/2000 and increases to severe in 2000/2001. In 2001/2003 the risk increases to extreme. The installation of Closed Circuit Television (CCTV) in public places (street) and car parks may reduce victimization, especially criminal damage to cars and public properties.

Reeve (1998) examined the use of CCTV in British town and city centres and concluded that it has become an acceptable feature of the public realm in recent years. He argued that CCTV is seem as a discrete technological response in management surveillance and policing practices of a perceived increase in crime and social disorder on the street and other urban space (particularly the city centres) is to create a predictable and risk free space for city dwellers. The risk maps (Figures 6.5 and 6.5) show a high risk of criminal damage around the city centre in Leicester despite the various CCTV cameras in the city. Criminal damage accounted for 24% of police recorded crime in England and Wales (BCS, 2001/2002)

Table 6.9

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-2.370	.872		-2.718	.009
	logaloneparent	-.299	.226	-.244	-1.322	.192
	logacar	.573	.100	.576	5.706	.000
	logaemployed	-.613	1.013	-.540	-.605	.548
	logaunemploye d	.220	.347	.190	.634	.529
	logaeubsiwc	1.787	1.160	1.558	1.541	.129
	logalsbswc	-.191	.133	-.169	-1.434	.157
	loganch	-.451	.278	-.436	-1.623	.111
	logaeighteenni neteen	.064	.483	.053	.133	.895
	logatwentytwen tynine	-1.258	.779	-1.130	-1.615	.112
	logafortyfivefort ynine	-.191	.564	-.170	-.339	.736
	logablackcarrib ean	-.220	.382	-.186	-.578	.566
	logawhite	1.143	.822	1.006	1.392	.170
	logaindia	.043	.290	.047	.149	.882

a Dependent Variable: logahomicideandassault

Table 6.9 shows the unstandardized and standardized coefficients sample result of multiple regression of log of homicide and assault (1999/2000) regressed against log of selected socioeconomic variables. The level of significant is also shown.
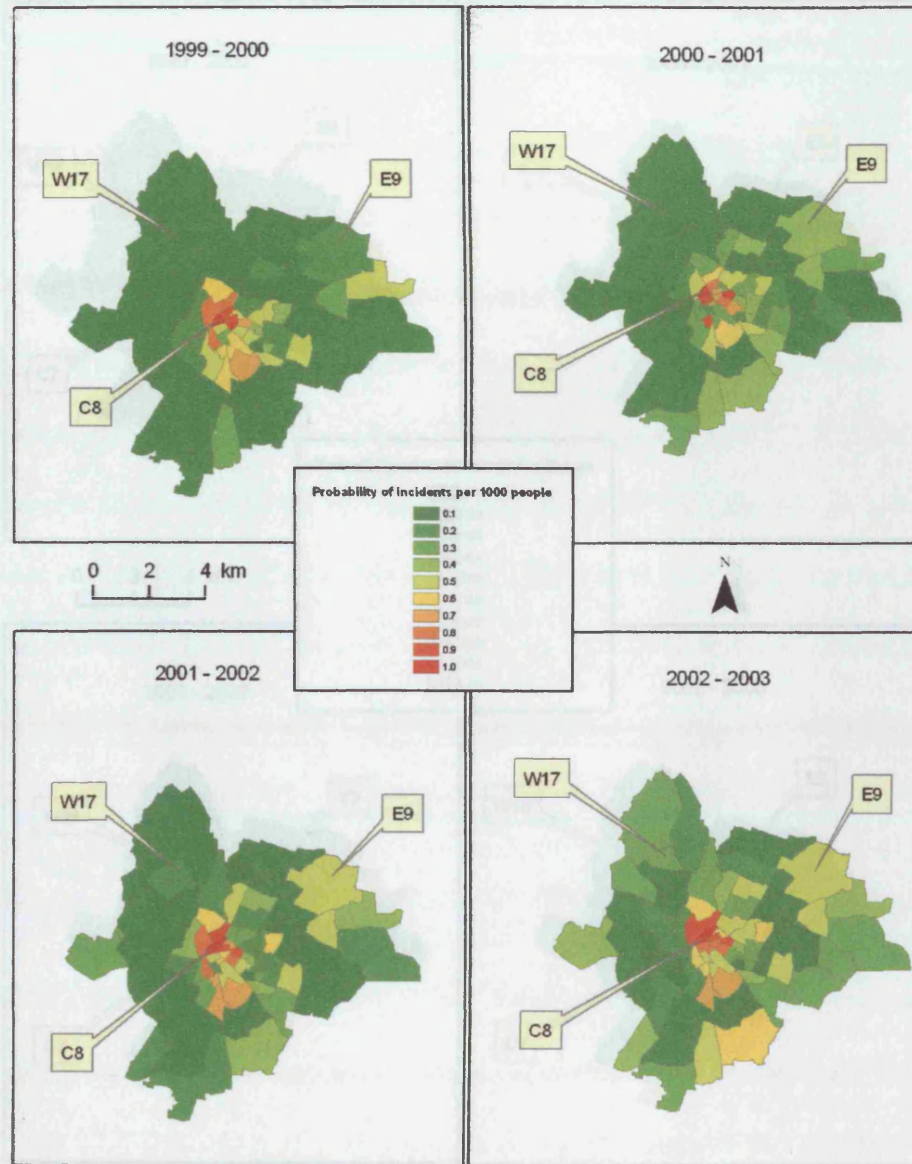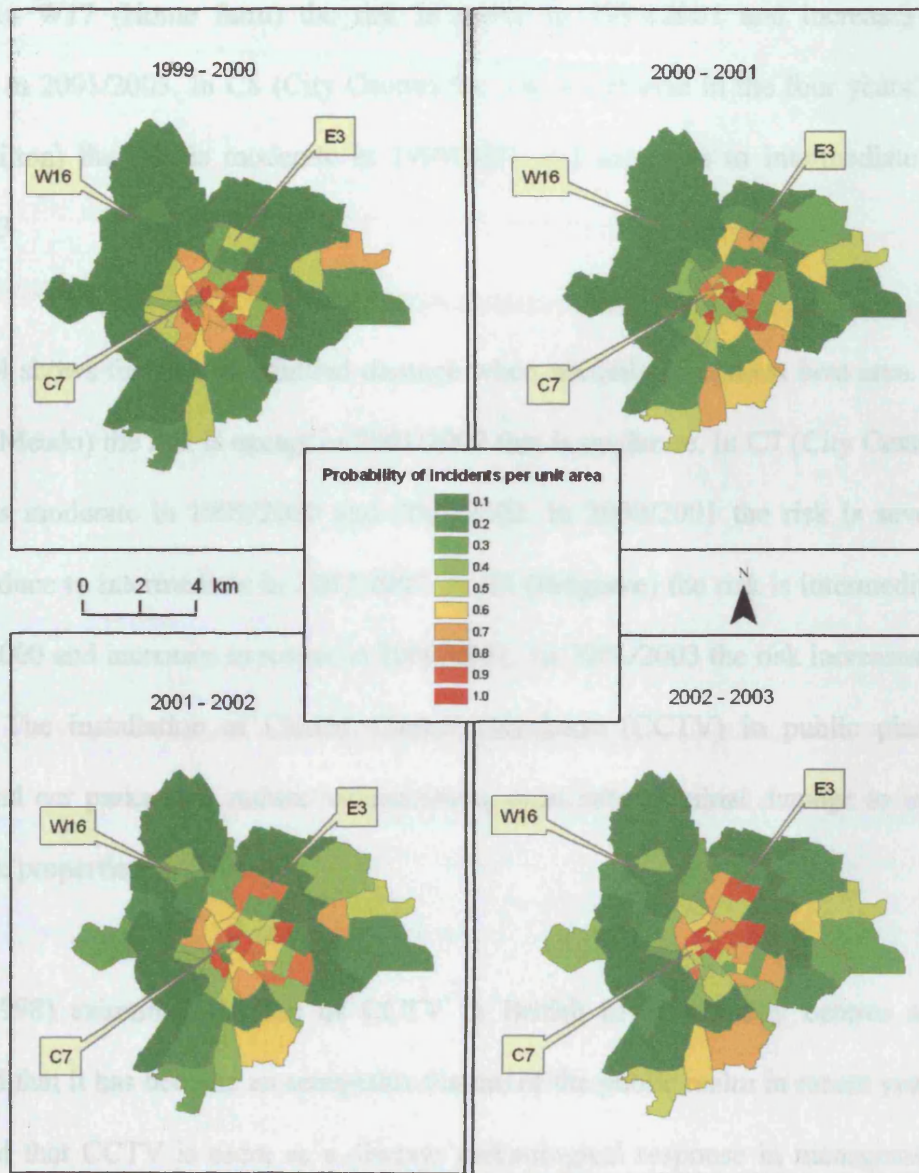
Table 6.10

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.262	.721		-.363	.718
	logaloneparent	-.168	.187	-.186	-.902	.371
	logacar	.024	.082	.033	.294	.770
	logaemployed	-.546	.828	-.643	-.659	.513
	logaunemployed	-.371	.284	-.429	-1.306	.197
	logaeubsiwc	3.138	.958	3.658	3.275	.002
	logalsbswc	.014	.108	.017	.134	.894
	loganch	.102	.225	.132	.455	.651
	logaeighteennineteen	-.129	.398	-.142	-.324	.747
	logatwentytwentynine	-.439	.645	-.528	-.681	.499
	logafortyfivefortynine	.071	.465	.085	.153	.879
	logablackcarribean	.902	.310	1.028	2.910	.005
	logawhite	-1.375	.677	-1.618	-2.030	.047
	logaindia	-.727	.235	-1.054	-3.090	.003

a Dependent Variable: logahomicideandassault

Table 6.10 shows the unstandardized and standardized coefficients sample result of multiple regression of log of homicide and assault (2000/2001) regressed against log of selected socioeconomic variables. The level of significant is also shown.

Table 6.11

<p align="center">Coefficients(a)</p>

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	-.085	.662		-.128	.899
	logaloneparent	-.181	.171	-.208	-1.056	.295
	logacar	.003	.075	.004	.037	.971
	logaemployed	-.921	.760	-1.128	-1.212	.231
	logaunemployed	-.373	.261	-.447	-1.429	.159
	logaeubsiwc	3.192	.883	3.864	3.615	.001
	logalsbswc	-.011	.099	-.014	-.115	.909
	loganch	.160	.207	.215	.774	.442
	logaeighteennineteen	-.214	.366	-.245	-.586	.560
	logatwentytwentynine	-.337	.594	-.421	-.567	.573
	logafortyfivefortynine	.206	.427	.254	.481	.632
	logablackcarribean	.959	.285	1.129	3.366	.001
	logawhite	-1.291	.622	-1.580	-2.074	.043
	logaindia	-.739	.216	-1.109	-3.423	.001

a Dependent Variable: logahomicideandassault

Table 6.11 shows the unstandardized and standardized coefficients sample result of multiple regression of log of homicide and assault (2001/2002) regressed against log of selected socioeconomic variables. The level of significant is also shown.

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Table 6.12

Coefficients(a)

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	1.164	.759		1.533	.131
	logaloneparent	-.090	.197	-.104	-.456	.650
	logacar	-.192	.086	-.274	-2.233	.030
	logaemployed	-.316	.872	-.391	-.363	.718
	logaunemployed	-.414	.299	-.502	-1.385	.172
	logaeubsiwc	2.623	1.009	3.204	2.600	.012
	logalsbswc	-.154	.114	-.193	-1.351	.182
	loganch	.246	.237	.332	1.039	.303
	logaeighteennineteen	.109	.420	.126	.260	.796
	logatwentytwentynine	-.041	.679	-.052	-.061	.952
	logafortyfivefortynine	.487	.490	.607	.994	.325
	logablackcarribean	.738	.326	.882	2.262	.028
	logawhite	-2.050	.713	-2.527	-2.876	.006
	logaindia	-.940	.248	-1.428	-3.795	.000

a Dependent Variable: logahomicideandassault

Table 6.12 shows the unstandardized and standardized coefficients sample result of multiple regression of log of homicide and assault (2002/2003) regressed against log of selected socioeconomic variables. The level of significant is also shown.

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Fig. 6.5   Multiple regression analysis of risk (homicide and assault) per 1000 people

In Figure 6.5 the risk of homicide and assault is represented against host population

Fig. 6.6   Multiple regression analysis of risk (homicide and assault) per sq km

1999 - 2000

E12

W44

C9

2000 - 2001

E12

W44

C9

Probability of incidents per sq km

0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0

0 2 4 km

N

2001 - 2002

W44

E12

C9

2002 - 2003

W44

E12

C9

133
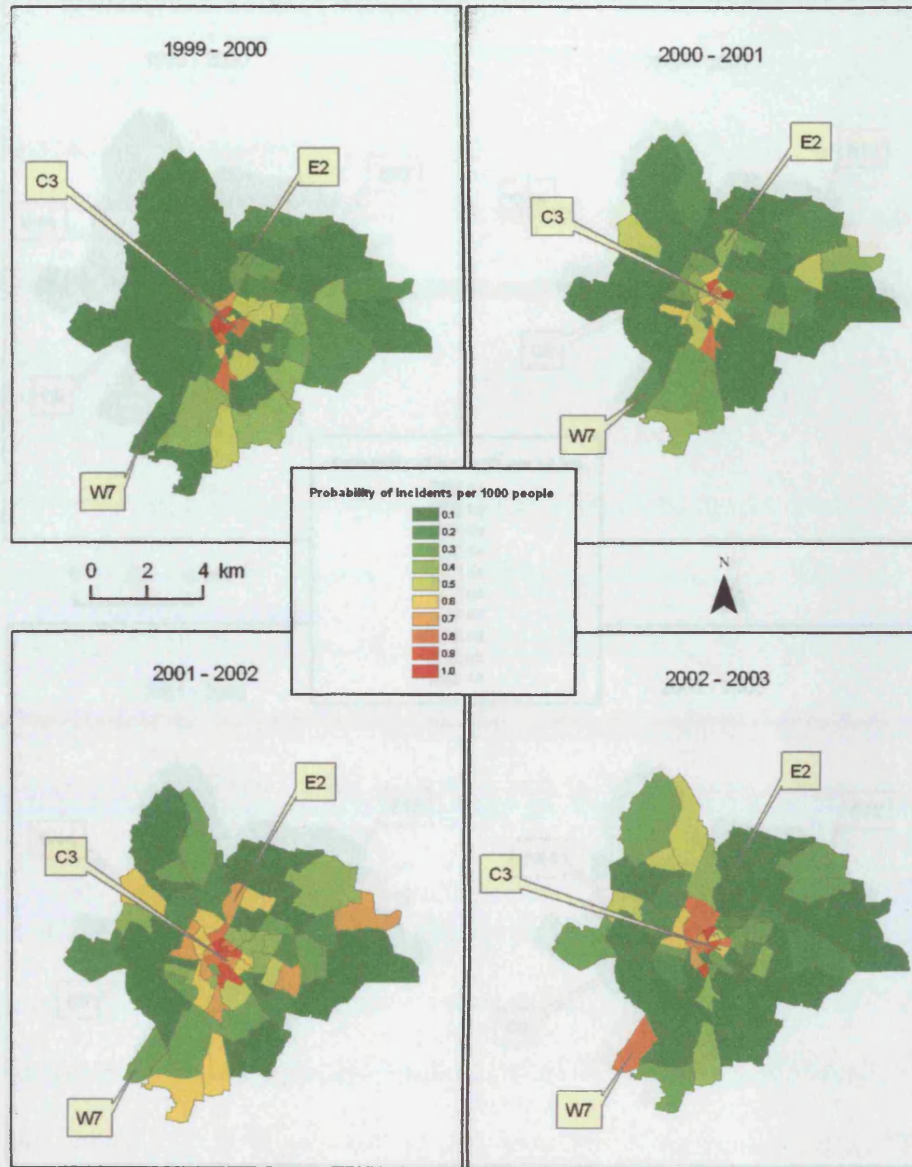
6:4 RISK OF HOMICIDE AND ASSAULT

In Figure 6.5 the risk of homicide and assault is normalized against beat population density, in W7 (Fosse Park) the risk is minor in 1999/2000 and increases to moderate in 2000/2002. In 2002/2003 the risk is extreme. In C3 (Charles) the risk is extreme in 1999/2000 and reduces to moderate in 2000/2001. In 2001/2002 the risk increases to severe and reduces further to intermediate in 2002/2003. In E2 (Belgrave) the risk is moderate in 1999/2001 and increases to severe in 2001/2002. In 2002/2003 it reduces to minor.

Figure 6.6 shows the risk of homicide and assault is normalized against beat area, in W44 (New Park) the risk is minor in 1999/2000 and increases to moderate in 2000/2002. In 2002/2003 the risk is extreme. In C9 (City Centre) the risk is extreme in the four years. In E12 (Humberstone) the risk is intermediate in 1999/2000 and increases to severe in 2000/2001. In 2001/2003 the risk further reduces to moderate.

Pederson (2001) asserted that lifestyle, alcohol problems, parental guardianship and socio-economic aspects of life affect victimization. Pederson concluded that adolescents were at high risk of victimization which includes crimes classified as homicide and assault. This proportion assault may be high among males. The concentration of pubs may aid the risk of homicide and assault particularly in Leicester city centre.

Tulloch and Jennett (2001) in their Australian study concluded that older women tended to live a lifestyle, in which they felt secure while younger women were fearful of sexual assault as a result of their life style. In England and Wales, Amnesty

International report (British Broadcasting Corporation, November 2005) announced that 'women that are victim of rape should be blamed' because in most cases their dressing is 'an open invitation to assault'.

Research has suggested that many citizens may feel vulnerable for a number of reasons such as inability to physically or economically protect their own, and to be incapable of making a fast retreat, while others may feel less able to cope with the emotional consequences of being a victim (Toseland, 1982). Research has identified four groups who fall into this vulnerability category: the old (Antunes et al., 1977; Baldassare, 1976; Clarke and Lewis, 1982; Giles-Sims, 1984; Jaycox, 1978; Jeffords, 1982; Miethe and Lee, 1984; Yin, 1980, 1982), women (Gordon et al.1980; Riger, 1978; Warr, 1984, 1985), the poor and ethnic minorities (Taylor and Hale, 1986).

6:7 DISCUSSION

The differences in the spatial pattern of distribution may be attributed to external factors such as environmental factors. The impact of the built and physical environment on crime rates shows that the physical environment influences criminal activities. This may include street design which may affect both offenders' perceptions of targets and unplanned 'opportunistic' crime against residential and non-residential properties. Rates of offending are also shown to be related to neighbourhood quality and the extent of urbanization. Previous studies and concepts to support this assertion are explained in chapter 2 in sections 2.3 and 2.4 respectively.

First, observed and objective risk of burglary from dwellings per 1000 people (Figures 5.2 and 6.1) are compared. The spatial pattern of observed risk (Figure 5.2) ranges mostly from intermediate to extreme around the west and city centres polygons during the period under study. While in the eastern polygons pattern is between minor and moderate in the four years. Whereas the objective risk (Figure 6.1) there is concentration of risk from intermediate to extreme around the city centre polygons with the exception in 2001/2002 that the risk pattern ranges from intermediate to extreme in the city centre and eastern polygon while in the western polygons the risk pattern ranges from minor to moderate. The pattern of observed risk (Figure 5.2) shows that risk is randomly distributed in Leicester whereas the objective risk (Figure 6.1) shows a concentration of risk around the city centre.

Second, is the comparison between observed and objective risk of burglary from dwellings per square kilometre. There is uniformity in the spatial distribution pattern of observed risk (Figure 5.3). The risk classes (minor to extreme) are distributed randomly during the period under study. Whereas objective risk (Figure 6.2) shows pockets of severe and extreme risk in the four years.

Third, observed risk (Figure 5.5) and objective risk (Figure 6.3) of criminal damage per 1000 people are compared. There is similarity in the spatial distribution of risk in the two maps. In the maps there is concentration of severe and extreme risk around the city centre. Intermediate risk is prominent in Figure 6.3 while moderate risk is prominent in Figure 5.5.

Fourth, there is a remarkable difference between observed risk (Figure 5.6) and objective risk (Figure 6.4) of criminal damage per square kilometre. There is uniformity in spatial distribution of classes of risk in Figure 5.6 except in 2000/2001 compared to concentration of risk in around the city centre. In Figure 6.4 minor and moderate risk dominate the western polygons while other classes of are equitably distributed across the city in the four years.

Five, there is a similarity in the pattern of observed and objective risk maps (Figures 5.8 and 6.5) of homicide and assault per 1000 people. The cases of severe and extreme risk are concentrated around the city centre in both maps. In Figure 6.5 there are pockets of intermediate and severe risk in 2001/2003 compared to cases of minor and moderate risk that dominates western and eastern polygons in Figure 5.8 during the period under study.

Six, intermediate risk is prominent for homicide and assault per square kilometres in observed and objective risk (Figures 5.9 and 6.6). In 1999/2000, objective risk (Figure 6.6) is minor especially in the western polygons of the city. There is concentration of severe and extreme risks around the city centre in Figure 5.9. Severe and extreme risks are sparsely distributed in Figure 6.6.

6:8 CHAPTER SUMMARY

In this chapter attempt is made to map objective risk which is derived from the statistical perspective. This is the outcome of regression analysis of crime against variables from census data is shown. This chapter reveals the ability of GIS to show the proportion of people exposed to victimization of any type of crime in a locality.

The concentration of risk may help to structure crime control efforts, resource allocation and focus on offenders, victims and locations at greater risk. The general belief in theory is that if something can be done about frequent offenders, vulnerable victims and places at high risk, crime rate may be reduced. A comparison between observed and objective risk was done to point out the similarities and difference in spatial variation of these types of risk.

It is important to note that the pattern of risk depends on socio-economic variable and the crime under consideration. When a particular crime is normalized against beat population density and area, different scenarios emerges. The ability of the GIS to measure risk rather than crime incidence is demonstrated. Such risk may be useful for planning purposes Also the insurance industry may use the risk map to aid their judgement when making decision on premium. The next chapter is chapter is summary, limitations, conclusion and suggestions for further study.

CHAPTER SEVEN

CONCLUSION

7:1 INTRODUCTION

The research presented in this study has highlighted a number of issues that need to consider in relation to crime and risk mapping. One was the objective was to map crime that there is a similarities and consistence between the police record and BCS. This is the yardstick for selecting these three types of crimes: burglary from dwellings, criminal damage and homicide and assault.

Another objective was the mapping and analysis of objective risk. This was achieved by regression of socio-economic indicators obtained from the census data: lone parent, car availability, economic position of household resident (employed and unemployed), tenure and amenities (exclusive use of bath/showers and inside WC; lacking or sharing use of bath/shower and or inside WC and No central heating), age group (18 – 19, 25 – 29 and 45 – 49 years) and ethnic group (White, Black Caribbean and India) and the log of the result was mapped. In order to relate crime data and census variables, cross estimation was done in ArcView. For further exploration, the objective risk was normalized against the beat population and beat area. Different polygons emerge as high risk area. The spatial variation in the risk of crime was display which can aid in policing resource allocation.

These objectives were refined through a review of existing literature as well the use of documentation and official statistics. Census variables were downloaded from the

Manchester Information Datasets and Associated Services (MIDAS). Table 3 shows the list of the variables used with previous studies and the rationale for using the variables. This is to ensure that the variables used in the current study are commonly used by criminologists use to analyze crime.

This chapter covers three areas: first, it presents an integrated summary of the research findings. Second, it deals with the contribution and implications of the research. Third, the effect of crime and risk map. The limitations to the current study are also pointed out. Finally, suggestions for possible future research in to crime and risk mapping.

7.2 SUMMARY OF MAIN RESEARCH FINDINGS

One of the main contributions of this study has been the ability of a GIS as a tool to draw the maps and normalized against beat population density and area. The normalization provides alternative view of risk. The rapid development in GIS capabilities, it has become an important tool, not just for crime mapping but many other application as well. GIS has proved useful in data sharing among agencies outside of law enforcement, such as public housing, schools, hospital, parks and recreation departments and urban planning can work toward community safety if they are better informed about risk of crime.

Also the ability to combine socio-economic variables from the census data to produce a risk map has been demonstrated. The risk map from this study may be useful to insurance industry, police officers, decision makers and analysts to focus on a particular type of crime in a beat area to analyze the pattern or display trend visually.

7:3 CONTRIBUTION AND IMPLICATIONS

The crime and risk map in this study may enable the police to focus on community –
based corrections by target and concentrate it efforts in high risk areas rather than
focusing narrowly on offenders. Information from such maps may enable beat officers
to work with multiple layers of information and scenarios, thus far more successfully
to identify emerging hotspots of criminal activity and target resources accordingly.

At management level, the risk maps from this study may help the administrators plan
resources more effectively. In addition to this, mapping can assist policy maker
identifying absconders, improving officer's safety and allocating resources.

The crime and risk map from this study may facilitate the sharing of crime data across
the police beat. This may provide innovative ways to facilitates communication and
corporation among beat officers. As a result, law enforcement officials will be able to
make more-informed decisions to allocate and develop, coordinate and provide a
central solution to crime problems.

The crime and risk map from this study may compliment understanding and promote
access to information about geospatial change. Risks of crime do change and changes
have pattern, trends and cycles. The capability of GIS to collect, refines, resample,
integrate and analyze time – varying geospatial information will promote the ability of
decision makers to make good decisions. The pattern of crime and risk in the previous
years can be compared with the present and make projection to the future.

The crime and risk map from this study may aid geographic profiling. Geographic profiling (Rossmo, 1999) is used by police investigator to search for serial criminals. The combination of a risk and crime can be useful to track down those trying to hide their home location but can't hide their action. Geographic profiling helps to define where a criminal might live, work or play based on the locations of crime committed. Using such information as where victims were picked up or dropped off, where phone calls were made and where supplies were purchased, it's possible to formulate a hunting ground as well as the most likely locations of criminal within the area. Also risk map can aid in geographic profiling to predict the spatial behaviour that can facilitate identification and capture the criminal.

The crime and risk map from this study may be a useful way of informing the community about safety issues in their neighbourhood. Such map can assist in community policing and enhance the public awareness. Maps can increase public awareness about neighbourhood crime problems. By making information public, the erroneous impression that police cook book to make them look better may be reduced.

7:4 EFFECTS OF CRIME MAPS

The information might be used for commercial purposes (NIJ, 2001), for instance alarm companies calling burglary victims which many citizens may find a violation of privacy or a nuisance. Although when list of crime incidence and risk map are released, security companies may not be able to identify specific households from the map, but they could target general areas of high risk of victimization. Incident-specific details associated with maps could easily be exploited.

Potential offenders may use crime maps to identify areas that have not been targeted and therefore may not be receiving much police attention. There is every possibility that police attention is diverted to the areas of high risk and incidence of crime, areas that receive less focus may be exploited by the potential offenders based on the information display on the map.

Crime maps could conceivably harm a high-crime area by reducing property values or increasing insurance rates. Neighbourhood characteristics such as decay graffiti, broken window and strange people hanging around (Hunter and Banmer, 1982; Maxfield, 1984) all signify that the neighbourhood is declining and pointer to the possibility of victimization. To date, there is no known definitive study of property values concern and insurance been published (at least in England).

Crime maps are open to misinterpretation by viewers if he maps are too complex or viewers do not understand statistics or crime data. There could be a concentration of crime in a particular block, but the entire beat would be treated as high crime area.

In United Kingdom (UK), the Data Protection Act of 1998 spells out principles for data exchange and release. In general when data are shared across agencies in the UK, the victim's name and street number are deleted, leaving only the street name and town, in an effort to depersonalize the record and overcome any privacy issues. If specific addresses are identifiable, all privacy is eliminated.

Some private issues needed to be considered in crime mapping such as, if maps shows the exert location of an offence, such as victim residence, or the incident address is released, the victim may be retraumatized by the fear that criminals will see him or her as an easier target (NIJ, 2001). Also, victims may decline to assist in investigation and prosecutions if they suspect that the offenders can find out their address base on the map information.

7:5 LIMITATIONS

Researchers identify specific limitations, not only to show the extent they are prevented from making their findings more rigorous and conclusive, but also to help others avoid them to the benefit of their own field of investigation. This study indeed is no exception. Thus, the following limitations are noted in this current study. The researcher does not have access to alternate sources (BCS) of crime data within this period; otherwise this would have been a good basis for comparison and evaluation. Rather than using yearly police crime data, it may be useful do carry out incidents mapping on a weekly basis.

The nature of the crime data also affect the choice of mapping carried out. Otherwise dot mapping would have been carried out rather than choropleth mapping. The empirical evidence of this study is based on police crime data and therefore the usual limitations of this method apply. Thus this study may not capture the respondents' views which might be better obtained by using an alternative approach. To enhance the findings it may be better profitable to use additional approach such as questionnaire in future research. However, the researcher feels that it is possible to argue validly that the research method chosen was appropriate in providing insight

into the research objectives and derivation of objective risk using the mathematical approach (see Methods Chapter four for justification of this method).

7:6 RECOMMENDATIONS FOR FUTURE RESEARCH

The utility of GIS in other areas of criminal justice such as identify areas prone to inmate violence in institutional settings; assigning probation and parole officers by geographic location; directing probationers and parolees to services and treatment centres and making site selection decisions for the placement of new facilities within a community.

To combine offender and incident data, develop real time end – user access to GIS, and improve, develop access to the system from police and probation offices. The ability of map to promote working relationship between the two organisations can be explored.

Mapping technology is not just for delineating space, mapping can be used to provide a geographic reference for placing, tracking and serving offenders. Such maps will be useful in inmate tracking through real-time monitoring, classification and housing of inmates in accordance with security level, and identifying pattern and relationships related to security or immediate change. Also the relationship between location of probationers and paroles in relation to readily available national services can be explored. The locations of identified probation officers and day reporting centres can be overlaid to the offender's residences. The product will reveal location of services and the concentration of offenders.

There is a need for a further research into combining risk analysis to the building of crime statistics web site. This will not only enable residents to access visual data about city wide – crime statistics and pattern, but include greater query possibilities and be able to display an entire crime incidence and risk. Citizens will be able to compare improved crime rate and risk of victimization from time to time.

Urban risk is very important, in order to show the local councillors and the urban decision makers the more risky zones, especially risk of crime, their factors which will aid them to establish priorities in urban risk management and control. There is a need for more research in urban crime risk since modern cities are more exposed to high-risk of crime which include terrorism. GIS will aid the flow of information in the area of homeland security. The area of potential threats and information to protect against harm can be display. Also, approaches proposed to minimize vulnerabilities can be analyzed thereby reducing the effect of criminal activities by the availability of real-time information.

There is a need to explore the integration of data and technologies. GIS offers a powerful toolbox, Global Position System (GPS) is another technology with untapped potential in law enforcement, permits accurate location findings in field setting and management information systems (MIS). The combination of these will allow close to real – time crime mapping. GPS offers the possibility of accurate reporting places that have no meaningful street address (for example, a shopping mall covering 100 acres) with GPS, crime inside the mall building could be reported with greater precision.

The exploration and combination of the three sources of crime identified in this study namely, the Police crime data, British Crime Survey (BCS), Self Report Survey (SRS) from this various data sources will be a contribution to the crime research. Mapping can reveal the variation in the three data. The inadequacy of one data may be complimented by other sources. This will enable the policy makers to make a comparison between the data and aid decision making.

A research into the combination of observed, objective and subjective risk to build an overall risk map of an area will advance GIS application in risk analysis. The subjective risk will combine the police source of data with the people's risk perception of their environment.

In conclusion the ability to display information about risk of victimization for different criminal offences and the spatial characteristics that can reduce or increase or reduce risk may prevent them from being vulnerable. Risks maps can fill the gap of demystify crime for the general public and represent a visual display of fact of crime.

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