Crime Prevention in Urban Design: towards Space Syntax Approach as a Quantitative Analytic Modeling of Qualitative Issue of Security (Based on Spatial Configuration)

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ABSTRACT: Crime is the product of an interaction between the person and the setting. Understanding crime has been the focus of researchers in both design and social fields for a few decades. The empirical research within the design field on the issue of crime has mainly focused on site-specific and situational features of a place. In the past decade, a considerable body of design research begun to devote to the relationship between the occurrence of criminal events and spatial configuration, which is a significant factor in human behavior. More recently, there has been developing a method for analyzing space in an urban environment, capturing its quality as being comprehensible and easily navigable named Space Syntax. Urban design researchers have employed space syntax technique to analyze the geographic distribution of crime due to spatial and socio-demographic factors that could influence crime patterns. In this paper, using descriptive and content analysis research, we first demonstrate the position of crime in both traditional social sciences and place-oriented theories. Finally, a configurational approach will be introduced as an analytical method in urban design, which is based on the theoretical foundations, analytical methods and modeling techniques of space syntax.

INTRODUCTION

Security feeling is a psychological and social phenomenon that includes a variety of variables and dimensions. The sense of being secured is a result of an individual's direct and non-direct environmental experiences and so different people have different experiences, but there is one fundamental point, which indicates that security and crime incidence are one of the products of built environments. Indeed, crime is the product of an interaction between the person and the setting. Not only can we understand crime events more fully by studying their settings, but we can also gain much more knowledge about crime patterns and trends (Felson & Clarke, 1998, P. 33). Understanding crime, in particular factors that cause crime, has been the focus of researchers both in design and social fields for a few decades (Baran et al., 2007, p. 1). However, what causes crime and what can we do to prevent it, is complex in nature and cannot be dealt with adequately in this paper. The remainder of this paper is organized as follows: Section 2 looks once over the background of using the advantages of modeling in urban studies. Section 3 briefly introduces criminology in both traditional social sciences and the new paradigm of place-oriented approach known as environmental criminology. Section 4 outlines the origins, intents and components of space syntax in brief. Section 5 reviews the connection between space syntax and analytical factors including social activities especially crime incidence and spatial configuration. Finally, section 6 draws some conclusions and exposes some limitations in space syntax technique and describes some further work that is now underway.

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BACKGROUND

Modeling in Urban Design

Intrinsic complexities and the diversity of the issues that are associated with urban design have made it a challenging task. A competent, experienced urban designer can use intuitive methods to deal with these complexities and still achieve a good design, but when projects become more complicated and multifaceted, the intuition of the designer is not always adequate to ensure a successful design (Karimi, 2012, P. 297). The inquiry of using analytical methods in urban designs along with ambiguities is about the types and applications of them in Implementation field; what type of analysis should be used; quantitative or qualitative? How they can be applied? Which factors should be taken in to account? What are their products, graphical outputs, histograms, maps, 3Ds…? Are these analytical methods going to predict our city's future or they are only descriptive tools? Just to name a few. To response these questions, urban thinkers started to discuss about analytical methods in urban design, predominantly in the second half of the 20th century. Even though, in the past century there were theorists, such as Camilo Sitte (1989) and Patrick Geddes (1918), who initiate methods that are the primary versions of introducing the analytical methods in urban analysis field.

The use of analytical methods becomes more evident in the second half of the twentieth century, when new urban ideas emerge and urbanists try to use quantitative methods and urban models. There is a wide range of these approaches. Conzen as an analytical urban geographer tries to push the extent of urban geography towards developing tangible methods of analyzing urban form based on the plan shape of its components: streets, plots, buildings (Karimi, 2012, P. 298). As an urban morphologist, he emphasized three elements of urban form: town plan, building types and land use (Cowan, 2005, P. 90). Kevin Lynch attempts to analyze the city based on the perception of main urban components; paths, edges, districts, nodes and landmarks (Karimi, 2012, P. 298). Lynch's methods of analyzing and graphically notating urban form are the most commonly used by urban designers today (Cowan, 2005, P. 228). Christopher Alexander's analysis of urban grid, which involves graph representation and graph analysis, gives rise to more systematic thinking about design. In the 1960s, the scientific methods or design methods became a predominant feature of the design discussions, immediately followed by major criticism of these methods in 1970s for not recognizing the complexities of design as "wicked problems". More recently, Mike Batty has used the mathematics of fractal geometry to demonstrate that cities could be analyzed and explained by principles of self-similarity, hierarchy and randomness. Apart from the attempts to create an analytical understanding of the city based on mathematical models and quantitative methods, there have been various analytical tools and models, such as transport models, economic models and planning models, which have not been developed specifically for urban design, but have been used in the disciplines that are associated with urban design. More recently, with the advancement of computer programs, new techniques of rendering and 3D modeling have emerged that are mainly used in the representation of design, but sometimes are also used to analyze specific aspect of the design. The most recent appearance of these approaches is Parametric Design, which enables designers to change the design parameters and visualize the results dynamically. Finally, among the most technical developments in this field, perhaps the invention of Geographical Information Systems (GIS) has had the most direct influence on analytical approaches in urban planning and transportation. The capability of overlaying layers upon layers of Geo-referenced data and the ability to analyze these layers quantitatively has turned GIS into a powerful tool in urban planning (Karimi, 2012, P. 298).

More recently, there has been developed a method for analyzing space in an urban environment, capturing its quality as being comprehensible and easily navigable (Volchenkov, 2008, P. 332). Urban design researchers have employed space syntax technique to analyze the geographic distribution of crime due to spatial and socio-demographic factors that could influence crime patterns. Space syntax is a set of measures for space configuration that have been shown a considerable correlation with how people move through and use building and urban spaces. It was first developed by Hillier and Hanson (1984), for representing and "measuring the pattern properties of open space in the built environment" (Mohammed, 2011, P. 32).

CRIMINOLOGY

Traditional Criminology (Social Sciences)

Criminologists, planners, and architects are still unable to predict criminals' preferences for committing an offense in one location over another. Criminologists associate crime with socio-demographic factors such as income, racial composition, youth concentration and level of education. Architects and planners on the other hand,

relate the crime to environmental design factors such as lighting, target hardening, or orientation of entrances, just to name a few (Nubani & Wineman, 2005, P. 413). As Nettler (1978) points out, criminological theory has been dominated by two units of analysis: individuals and communities (Sherman, 1995, P. 37). Criminologists have investigated why certain individuals become criminals and why some communities have unusually higher crime rates than others (see Sampson & Groves, 1989). Usually, research on individuals and communities provides several significant factors relevant to crime, such as relative deprivation, low socio-economic status, and lack of economic opportunity (Kim, 2007, pp. 27-28).

In social sciences, the predominant theory of the spatial location of crime has been social disorganization theory. Three exogenous factors -poverty, racial and ethnic heterogeneity, and residential mobility- are hypothesized to result in a withdrawal in community social control activities and an increase in delinquent and criminal activities (see Sampson & Groves, 1989, P. 780) (Baran et al., 2007, P. 1). Spatial criminology, or geographic criminology, can be divided into two categories; micro level place and crime analysis, and macro level neighborhood examination of crime. Recent criminologists have reviewed the historic literature on spatial criminology. Early studies were limited to macro level approaches. In the 20th century, up to the 1960s, criminologists studied crime components separately at the micro level (Liang, 2001, P. 13).

As a relationship between crime and place, environmental criminology does not focus on offender dispositions but on the characteristics of the crime event. While related to and influenced by traditional social theories, the academic and analytical frameworks of environmental criminology are derived largely from geography, urban planning, mathematics and human ecology, and especially Hawley's work (1950) on the importance of the relation of time and human activity patterns. It focuses on uncovering patterns of criminal and victimization events and has also been referred to as pattern theory (Schneider & Kitchen, 2007, p. 32). Meanwhile Routine activity theory (RAT), as a major theory of the spatial location of crime, claims that criminal event results from motivated offenders, attractive targets (opportunities), and an absence of capable guardianship against crime converging non-randomly in time and space (see Cohen & Felson, 1979) (Baran et. al, 2007, pp. 1-2). RAT studies crime events at the micro level, which is even more detailed than environmental criminology (Liang, 2001, P. 14) which explains crime occurrences by the routine of people in any space and time (Kim,

2007, P.18). The routine activity approach started as an explanation of predatory crimes (Felson & Clarke, 1998, P. 4). This theory, presented by Felson and Cohen (1979), was first proposed in victimology and then became one of the substantial theoretical bases of criminology.

Space syntax theory is relevant to one of the social theories of the spatial location of crime, i.e. routine activity theory (see Cohen & Felson, 1979). Part of that theory refers to the accessibility of potential victims (person and places) as an opportunity to motivate offenders. Social science studies that have tested the relationship between accessibility and crime from a routine activity theory perspective have operationalized accessibility either as the number of "turnings" into a street segment (see Beavon et al., 1994) or as the number of access streets from traffic arteries to the neighborhoods (Baran et. al, 2007, p. 2).

Environmental Criminology (Urban Design Field)

The Urban design theory also has addressed the issue of crime in new paradigms. The empirical research within the design field has mainly focused on site-specific and situational features of a place. Starting in the 1960s, this body of research has emphasized the role of environmental attributes in crime prevention (Baran et. al, 2007, p. 2). Jane Jacobs's book, "The Death and Life of Great American Cities" (1961), was the first real indictment of the new urban architecture that had developed after the end of the Second World War. She wrote: "Deep and complicated social ills must lie behind delinquency and crime, in suburbs and towns as well as in the great cities... if we are to maintain a city society that can diagnose and keep abreast of deeper social problems, the starting point must be to strengthen whatever workable forces for maintaining safety and civilization do exist… To build city districts that are custom made for easy crime is idiotic. Yet that is what we do" (Jacobs, 1961, p. 31). "The public place of cities is not kept primarily by the police... it is kept primarily by an intricate, almost unconscious, network of voluntary controls and standards among the people themselves, and enforced by the people themselves." (Nubani & Wineman, 2005, P. 416). Jacobs (1961) argued that the circulation of people and appreciation of public space are crucial elements to the urban vitality and indicated that informal (natural) surveillance ("eye on the street") is a good deterrent to criminal activity (Baran et al., 2007, P. 2). She argues that only the co-presence of strangers and residents alike produces the "eye on the street" that makes the streets safe – this requires open, permeable and

accessible environments of mixed land use that attract people to populate the streets (Friedrich et al., 2009, p. 3).

Oscar Newman (1971) takes a contrary point of view. In the area of urban design, the most influential empirical study that examined the crime-environment connection was conducted by Newman, who brings up the idea that a community that can defend itself against disorder and crime can be "planned into the urban fabric". He called for the creation of a hierarchy of zones from public to private. This type of separation, termed territoriality, allows residents to adopt an attitude that the private area is theirs. To achieve this attitude Newman suggests placing walls or fences around private areas, or employing symbolic devices such as changes of level, materials, portals or landscaping (Nubani & Wineman, 2005, P. 416). Newman's central concept, "defensible space", is a paradigm that evolves around the notion of "territorial space" dedicated to a closed community, where access from the outside is limited and controlled (Friedrich et al., 2009, p. 3). Although territoriality is at the heart of Newman's idea, there are other important and related design elements, based on which, he elaborated the idea of defensible space. These contribute both individually and together (including territoriality) in the concept of defensible space. They are:

- Surveillance
- Building image
- Juxtaposition of residential with other facilities (Colquhoun, 2004, P. 40).

As it is obvious, to some extent, contradictory to the Jane Jacobs' views was the study of Oscar Newman. These two ideas not only differ in what is thought to be the social principles that are effective against disorder and crime, but also promote different spatial paradigms for these social dynamics – the enclosed territorial space on the one hand versus the permeable public mixed use space (Friedrich et al., 2009, p. 3). Mentioned above, Newman used the concept of "territoriality" as the basis of his defensible space model. Anonymous streets where more strangers appear are considered more vulnerable than a dead end cul-de-sacs where strong local inter-visibility in an enclosed area can increase a well-defined neighborhood to deter any intrusion of strangers, thus spatial control by local inhabitants is the key to prevent area from crime (Shu,2009, 102, p. 2).

There are three schools of thought that determine much of today's practice in designing out crime from the environment: Defensible Space, Crime prevention through environmental design (CPTED), and Situational Crime Prevention (2nd Generation CPTED) (Colquhoun, 2004, pp. 37-38). It is interesting to mention that Newman's ideas formed what currently referred to as Crime Prevention Through Environmental Design, also known as CPTED. CPTED, first used by the American criminologist, Professor C. Ray Jeffrey, in his book of the same name written in 1971, is defined by Crowe (2000), as the use of the built environment in reducing fear of crime and incidence of crime and improving the quality of life. (Nubani & Wineman, 2005, P. 416). The long history of the relationship between humans and their environment has proved that the behavior of humans is affected by the environment and this is the major underlying implication of deploying CPTED (Tseng, 2006, pp. 18-19). At its core, the principles of CPTED include:

- Natural surveillance;
- Access control;
- Territorial reinforcement;
- Proper placement of land uses (Schneider & Kitchen, 2007, P. 24).

It is then possible by analyzing different kinds of spaces or city patterns, as well as, observing social activities that are embodied within each space, to determine many aspects of which the spatial layout structure affects the human social activities. By looking at space in this way, we can see both how social and cultural patterns are imprinted in spatial layouts, and how spatial layouts affect the functioning of buildings and cities (Mohammed, 2011, P. 35). Recently, some work using space syntax demonstrated statistical relationships between properties of spatial layouts and the occurrence of certain types of crimes. (Nubani & Wineman, 2005, P. 413). Typical applications of space syntax include pedestrian modeling, way-finding processes and criminal mapping. All these inquiries tend to be based on the assumption that spatial patterns or structures have a significant impact on human activities and behavior in urban environments.

DEFINING SPACE SYNTAX

Origins and Intents

The model is a simplified representation of reality that can be in the form of a theory or a set of mathematical and statistical formula. Physical models can help urban thinkers understand the form of a city. Studies of spatial configuration of urban textures are instrumental in predicting human behavior such as pedestrian and vehicle movement through urban environments. The set of theories and techniques for the spatial analysis is called space syntax theory (Volchenkov, 2008, P. 332). Space syntax is a concept of urban morphology that was

developed in the 1980s by Hillier and Hanson (1984) and subsequently expanded by Hillier and disciples around the globe. It is a theoretical and analytical approach that provides graphical and mathematical methods of depicting relationships between constructed objects and urban spaces. To accomplish this, space syntax uses a vocabulary of spatial types, syntactic maps, graphs, and measures to represent and analyze quantitative relationships between buildings and urban spaces (Schneider & Kitchen, 2007, P. 38). Hillier and Leaman (1975) and Hillier et al. (1976) use the term "syntax" to refer to rules that account for the generation of elementary, but fundamentally different, spatial arrangements. Hillier and Hanson (1984) define syntaxes as combinatorial structures which order the world and also allows us to retrieve descriptions of it (Peponis, 1997, p. 2). Hillier et al. (1983) and Hillier et al. (1987) define "space syntax" as a methodology, or a set of techniques for the representation, quantification, and interpretation of spatial configuration in buildings and settlements (Peponis, 1997, p.2). One of its fundamental aims is to capture the extraordinary complexity of city space in such a way that space itself can be measured as a research variable. Scholars have employed its modeling techniques to help explain and predict some crime patterns in urban settings, although this is only one of its intents (Schneider & Kitchen, 2007, P. 38). The techniques allow the effects of design to be measured together, so that design can be informed and objectively assessed. The process uses computer-based technologies, which produce graphic representations of factors such as spatial networks, pedestrian movement rates, land use, patterns of reported crime, etc. These are used in three ways:

- For analysis, to better understand the urban context and identify regeneration opportunities;
- For design, to make sure that new proposals respond to the spatial potentials of their new context;
- For a consultation, to explain the reasoning behind the proposals, discuss the implications of these and test new ideas emerging from this process (Colquhoun, 2004, P. 72).

For space syntax, it is not the substance of urban places (their physical objects such as buildings) that matters most; rather, it is the spaces and linkages among and between them that are crucial. These become the means to connect urban structure with urban function. Space syntax has been hailed by some as a means to "transform urban design" (Schneider & Kitchen, 2007, P. 38).

Components

In space syntax, the focus is on lines not points, streets not the junctions that anchor (Batty, 2004, P. 4). Rooted in graph theory and the idea of urban morphology, the space syntax theory describes and measures quantitatively the configurational properties of urban space (Baran et al., 2007, P. 2). Space syntax describes the logic of society through its manifestation in spatial systems: how spaces are put together – or the configuration of space – relates directly with how people perceive, move through and use spatial systems of all kinds, ranging from small domestic spaces to large-scale urban settlements. Generally speaking, space syntax is an overarching concept – or a paradigm – and a set of specific theories, such as the theory of order and structure, natural movement, centrality as a process, movement economy and movement generated land-use agglomeration. Furthermore, there are analytical models and tools, such as axial analysis, visual graph analysis and segment-angular analysis, which are direct products of the main theoretical paradigm and its theoretical propositions (Karimi, 2012, P. 304). Configurational modeling of urban networks has become a major focus of space syntax studies. Such models are constructed by breaking up the urban layout of a city or town into the fewest and longest lines of sight and access that pass through all possible routes of movement. The resulting axial map can then be analyzed using a number of statistical measures that describe the configurational properties of the network (Dawson, 2003, p. 3). Two other space syntax measures, known as Integration and Connectivity, calculate the level of accessibility of street segments from all other street segments within a spatial system (Nubani & Wineman, 2005, P. 416). The theory posits that the built environment, viewed as a system, affords or carries the movement from every space to every other space within the system. Environments that are most directly linked to other environments (i.e., high on integration and connectivity) will tend to attract higher densities of movement. Empirical research has widely supported this view by showing that areas with high syntactical accessibility have a higher number of pedestrians and car users (Baran et al., 2007, p. 2).

SPACE SYNTAX AND SOCIAL-SPATIAL FACTORS

Social Activities

There is a relationship between the generators of form and social forces. Over the past two decades, space syntax has been considered as a new computational language. The notion of syntax, refers to relationships between different spaces, or interactions between space and society. "These principles support the belief that spatial layout or structure has a significant impact on human social activities" (Mohammed, 2011, P. 32). The core concepts of space syntax can be explained through two fundamental propositions. The first proposition is that space is intrinsic to human activity, not a background to it. Space is shaped in ways that reflects the direct interaction between space and people, and through this the space we create, or the built environment, becomes humanized. An important implication of considering space and society as inherently corresponding entities is that by analyzing one we create a deep understanding of the other. Analysis of the society, or social patterns, is admittedly a much more difficult task, as it involves dealing with the intricacies of humans and lack of tangible, measurable components or features. On the contrary, analysis of space is a much more achievable task. The second core proposition of space syntax is that space is fundamentally a configurational entity. From the most primitive spatial forms to most advanced types, the built space is always divided into components, or sub-spaces, which play different roles or are used in different ways (Karimi, 2012, P. 304).

Space syntax has been used to determine the effects of the space properties on social activities, such as pedestrian traffic or way finding. Hillier showed that by translating the spatial properties of the space into mathematical based measurements, and then by analyzing different kinds of spaces or city patterns, it will be possible to determine many aspects of which the spatial layout structure affects the human social activities. He called the resulting form of numerical representation of space layout the spatial configuration. It refers to the simultaneously existing relations amongst the parts or the interrelations between the many spaces that make up the spatial layout of a building or a city (Mohammed, 2011, pp. 32-33).

Spatial Configuration and Crime

The term spatial configuration is used to refer to the structure of potential movement and co-presence as determined by the placement of boundaries in space and by the connections and disconnections between areas that results from the presence of boundaries (Peponis, 1997, p.1). Spatial configuration, therefore, not only reproduces existing hierarchical relationships, but it also helps produce particular patterns of social relationships (Mohammed, 2011, P. 35). Configuration, simply defined as simultaneously existing relations, is about the composition of the built form of the parts that are in a unique relationship with each other (Karimi, 2012, P. 304). Space syntax argues, among other things, that urban spatial configurations have reciprocally moulding relationships with movement (and especially pedestrianism) which affect land use patterns and urban densities (Schneider & Kitchen, 2007, P. 38). In the past decade, a considerable body of design research begun to devote to the relationship between the occurrence of criminal events and spatial configuration. Such studies found correlations between measures of Space Syntax, and crime in residential neighborhoods (Nubani & Wineman, 2005, P. 416). Space syntax, in effect, takes certain common measures of relationality in graphs, and first theorizes them in terms of their potential to embody or transmit social ideas, and then turns them into measures and representations of spatial structure by linking them to geometric representations of the system of spaces under examination (Mohammed, 2011, pp. 33-34). In earlier Space Syntax research on crime (see Hillier & Sahbaz, 2007), two aspects of movement and land use in order to prevent crime have been highlighted: the co-presence of pedestrians on the street on the one hand, and the constitutedness of a street: a street "protected" through continuous and numerous residential entrances (Friedrich et al., 2009, p. 2).

The theory provides a mathematical logic with which to connect spatial and social information, such as relationships between the flow of pedestrian and vehicular movement and crime in urban areas. A fundamental intent is to uncover the hidden patterns and structures within spaces. In this context it bears a similarity to pattern theory as derived from environmental criminology (although that is specifically focused on crime and space) and to Christopher Alexander's pattern language theory (1977), some of which has also been adopted into new urbanism (Schneider & Kitchen, 2007, P. 38).

Because of availability of adequate computational tools, the advantage of space syntax method is that it allows us to calculate the relative degree of accessibility for each street segment relative to the whole, or to its surroundings, for an entire city street network. Most of the space syntax research has shown that crime, in particular property crime, tends to cluster in segregated areas, particularly in those "unconstituted enclosed

clusters which Newman considered to be the key to increase local surveillance and hence to exclude causal intrusion by non-residents". Hillier (1988) argues that if the spatial configuration makes the natural movement of pedestrians more difficult, there will not be a sufficient number of people to generate the perception of a well appropriated and used space. Empirical research has supported this idea by showing that places with higher accessibility tend to have lower crime rates, while places with low accessibility, i.e. segregated places, have higher crime rates. These research findings also confirm Jacobs' (1961) view (Baran et al., 2007, p. 3).

CONCLUSION

Space syntax techniques have been employed to help predict how space will be. As noted above, they have been drawn upon to help explain the distribution of crime in urban areas. Similar to the conceptual framework of Jacobs, Hiller as the originator of this theory, asserts that "intelligible deformed grid" and "constituted outward facing block" are the main features of spatial configurations that design out crime from urban areas. Contrary to the position of Newman's territoriality based defensible space system, Hillier considers passing strangers often generated by the intelligible through the street system as beneficial elements who can in effect protect the streets from crime incidences whereas strong inter-visibility of the immediate surroundings of each dwelling within those constituted outward facing blocks allows residents to guard the strangers. Actually, Jacobs' mechanism of "strangers protect the streets and residents watch the strangers" is which echoes the function of natural surveillance.

Besides the advantages of the space syntax method in analytical urban design and its helpful tools, due to its abstract and quantitative nature, some of the simplifications introduced by the theory limit its applicability and need to be taken into consideration. This model remains as an abstract representation against complex set of factors, which can influence the distribution of spatial activities. These limitations are summarized below:

Curvy Streets: A slightly curvy street of the same length of straight street, would typically not be enumerated as a single line, but instead be segmented into individual straight segments, which makes curvy streets appear less integrated in spatial analysis.

Building Height: The analytic tools in space syntax do not take into account building height and land use, and its sensitivity to the boundary conditions. Therefore, it is not possible to convey adequate information about the

urban environment with such a limited amount of data. Building heights change from one location to another, which affect the movement volume, taller buildings that act as generators of movement attract higher density of people.

Land use: Batty et al. (1998) stated, "[Space syntax] accessibility measures, although providing indices associated with forecasting trip volumes, are not based on models which simulate processes of movement and thus do not provide methods for predicting the impact of locational changes on patterns of pedestrian flow. In short although these indices can show changes in flow due to changes in geometry and location of entire streets, they are unable to account for comprehensive movement patterns which link facilities at different locations to one another"[1]. For example, at a shopping mall, the movement pattern of people is not purely generated from street flows but heavily impacted by attractive shopping stores. Also the environmental contents of spaces, such as natural settings which become increasingly valuable for spatial experience and social interaction patterns in cities, may work as an attractor of movement.

2D Topological Measurement: Most limitations of axial map analysis in space syntax technique seem to be related to the simplified support it uses: a 2D topological description of the street network that does not take into account metric information. The choice of such a simplified support to describe cities might have been a necessity in the early days of space syntax, when computation was less developed[2].

3D Movement: Axial analysis discards any vertical movement, which is as significant as horizontal movement. The axial map in space syntax only emphasizes the urban grid, not urban attractors as the determinant of pedestrian movement.

Building Density and Form of Block: Factors such as building density and geometry of the urban block are undetected in street network analysis despite the potential effect of these factors on movement[3]. Combining the space syntax methodology with geographic information systems in order to capture environmental and contextual factors is one solution to prevent this inconsistency.

Distortion of textures: systematic analysis of the urban grid texture reveals the difficulty to accept the argument that the space syntax allows the modeling that provides a choice of paths for pedestrians. In more complex cases, the distortion of two ideal textures produces a topological discontinuity, leading to an unacceptable situation where one single urban configuration produces two conflicting outcomes when analyzed with space syntax[4].

Recently, a new technique aimed at the spatial analysis

of centralities in urban networks constituted by streets as links or "edges", and intersections as "nodes" (Strano et al., 2007, P. 2) has developed, named Multiple Centrality Assessment (MCA). MCA provides a new perspective to the network analysis of spatial systems, which is inherently different from space syntax in that: 1. It is based on a primal, rather than a dual, graph representation of street patterns; 2. It works within a fully metric, rather than topology, framework; 3. It investigates a set of peer centrality indices rather than just a principal one[5]. It seems that taking an analytical approach to designing out crime, surrounded by complexities and variables needs advanced or combined methods. Therefore, employing an integrated combinatorial method using both Space Syntax and MCA in the spatial configuration analysis of crime prevention will result to more efficiency and applicability in analytical techniques of urban design and planning.

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ENDNOTES

1- See: Batty, M. Jiang, B. Thurstain-Goodwin, M. (1998). Local movement: agent-based models of pedestrian flow. Working Papers Series: Paper 4. Centre for Advanced Spatial Analysis. University College London.

2- See: Ramadanta, Asyra, Darjosanjoto, Endang Titi B. (2012). Application of Space Syntax as Presentation and Analysis Technique in the Study of Spatial Integration in Contoured Landform. Journal of Basic and Applied Scientific Research. Vol. 2(7). pp. 6850-6856.

3- See: Rohloff, Ipek K. Rohloff, Kurt R. (2012). Modeling Spatial Activity Distributions in Complex Urban Conditions: The Markov Chain Model for Weighting Spaces with Attractors. In: Goulthorpe, M. Murphy, A. ACSA's 100th Annual Meeting. International Conference, and Technology Conference proceedings. pp. 1-9.

4- See: Ramadanta, Asyra, Darjosanjoto, Endang Titi B. (2012). Application of Space Syntax as Presentation and Analysis Technique in the Study of Spatial Integration in Contoured Landform. Journal of Basic and Applied Scientific Research. 2(7). pp. 6850-6856.

5- See: Porta, Sergio, Crucitti, Paolo, Latora, Vito. (2006). The Network Analysis of Urban Streets: A Primal Approach. Environment and Planning B: Planning and Design., 33, pp. 705 – 725.