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Testing the veracity of crime prevention through environmental design (CPTED) in residential neighbourhood crime prevention

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Abstract
Over the years, the use of penal system (use of police, court and prison) in combating urban crime in general and residential neighbourhood crime in particular has been found to be grossly inadequate as it has failed to meet the required expectation. Hence, one of the alternative measures taken to complement this approach is crime prevention through environmental design (CPTED). The aim of this study is to test the veracity of CPTED as a tool for controlling residential neighbourhood crime (RNC). The basic method used in achieving the research's objective was content analysis through a critical review of existing literature and empirical studies in respect of the subject matter. The result of the findings showed that there were enough practical and theoretical proofs attesting to the desirability of CPTED as a veritable tool in residential neighbourhood crime prevention. This research is making awakening call to developing nations, policy makers and researchers yet to embrace this concept to consider the option as its effectiveness and efficient application would not only reduce crime but also ensure housing sustainability and promote housing investment.

Keywords: CPTED; Crime prevention; Residential neighbourhood crime; Veracity

1. Introduction

Residential neighbourhood crime which is otherwise called property crime comes in the forms of burglary and theft, incivility and street crime, vandalism, robbery and violent crimes. Its occurrence and consequence are becoming worrisome globally (Gibbon, 2004). This might not be unconnected with the vintage position that housing/residential property occupies among other classes of properties like commercial, industrial, agricultural and other institutional properties being the only one providing living accommodation for the populace. Also, residential neighbourhood is seen to be susceptible to crime due to the fact that residents keep their most valuables inside the house and to make the matter worse, houses are left vacant for a long time within the day, week and month as residents may have reasons to go to workplace, place of worship, recreation, shopping and even holidays (Olajide & Lizam, 2016) [42].

The consequence of residential neighbourhood crime is said to be lethal (Cohen, 1990) [13] as it cuts across every activity of man and government. For instance, residents are likely to suffer psychological fear and a times sudden death. Also, residential neighbourhood crime could increase the maintenance budget of residents as there might be need to employ additional security (human and mechanical) and sophisticated locks. Furthermore, the residential neighbourhood itself may suffer neighbourhood decline which could result in negative residential mobility as well as discouraging housing investment. In addition, residential neighbourhood crime is found to be capable of affecting government activities. For instance, urban incivility can make governance problematic. It can also lead to avoidable increase in public expenditure especially on security as there might be need to procure more police, build additional prisons and employ more judges.

In the recent past, researchers have criticized the ineffectiveness of the penal system (courts, police and prisons) in the area of crime as not meeting the expected result. Some of the criticisms against the predominant use of the penal system include high rate of recidivism (re-offending) which is found to be between 50-80%, police brutality and imprisonment are seen as hatred than correction, high cost of maintenance, loss of lives being rampart, 'though on crime' risks which is encapsulated in the penal system is said to be damaging the fabric of a democratic setting and a host of others (Sutton, *et al.*, 2013) [54]. Hence, researchers have since being searching for a more flexible and citizens' friendly approach to residential neighbourhood crime prevention. Essentially, Crime prevention through environmental design (CPTED) is one of the prominent discoveries in this respect which studies have found to be more effective (Crowe, 2000; Cozens, 2014; Cozens & Love, 2015) [21, 16].

CPTED opines that the tactical and purposeful manipulation of the residential neighborhood design is capable of discouraging potential offenders to commit crime (Crowe, 2000; Cozens, 2014; Cozens & Love, 2015) [21, 16]. The key elements of CPTED as shown in Figure 1 include access control, surveillance, maintenance, target hardening and territoriality among others. The intention of this article is to test the veracity of CPTED as a veritable tool for residential neighbourhood crime prevention through a critical review of related empirical studies.

Hence, in line with the objective of the study, this paper consists of five sections. Section one treats general introduction to the study while section two presents the main thrust of CPTED concept. The third section dwells on the analysis of empirical studies, whereas section four presents the data analysis and results on the strength and weakness of the

concept. Section five concludes the paper, as well as presenting the limitation of the study and further research.

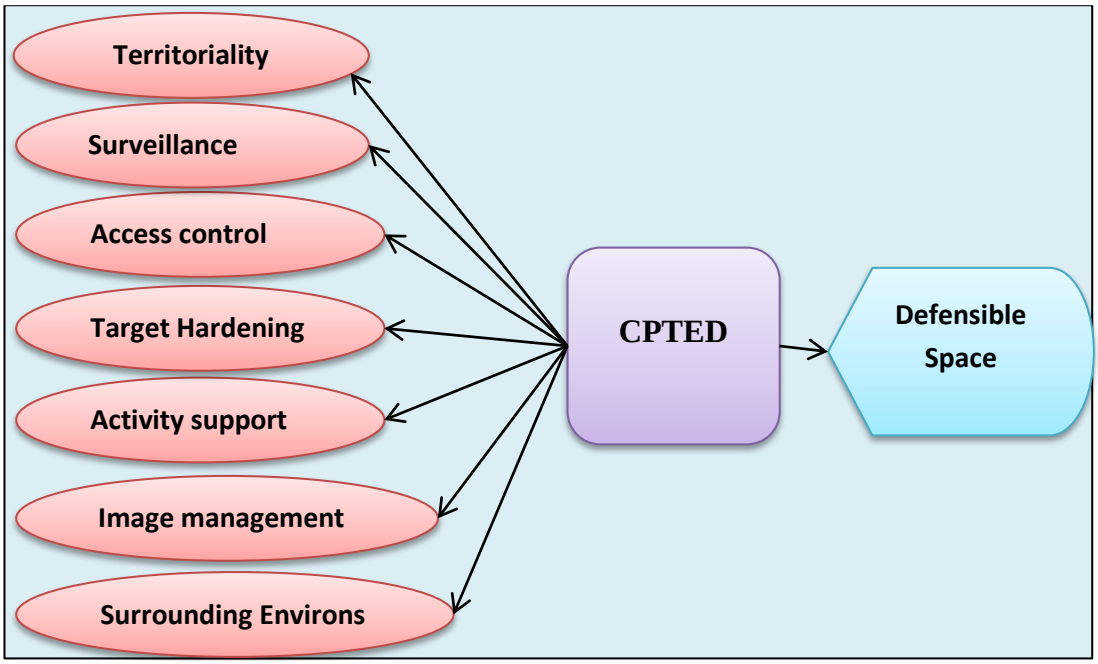

Fig 1: Causal effect of CPTED elements on residential neighbourhood crime (Cozens & Love, 2015) [16]

2. Thrust of CPTED concept

CPTED, also known as "designing out crime" is an acronym for Crime Prevention through Environmental Design. It asserts that 'the proper design and effective use of the built environment can lead to a reduction in the fear and incidence of crime, and an improvement in quality of life (Crowe, 2008; Cozens, 2000). CPTED is a multi-disciplinary approach drawing on criminology, planning and environmental psychology, and is specifically located within the field of environmental criminology, deriving theoretical support from opportunity theory such as rational choice theory and routine activity theory which is also concerned with identifying conditions of the physical and social environment that provide opportunities for criminality, and the modification of those conditions in order to reduce such opportunities (Brantingham & Faust, 1976). Its objective is to proactively prevent crime, as compared to the reactive strategies of most criminal justice system like police, courts and correctional facilities (Cozens & Hillier, 2012).

Crime prevention through environmental design is not a new concept. The phrase was coined by Jeffery (1971) but a significant contributor to the concept of CPTED was renowned criminologist Timothy D. Crowe, a legend in the security industry. His book 'Crime Prevention through Environmental Design' (1991), is a primary resource for crime-prevention practitioners in the security industry to help them in better understanding the relationship between design and human behavior. CPTED, Perry (2013) saw as not a reactive discipline. Rather, he described it as a proactive approach to manipulate the physical environment and bring about the desired behavior of reduced criminal as well as reduced fear of crime. However, Cozens (2008) [17] saw the emergence of CPTED as a process as it took different forms and given different names but without much departure from the tenets of CPTED (see Figure 2). According to Clarke (1989) [12], the theory of crime prevention through environmental design is based on one simple idea that crime results partly from the opportunities presented by physical environment. This being the case, it should be possible to alter the physical environment so that crime is less likely to occur. The three main elements of CPTED as identified by Crowe (1991) include territorial reinforcement, natural surveillance and natural access control. However, refinement of CPTED has added several other strategies including activity support, image/ space management and target hardening.

Obviously, Crowe (2000) [21] posited that a number of related concept have become confused with CPTED operation theories and applications. Although some of these concepts according to him overlap with CPTED, others are very different in that they attempt to repackage and redefine the commonsense approach of CPTED. Some of these related concepts include: a CPTED-organised and mechanical approach versus a natural approach; defensible space; environmental security; security by design; natural crime prevention; safer cities; situational crime prevention; place-specific crime prevention and second-generation CPTED. A good understanding of these concepts is required as they relate to or distinct from CPTED. This is not treated as it does not fit within the scope of this study. Commenting on the popularity, development and acceptability of CPTED, there are enough evidences that CPTED despite criticisms had been accepted by governments of different nations, its agencies like Police and Practitioners (Armitage 2013; Cozens, 2008; Labs, 1989; Smith 1987) [23, 17].

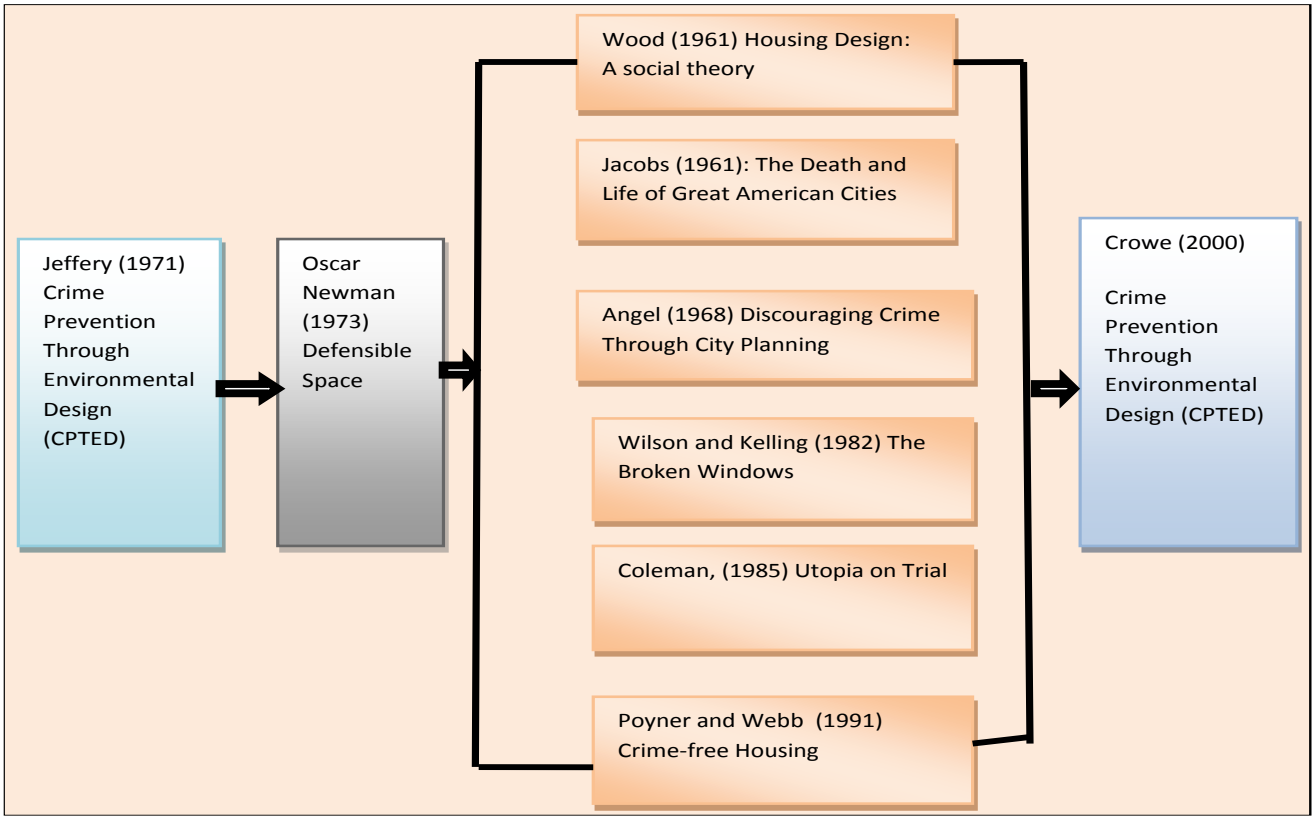

Fig 2: Chronological evolution of CPTED

2.1 Elements of crime prevention through environmental design (CPTED)

The principles of CPTED have been presented by several authors, including, but not exclusively Poyner (1983), Cozens *et al.*, (2005) and Armitage (2013) [23] and adapted across different countries to form the attributes of safe places/environments within planning policy and guidance. Poyner (1983) outlined the principles as surveillance, movement control, activity support and motivational reinforcement. Cozens, *et al.* (2005) extended this to include the seven principles of defensible space, access control, territoriality, surveillance, target hardening, image and activity support. Armitage (2013) [23] offered yet another combination of physical security, surveillance, movement control, management and maintenance and defensible space. Ekblom *et al.*, (2012) amended these (to enhance transferability to the United Arabs Emirate) to include: access and connectivity, structure and spatial layout, ownership, surveillance, activity, public image and adaptability. Montoya, *et al.* (2014) assess the impact of the six principles of territoriality, surveillance, access control, target hardening, image/maintenance and activity support on burglary offences. Finally, Marzbali *et al.*, (2016) [31] propose four primary dimensions - surveillance, access control, territoriality and maintenance, and eight sub-dimensions – visibility, lighting, physical barrier, security system, markers, landscaping, front house maintenance and back-lane maintenance. Anyone new to the subject would be forgiven for expressing confusion. As Marzbali, *et al.* (2016) [31] summarise in their study of CPTED in Malaysia, the problem is that the terms used as CPTED components vary from study to study. However, as will be argued later in the section, perhaps these differences are not only to be expected, but should be positively applauded.

- **Defensible space and territoriality**

The term defensible space was coined by Newman (1973) who suggested that the physical design of a neighbourhood can either increase or inhibit people's sense of control over the spaces in which they reside. Newman categorized space into public (for example, the road in front of a property), semi-public (for example, the front garden), semi-private (for example, the back garden) and private (inside the property). He argued that if space is defensible, it will be clear to the owner/user of that space, and to non-legitimate users, who should and who should not be in this space. CPTED interventions ensure that space is clearly demarcated, that it is clear who has control/ownership/rights over that space and that potential offenders have no excuse to be in that space. Territoriality involves the human emotion/response to the space which they define as their own. Physical responses to territoriality might include a resident marking an area as their own through the installation of a house sign or gate.

Emotional responses to territoriality would include a resident's feelings of intrusion or infringement should a person enter what they consider to be their space. Thus, territoriality refers to the human motivation to control the space which they believe is theirs, be that through the legal ownership of that space or through their adoption and management of that space. Brown & Bentley (1993) interviewed offenders, asking them to judge (from pictures) which properties would be more vulnerable to burglary. The results revealed that properties showing signs of territorial behaviour (such as the installation of a gateway at the front of the property or a sign on the gate/door marking the area as private) were perceived by offenders to be less vulnerable to burglary. Montoya, *et al.* (2014) also found a significant relationship between signs of

territorial responses and burglary risk, but only for daytime (as opposed to night time) burglary offences.

The design concept of territorial reinforcement seeks to promote notions of proprietary concern and a sense of ownership in legitimate users of space, thereby reducing criminal opportunities by discouraging the presence of illegitimate users. Early CPTED ideas are now known as first-generation CPTED, and territorial reinforcement was considered to be the primary concept from which all the others are derived. It includes symbolic barriers (e.g., signage, subtle changes in road texture) and real barriers (for example, fences or design elements that clearly define and delineate private, semiprivate, and public spaces). Access control and surveillance will also promote territoriality by enhancing the levels of informal social control for legitimate users. These strategies act in combination, to use the physical attributes to promote opportunities for surveillance (for instance, placement of windows); to separate public, public– private, and private space; to define ownership (for instance, fences, pavement treatments, signs, landscaping, and artwork); and define acceptable patterns of usage.

- **Surveillance**

The promotion of natural surveillance is a long-established crime prevention strategy. Opportunities for residents to observe the street are facilitated by the design of the street, the location of entrances, and the placement of windows, for example. This natural surveillance is considered as a form of capable guardianship that can reduce crime since offenders who perceive that they can be observed (even if they are not), are less likely to offend, in the light of the increased potential for intervention, apprehension, and prosecution. Other forms of surveillance include formal or organized (e.g., police and security patrols) and mechanical/electronic surveillance strategies (e.g., street lighting and closed-circuit television [CCTV]).

Furthermore, surveillance refers to the way that an area is designed to maximise the ability of formal (security guards, police, employees) or informal (residents, passersby, shoppers) users of the space to observe suspicious behaviour. These formal and informal users are referred to in routine activity theory as capable guardians. Within situational crime prevention, more generally, surveillance may include the installation of CCTV or the use of formal security guards. Within CPTED, surveillance rarely relates to formal measures but refers more to the informal surveillance created through measures such as ensuring that dwelling entrances face the street, that rooms facing the street are active (such as the kitchen or living room) and that sightlines are not obstructed by shrubbery or high walls. Linked with territoriality, the principle of surveillance requires users of that space to recognise that an individual is behaving in a suspicious manner (be that through their behaviour or simply their presence within a private/semi-private area) and to have the confidence to challenge them or intervene. Therefore, the term surveillance includes the operational tasks of active (formal) and passive (informal) surveillance, the surveillability (Ekblom, 2011) [22] of that space and the creation of the perception amongst offenders that they are being observed.

Research suggests that surveillance and visibility play a major part in offenders' decision-making processes when selecting properties to offend against. Offenders prefer to avoid confrontation and, where possible, select targets which are unoccupied. Reppetto (1974) interviewed 97 convicted burglars and found that the most common reason for avoiding a target was that there were too many people around. Offenders stated that the possibility of neighbours watching them deterred them from selecting a property and that they would select targets where they felt less conspicuous and where there was less visual access to neighbouring properties. In interviews with a sample of 30 active burglars, Cromwell & Olson (1991) found that properties considered to be the most attractive targets were those which were located within close proximity to a stop sign, traffic lights, commercial business establishment, park, church or four-lane street – these properties being within the activity and awareness space of offenders. This research also revealed that over ninety per cent of the sample stated that they would never enter a residence which they suspected to be occupied.

- **Physical security**

Target hardening is often referred to as physical security and includes the initial design, or retrofit upgrade of doors, windows, fences and other physical structures to increase the difficulty for offenders in entering a building or space. Research on security measures as a means of preventing burglary suggests that, all other factors being equal, burglars prefer to offend against properties with lower levels of physical security (Cromwell & Olson, 1991). Budd's (2001) analysis of the British Crime Survey found that security devices are extremely effective in reducing the risk of burglary victimization. Budd found that, in England and Wales in 1997, 15% of households without security measures were burgled, compared to just 4% of households with basic measures in place and 3% with higher levels of security.

Vollaard & Ours (2010) report the findings of an extensive assessment of built-in security in the Netherlands. This study utilises the introduction of regulatory changes in building regulations introduced in 1999 which saw all new-build homes required all windows and doors (for new build properties) to be made from material certified and approved by the European ENV 1627:1994 Class 2 standard, or the Dutch NEN 5096, Class 2 standard. Using data from four waves of the annual National Victimization Survey (VMR), the results revealed that the regulatory change resulted in a reduction in burglary (within the sample) from 1.1 to 0.8 per cent annually – a reduction of 26 per cent. The results also revealed that the enhancement in security within new homes resulted in increased protection for older, less-protected homes within close proximity of the new homes – thus suggesting a diffusion of benefits whereby offenders are unable to distinguish between homes protected and those which are not. The analysis also suggested that burglary offences are not being displaced to other property crimes such as bicycle or vehicle theft.

- **Limiting access and through movement**

Access control refers to the design of buildings and space to actively keep people out. Whilst this principle has traditionally been referred to as access control, perhaps due to its routes in more traditional situational crime prevention measures to restrict entry into buildings and rooms within buildings, within CPTED the aim is much wider. What has been referred to as

access control encompasses the aims: 1) To limit the likelihood that offenders will become aware of that area as a potential target; 2) To make it more difficult for offenders to navigate into, out of and within an area should they select it as a target; 3) To increase the *physical* difficulty of entering a building/space should offenders become aware of the area as a target; 4) To increase the difficulty psychologically for offenders to enter and move around an area without feeling conspicuous, and 5) to remove any excuse for potential offenders to be within a private or semi-private space and maximise the legitimate users' confidence in challenging non-legitimate users of space. Given the wider aims of this principle, access control would appear too limited a definition. A more appropriate term might be the 'limitation of access, egress and through movement'. In terms of evidencing the impact of limiting access, and through movement on crime levels, the efficacy of this principle is less clear-cut and this is one of the reasons why the encounter versus enclosure debate emerged.

There are many research studies that support the first mechanism – that offenders prefer areas with high levels of through movement due to the ease of entry, through movement and escape. These include the studies of Murray *et al.* (2001) and Poyner & Webb (1991) [46]. The second explanation for higher crime within permeable neighbourhoods suggests that offenders have to be aware of a property's existence before they can select it as a target for crime. As offenders spend much of their time travelling between home, work, school or leisure activities, the properties that they become aware of are likely to be along the travel paths that they frequent. Wiles & Costello (2000) used interviews with offenders, police recorded crime data and forensic science data from the police DNA database as a means of investigating the distance which offenders will travel to offend. Their findings suggested that burglars are largely opportunistic, with the selection of a particular target taking place as they pass properties and notice their suitability. The dominant reason given by offenders for selecting a target was chance – with 63% of offenders giving this response. Additional research findings which support the premise that offenders select properties as they take part in day to day activities include Letkemann (1973) who found that burglars interviewed in British Columbia stated that they generally kept their eyes open for targets all of the time. The final rationale, that offenders prefer targets located within areas of high pedestrian movement due to the anonymity which this movement provides, is supported by Brantingham & Brantingham (1995), Poyner & Webb (1991) [46] and Taylor & Gottfredson (1987).

- **Image/management and maintenance**

Cozens, *et al.* (2005) use the term 'image', while others have used 'management and maintenance' to cover the principle of creating buildings/spaces which are physically free from litter, graffiti, vandalism and damage but are also areas without stigma or a poor social reputation. It is difficult to allocate a specific label to these concepts as image refers to a state and management and maintenance to the activities that create that state.

Several studies have suggested that if low-level disorder such as vandalism and litter are not addressed, they can act as a catalyst for more serious crimes. Skogan (1992) [53] refers to this as the contagion theory, suggesting that the presence of vandalism stimulates more vandalism. Wilson & Kelling (1982) [57] referred to this contagious effect as the "*broken windows theory*". This suggests that an area with existing deterioration such as graffiti and vandalism conveys the impression that a) nobody cares so apprehension is less likely and b) the area is already untidy so one more act will go unnoticed. This is supported by Taylor & Gottfredson (1986) who found that physical incivilities indirectly influence offenders' perception of risk in that they portray a resident's level of care or concern for the area in which they live, thus acting as an indicator for the likelihood that they will intervene if they detect an offence taking place.

- **Activity support**

Activity support relates to the creation of an environment which increases the likelihood that legitimate users will make use of space and subsequently act as additional surveillance. Although activity support is included by many as a distinct principle of CPTED, the ultimate aim is to enhance surveillance and so, the authors would argue, that the two principles can be combined.

- **Transferring the principles of CPTED**

Several authors have discussed the dangers of presuming that CPTED principles can simply be transferred to different countries without consideration for the local culture, climate and context (Cozens & Melenhorst, 2014; Ekblom, *et al.*, 2013; Armitage, 2013; Reynald, 2009) [16, 23, 23]. To do so would be to ignore the different ways in which people utilise public and private space, design requirements and solutions to meet the climate and culture of a region and the specific crime risks associated with a particular location. It would never presume that residents would use their space in the same way in England, Abu Dhabi, Brazil, Australia, Holland and Sweden, therefore, why should one presume that what works to reduce crime and improve quality of life through the design and management of the environment would transfer seamlessly between these areas? Crime prevention solutions cannot simply be bolted on or imposed without consideration for local context. Because these mechanisms work through motivating and directing the action of residents, passers-by, offenders, they have to take into account the way that people use their surroundings.

3. Analysis of empirical studies

Table 1 represents a collection of some empirical studies conducted basically on the elements of crime prevention through environmental design.

Table 1: Environmental design factors and Neighbourhood crime control

S. No	Title/Author(s)	Purpose	Methodology	Result(s)
1.	Examining the effects of crime prevention through environmental design (CPTED) on residential burglary. Marzbali, *et al*, 2016 [31]	To develop and validate a hierarchical CPTED model for urban neighbourhood and modelling its impact on burglary victimization.	Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM)	CFA revealed that CPTED is a third-order, reflective construct model with four main dimensions: surveillance, access control, territoriality and maintenance. SEM supported the theoretical findings in the literature that associated high CPTED with low victimization.
2.	The influence of street lighting on crime and fear of crime. Atkin, *et.al*., 1991	To determine, as a public policy, the effect of street lighting on crime and fear of crime	Regression analysis through questionnaire survey.	The effect was found to be minimal especially during the day time.
3.	Territorial functioning (TF) and fear of crime. Testing for mediation in structural equation modelling. Abdullah, *et. al*., 2016	To examine a model that explains the direct and indirect influences of TF disorder and victimization on fear of crime in a residential neighbourhood with high crime rate.	Use of questionnaire survey with systematic sampling method. Structural Equation Modelling.	TF had a negative impact on disorder, victimization and perceived risk. Disorder positively influenced both victimization and fear of crime. Generally, TF has the capacity of shaping fear of crime through perception of risk.
4.	The effects of neighbourhood conditions on perception of safety. Austin, *et.al*., 2002	To investigate the relationship between neighbourhood conditions and residents' express perception of safety.	Regression – Structural Equation Modelling (SEM).	It was found that housing and neighbourhood's quality had an impact on satisfaction with the local physical environment and perceptions of safety.
5.	Effects of Closed-Circuit Television (CCTV) on crime. Welsh & Farrigton, 2003	To report findings on available research evidence on the effects of CCTV on crime in public space.	Secondary data based on published studies using the Meta-analytic technique	All the nine studies showed evidence of a desirable effect of CCTV on crime.
6.	Fear of crime in gated and non-gated residential areas. Abdullah, *et.al*., 2012	To test the hypothesis that physical environmental elements like gated communities are believed to have effect towards the reduction of fear of crime.	AMOS using the Confirmatory Factor Analysis (CFA). Use of structured questionnaire.	Respondents inhabiting a gated residential area exhibit a higher fear of crime level when compared to respondents living in a non-gated residential area.
7.	Measuring crime prevention through environmental design in a gated residential area: A pilot survey. Sakip, & Abdullah, 2012	To identify the measurement level of CPTED component in terms of their correlation in reducing anxiety towards crime	Structured questionnaire and Confirmatory Factor Analysis (CFA) through AMOS.	Respondents who occupy individual gated residential areas demonstrated a higher fear of crime when compared to their counterparts who live in non-gated residential areas.
8.	Predicting the influence of CPTED on perceived neighbourhood cohesion: Considering differences across age. Abdullah *et.al* 2013	The study investigated the hypothesised relationships between CPTED and perceived neighbourhood cohesion (PNC) in elderly and non-elderly homeowners in Penang	Higher Order Confirmatory Factor Analysis. SEM-AMOS	A significant positive effect of CPTED on the PNC scale for the elderly respondents but not for the non-elderly respondents.
9.	Validating crime prevention through environmental design construct through checklist using SEM Marzbali, *et. al.*, 2012	To validate CPTED dimensions and its respective indicators developed to measure the CPTED construct	Validation using AMOS through Confirmatory Factor Analysis (CFA)	The various elements of CPTED (Natural surveillance, access control, territoriality and external maintenance) have influence on residential neighbourhood security control.
10.	CPTED and built-environmental manifestations in Accra and Kumasi. Owusu, *et al.*, 2015	To assess the degree of applicability of CPTED elements in Ghanaian cities of Accra and Kumasi	Structured interview with Police policy makers and practitioners. Descriptive analysis	No direct consciousness of the application of CPTED principles but individual perception of neighbourhood crime and the need to control it.
11.	The influence of CPTED on victimization and fear of crime. Marzbali, *et.al.*, 2012	To investigate the hypothesised relationships between CPTED, victimization and fear of crime (FOC)	Checklist through on-site observation to measure CPTED constructs. Use of SEM- AMOS	Significant positive direct influence of victimization on fear of crime. No direct significant relationship between CPTED and FOC.. Negative indirect relationship between CPTED and Fear of Crime (FoC).
12.	The effectiveness of burglary security	To measure the effectiveness of anti-burglary security devices, both	Multi stage stratified sampling; Use of Security	Certain combinations of security features confer a crime reduction

	devices. Tseloni, *et. al.,* 2014	individually and in combination.	Impact Assessment Tool (SIAT).	advantage, but protection conferred against burglary did not consistently increase with the number of devices installed.
13.	Stability and charge in High-Tech Enterprises: Organisational practices and routines in London. Costello, 2000	To provide rich analysis of the routine of choosing high-tech security gadgets to discourage offenders	Interviews with offenders, police recorded crime data and forensic science data from the police NDA database	Burglars are largely opportunistic, with the selection of a particular target taking place as they pass properties and notice their suitability. Little resistance put off the opportunist.
14.	Crime prevention through environmenta design in the United Arab Emirates. A suitable case for Reorientation? Ekblom, *et.al.,* 2013 [23]	To redress the Western bias on the application of CPTED as it focused on its desirability in the Middle Eastern nation of Abu Dhabi, UAE	Using Benchmarking, the CPTED principles were considered for local context.	There was dearth of international and comparative research in CPTED. Increasing CPTED knowledge would enable other non-Western nations to benefit
15	Exploring community perceptions of crime and CPTED in Botswana. Cozens, & Melenhorst, 2014 [16]	To investigate the application of CPTED to a non-Western setting in the developing world in order to explore to what extent local perceptions of community safety align with the Western principles of CPTED in Gaborone, Botswana	Use of CPTED Audit to measure the presence or absence of CPTED features. Observational analysis and photographic documentation. Community safety survey	The Western CPTED Audit and the non- Western Botswana respondents in the community safety survey both indicated there were low level of CPTED features in the environment through the respondents reported high levels of personal safety.
16	The relation between residential property and its surroundings and day-and night time residential burglary. Montaya, *et.al*., 2014	To examine how residential property and its surroundings influence day- and night-time residential burglary with focus on CPTED principles	Use of Multilevel Multinomial regression models	That Territoriality and access control predict day time burglary while access control and target hardening predict night- time burglary. That two separate burglary prevention frameworks are needed.
17.	Predicting and preventing: Developing a risk assessment mechanism for residential housing. Armitage, 2006	To present a comprehensive crime risk assessment mechanism for crime prevention design advisors to predict the vulnerability of residential housing.	Burgess crime risk assessment mechanism.	There is a link between environmental design features and crime within West Yorkshire. Armitage found evidence of brief and long-term desertion to be statistically significantly associated with prior burglary in a sample of 1058 properties.
18.	Disorder and Decline: Crime and the spiral of decay in American neighbourhood. Skogan, 1990	To determine the relevance of environmental management and maintenance in Neighbourhood crime prevention	Collection of pockets of research in a text	Suggestion that if low-level disorder such as vandalism and litter are not addressed, they can act as catalyst for more serious crimes. This connotes "presence of vandalism stimulates mores vandalism (p.39).
19	Deconstructing CPTED…and reconstructing it for practice, knowledge management and research. Ekblom, 2011 [22].	The paper described the latest stage of an on-going attempt to update and upgrade CPTED's concepts and actions and link them more closely to development in architecture, design and crime science.	Assessment of secondary data on CPTED	To produce a more rigorous, yet deeper and better-integrated conception (CPTED) useful for practice, research and theory alike.
20.	Crime and the design of residential property – exploring the perceptions of planning professionals, burglars and other users (part 2). Cozens, *et. al.,* 2001	To investigate the perception of planning professionals, convicted burglars and other users and provide both qualitative and quantitative analyses of result from series of interview which presented slide representations of different residential designs	Intensive interview and review of literature. Descriptive statistics	The result of the exploratory investigation underpins Newman's theory of 'defensible space' in that a hierarchy of place appears to exist with regard to housing design.

From Table 1, the summary of the relationship between environmental design and neighbourhood crime control as encapsulated in the previous empirical works is in this order: careful implementation of the elements of crime prevention through environmental design (CPTED) which comprise of access control, target hardening, territoriality, surveillance and maintenance among others was found to be capable of checkmating residential neighbourhood crime. Some of the findings (Owusu, *et al.*, 2015; Cozens & Melenhorst, 2014; Ekbolom, *et al.*, 2013) [16] also showed that the concept of CPTED had been proven useful in neighbourhood crime prevention in the developed economies like US, UK, Australia, Asia and Europe. Whereas, in the developing nations like Ghana, Nigeria, South Africa, and the likes, the

concept was found to be strange, though residents were conscious of the need to secure their homes from external attacks and intruders. Hence, there is a clarion call that international organisations like the United Nations should support researches based on the application of CPTED elements in the developing countries. Sequel to this, the need for this research partly based on the application of CPTED concept by testing its desirability.

4. Discussion on strength and weakness

In the collections of Garner Clancy on the First Generation CPTED, Crowe (2000) [21] attempting to expatiate on the CPTED concepts and strategies asserted that "the physical environment can be manipulated to produce behavioural impacts that will lessen the frequency and fear of crime, thereby improving the quality of life". Rosenbaum, Lurigio & Davis (1998) [49] also summarized the first generation CPTED intentions under the following: that the physical environment can check offences by hindering opportunities for crime by creating obstacles or barrier to targets; change residents' behavior to raise the likelihood that offenders will be observed, prevented or arrested; be structured or used by citizens to reduce crime through a surveillance enhancement, social control and social cooperation and social union among residents and deter the behavior of offenders by reducing places for concealment and convenient escape routes. Criticizing CPTED under these definitions, Shaftoe & Read (2005) [52] believe that terms such as 'defensible space', 'natural surveillance', and 'symbolic barrier' are literally used by professional as though they were established scientific approaches. Also, they observed that it is expedient to apply a 'designing out crime' strategy, but that also a danger of over-emphasizing its relevance and slipping into a design determinist viewpoint, thereby people are seen as robots whose behavior is wholly conditioned by the environment they find themselves in.

Mainly, some of the criticisms against the first generation CPTED brought about the development of second generation CPTED which embraced four new approaches namely: social cohesion, connectivity, community culture and threshold capacity (Sallive & Cleveland, 2008) [51]. Though, the second generation CPTED supports consideration of variables at the neighbourhood level. Nevertheless, Brantingham & Brantingham (1981) [9] have identified critical dynamics performing at this level in their crime pattern theory. The theory draws attention to: nodes- setting such as homes, schools, workplaces, shopping or strip-malls, and recreation area can provide particular crime opportunities and risks like they argued a node that supports one type of crime might not favour the other since specific risks differ greatly among nodes; paths – leading from one node to another, also offering crime opportunities and risks as not only do paths convey more people per square foot –hence providing potential criminals, targets and guardians- but paths drive people to nodes that might include them in crime; and edges- places where two local areas touch makes offence more risky place as outsiders can trespass quickly and then disappear without being challenged or even discerned.

However, while CPTED had received considerable attention from government, it was to a large extent ignored by criminologists who showed little interest in design theory. (Bottoms & Wiles, 1988; Mawby, 1977; Reppetto, 1976) [8, 30, 48]. Clarke (1989) [12] observed that Newman's ideas which later transformed to CPTED did not concur with most contemporary criminologists since criminology (particularly in America) is an offshoot of sociology and thus social factors are seen as most important in explaining causation. Newman was not a social scientist and seemed ignorant of the findings of traditional criminology. Reppetto (1976) [48] argued that planning and architecture disciplines provided the most committed leverage for the urban design theory. However, given the lack of interaction between urban design theory and criminology, it is not surprising that criminologists were dismissive of the methods and theories employed. For Reppetto, skepticism of CPTED by criminologists is acceptable on a theoretical level, but it is a different thing to simply ignore its possible policy pay-offs (Cozens, 2008) [17].

Melenhorst (2012) [35] in his work noted that there are a few academics across criminology, urban planning, human geography and social sciences who argue for the inherent limitations of the physical determinism of CPTED. He further affirms that the depoliticisation of environmental crime prevention; the neoliberal imperialism of global design and planning; the self-legitimization of the 'expert'; the indeterminacy of predicting danger and the empirical limitations of the 'rational' offender; as well as the 'fortressification' that can result from excessive use of CPTED. Among the 'opponents' of CPTED, according to Hills (2014) are those that perceive its strategies as being aimed at targeting or marginalizing groups such as youth or indigenous groups, the homeless or the disadvantaged. Ramm (2014), a CPTED practitioner believes that most of the criticisms against CPTED are as a result of lack of adequate education. He grouped such persons as those who assume they know what CPTED is but in reality have no clue and that those making assumptions often think it is about fortressing and ugly security measures. However, Ramm (2014) [47] added that any notion based on the expectation that CPTED is a panacea for solving all crime is unrealistic and far beyond the objectives of CPTED.

Parnaby is another notable opponent of CPTED based on his two pieces of research in 2006 and 2007. Parnaby (2006) [44] conducted a Canadian study of CPTED, where 25 individuals interviewed were considered to be professionals and supporters of CPTED model. Many of those who received CPTED accreditation were ex-police officers or employed in the private security sector. The analysis by Parnaby questioned the guiding principles of CPTED, implying that the assumptions were somewhat simplistic. Parnaby's study revealed that CPTED professionals were continually influenced by the idea of 'forseeable danger', inferring that if an area had unsafe environment or identifiable defects that went unfixed, the consequence would unavoidably lead to some form of criminal activity. Parnaby (2006) [45] therefore critically noted that (i) CPTED professionals see the cause of crime one-dimensional because of the use of word such as certainty (prevention) as opposed to probability (reduction) when prognosticating crime, which results in crime being provoked by poorly designed environment, such methods, he claimed could lead to other programmes being overlooked; (ii) thinking this way separates people into two groups: responsible citizens and criminals, and the separation of 'good' and 'bad' people, according to Parnaby, is probably established on social stereotype based on what people think

about race, socio-economic status, and gender by the exclusion of certain types of persons from certain neighbourhoods; and (iii) CPTED professionals wooing their clients into becoming willing associates as they made it seem that risk management was an individual's moral, civic and ethical responsibility, claiming that personal safety is also an individual's ability which he declared could make the strategy lead to vigilantism. Parnaby (2007) [45] principally dwelled on the financial hardship that the concept and theory of CPTED can put on its implementers.

Clarke (2005) [11] responding to the critics of situational crime prevention, which principles are embedded in CPTED identified and addressed seven points which he referred to as misconceptions to include: overly simplistic and theoretical; possibility of displacing crime and making it worse; diverted attention from the underlying causes of crime; its conservativeness and managerial approach to crime; promotion of selfish, exclusionary society; restriction of personal freedom; and its attempt to put all blames on the victim. He identified among others 'diffusion of benefits' as an antidote to crime displacement.

Other criticisms leveled against CPTED include absence of social cohesion within the residential neighbourhoods; no long-term results, most existing built neighbourhood were not planned with CPTED in mind, and alteration would be costly if at all practicable; displacement of crime weakens its general effectiveness; its resistance to change; lack of adequate acknowledgement of CPTED by environmental designers, land managers and individual community members thereby calling for community educational programmes; the controversy in the use of 'Designing' out crime whether it exclusively mean 'architectural an planning term' or 'to eliminate'; CPTED seems to be discriminatory as concepts like gated community and secured by design though sometimes mentioned but are yet to be incorporated as part of CPTED (Casteel & Peek-Asa, 2000; Moffat, 1983; O'Grady, 2011; Foucault, 1988; Flvberg, *et al*., 2002; Nussbaum, 2010; Marzbali, *et al*., 2011) [10, 36, 40, 25, 39].

5. Conclusion

This paper was able to expatiate on the main thrust of the concept (CPTED), and effort was intensified to appraise the efficiency and applicability of the technique. However, the concept was not without a number of weaknesses and criticisms as already highlighted but the general assessment showed that CPTED is a reliable tool in the area of residential neighbourhood crime prevention. Apart from the empirical studies supporting this position, there were enough proofs that the strategy had been successfully put into application in the Western countries in US, Europe, Australia and Asia (Cozens & Melenhorst, 2014) [16]. A clarion call is therefore being made to governments, policy makers, professionals and researchers especially in the developing nations to consider the strategy if not as an alternative, as a supplement to residential neighbourhood crime prevention so as to checkmate the soaring trend of the social menace (RNC) in consideration to its devastating consequences as already mentioned.

As a matter of fact, a tenacious application of the principles of CPTED is capable of enhancing housing sustainability; ensure smooth governance; enhancing housing investment and boosting the national economy. Essentially the scope of the research did not extend to testing empirically the influence of each of the elements of CPTED (access control, surveillance, maintenance, target hardening and territoriality among others) on residential neighbourhood crime. This was however recommended for future research.

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