

Benefits and Limitations of Crime Prevention through Environmental Design (CPTED) - A Review of Literature

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Abstract

The goal of this study is to conduct a literature review using the PRISMA protocol to examine the benefits and limitations of the CPTED approach to reducing crime. The PRISMA protocol was used to define the methodology for the literature search. The relevant keywords were graphically mapped using VOSviewer®. The keywords that were identified were then used to search for relevant articles on Engineering Village and Web of Science. For the selected publications, bibliometric and qualitative analyses were carried out. Even though the research topic has existed since the 1970s, it did not capture the attention of researchers until the 2000s. According to bibliometric analysis of research locations, the United States has been the primary focus of CPTED, followed by Australia and England. According to the secondary literature on the subject, there is growing evidence demonstrating the success of CPTED in several countries. CPTED is developing visualizations of environments as a future research direction. As new imaging technologies developed, they were used to assess the perceived vulnerability of real or proposed environments to various types of crime (such as burglary).

Keywords

CPTED Benefits, CPTED Dis-benefits, PRISMA, VOSviewer®

1. Introduction

Given the state of both local and global security, it is difficult to overstate the need of strong physical protection given the rising crime rate. If we stick to discussing burglaries, Statista (2021) stated that in 2020, there were 399.5 burglaries for every 100,000 people in the US, while in 2018, there were 376 burglaries for every 100,000 people. The FBI estimates that there were 1,117,696 burglaries in 2019, making about 16.1% of the total anticipated number of property offenses. In 2019, the anticipated \$3 billion in property losses were incurred by burglary victims. An average of \$2,661 was lost because of each burglary. One property crime is anticipated to occur every 4.1 seconds in 2017, while one burglary is anticipated to occur every 22.6 seconds, according to the FBI (2018). Given the figures, it is difficult to understate the need of having strong physical protection, especially when the crime is increasing quickly.

To tackle this phenomenon as of right now, the appropriate authorities have made significant financial investments in crime prevention programs using a reactive strategy. However, as rising crime rates invalidate any claims of progress, these investments have fallen short of expectations, just like they do in every other firefighting scenario. The industrialized world has shifted toward principles of Physical Security Assessment to minimize the threat. It involves inspecting a facility and determining the danger of intrusion without notice or a suitable reaction (Porter et al. 2014). A security specialist who is highly valuable in their field and whose expertise and experience bear a representative cost is needed to accomplish this historically. Because of this, security issues frequently come as virtually an afterthought in many situations.

2. Methodology

The following criteria have been applied to include and exclude sources from the analysis. Adopting the inclusion criteria from (Akinlolu et al. 2020), the following criteria will be used in the selection of publications. The methodology is presented in Fig 1 below.

- i. Only studies published in the last 10 years is included
- ii. All articles in peer-reviewed journals were included because their research methodologies and aims could easily be investigated.
- iii. Studies in the subject areas of Civil Engineering, Construction Engineering, Facility Management, BIM, GIS, and Social Sciences were considered.
- iv. Peer-reviewed publications written in a language other than English were excluded because their impact on the research community cannot be effectively evaluated.

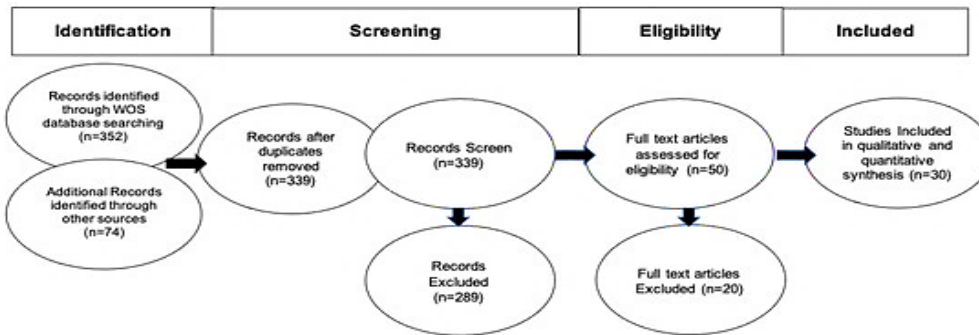


Fig. 1. PRISMA's Systematic Review Process (Adapted from Moher et al. 2015; Salman et al. 2021)

3. Data Analysis

Adopted from (Akinlolu et al. 2020), the following bibliometric techniques are utilized.

- i. Frequency analysis to establish publications by country/region distribution, and the number of publications annually.
- ii. Co-authorship analysis to present co-occurrence and collaborative network of authors in the selected domain of study.
- iii. Co-occurrence of keywords to present the occurrence of correlated keywords CPTED Benefits and CPTED Disadvantages, CPTED Criticism, etc. It facilitates the visualization of secondary literature in the aforementioned areas over time.

3.1 Bibliometric Analysis

The bibliometric analysis of the frequency of publication was performed using VOSviewer®, and the research topic gained popularity in the academic and research community after the year 2000 (refer to Fig 2). Although the research topic has been around since the 1970s, it did not capture the attention of researchers until 2000. It is easy to argue that the post-2000 era presented the built environment's research and professional community with enormous challenges in keeping building occupants "safe," in addition to other traditional requirements and expectations. With the changing world since the year 2000, an enormous increase in research related to the role of the built environment and safety is hypothesized for further investigation.

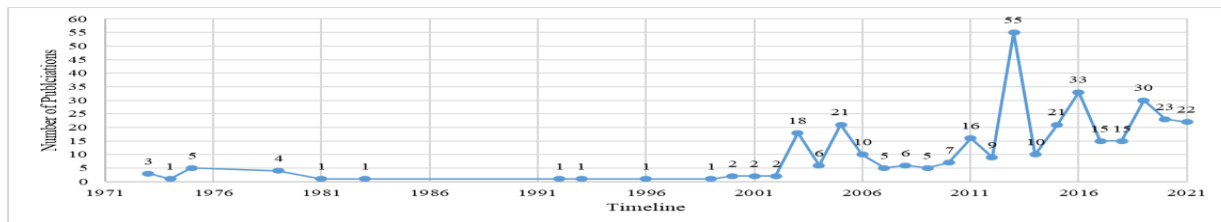


Fig. 2. Frequency of Publication (1973-2021)

The bibliometric analysis of research locations (Fig 3: top left) reveals that the United States has been the focal point of CPTED, followed by Australia and England. Fig 3 shows cross-country collaborations, implying that CPTED is a global phenomenon. It should not be limited to a few countries; rather, there should be a global movement to learn from and adopt mature construction cultures' experiences.

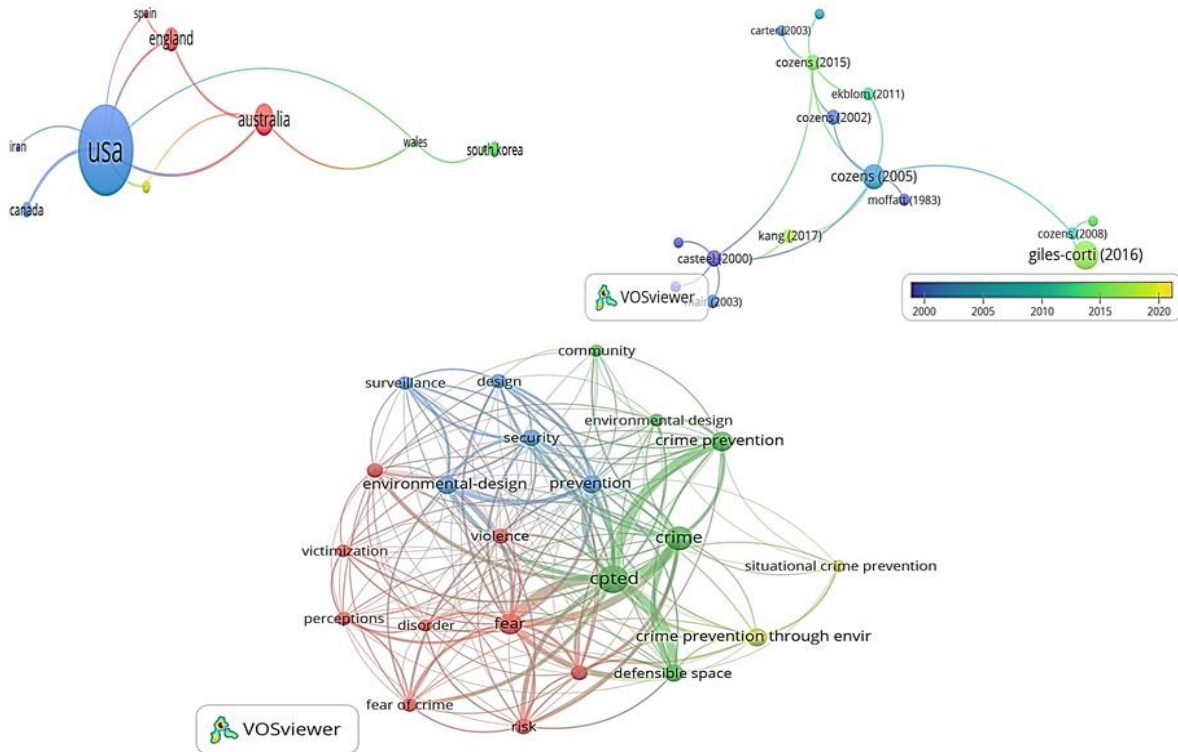


Fig. 3. Bibliometric Analysis

The bibliometric analysis addresses the most prominent citations (Fig 3: top right). A quick glance at the figure reveals Giles-Corti and Cozens' significant contribution to the field of CPTED. Since 2000, when CPTED research gained traction, the respective researcher has been actively present on the research canvas (refer to Fig 2).

For the eminent keywords (Figure 3: bottom center) within the domain of CPTED, it is critical to understand the Occurrences and Link Strengths of the top ten most repeated keywords. According to (Guo et al. 2019), in the VOSviewer manual, the link strength has a positive numerical value, and the larger this number is, the stronger the link. Furthermore, the total link strength represents the sum of all the link strengths of its individual links. Using this interpretation, it is important to emphasize the use of the terms "crime-prevention" (Occurrence: 30 and Total Link Strength: 81) and "crime prevention" (Occurrence: 34 and Total Link Strength: 65). When compared to 'crime prevention' 'crime-prevention' is connected to other keywords in a much stronger (Relatively Higher Total Link Strength) sense than 'crime prevention' (Relatively Lower Total Link Strength). We believe that the distinction between "crime-prevention" and "crime prevention" is purely semantic and that the intent of the defining aspect is the same.

3.2 Perceived and Experiential CPTED Benefits Results

According to Peeters and van der Beken, (2017), place design is effective in reducing crime, and the CPTED framework has a particular advantage in that it can be used to develop tangible measures to improve security. There is some empirical evidence that the CPTED policy has been a successful and viable tool for reducing crime rates in several international contexts. According to Cho and Jung (2018). (Baek et al. 2010; Kim et al. 2011; Kim 2007; Park 2010; Shin and Kim 2012). The secondary literature on the topic contends that there is growing evidence demonstrating the success of CPTED (Cozens et al, 2005; Haywood et al, 2009; Armitage et al. 2011), but there are also criticisms.

On this basis, the discussion that follows expands on the international context of CPTED's success in various countries.

- The United States of America, for example, after a variety of CPTED interventions in Portland, Oregon (Kushmuk and Whittermore 1981), there was a reduction in commercial property burglaries as well as "a stabilization" of the neighborhood's quality of life, physical appearance, and social cohesion among the business community" (Schneider and Kitchen 2002). CPTED has also been implemented in industrial areas. Access control, reducing escape routes, improved signage, target hardening, improved lighting, CCTV, and nighttime security patrols were all examples used in California (Peiser and Chang 1998). Break-ins, vandalism, and graffiti were drastically reduced (from every weekend to bi-monthly), and the industrial park's occupancy rate increased from 75% to 98.5% in one year. The costs of the security measures, according to the Park's management, were far outweighed by the income generated by increased rents, higher occupancy rates, and shorter vacancy periods (Schneider and Kitchen 2002). In addition to these CPTED-focused studies, evaluations in other fields provide evidence of the approach's effectiveness. A review of over a hundred problem-solving projects conducted by police departments across the country by the US Department of Justice found that 57 percent of successful projects used CPTED strategies as a major response (Scott 2000).
- Canada- Schneider (2002) reviewed "successful" CPTED case studies in Canada (though these were not independently evaluated) and contends that it is most successful "when residents are made aware of and educated on the design strategies that have been implemented and their role in maximizing the potential of these strategies."
- United Kingdom- Piroozfar et al. (2019) observed that ever since the interventions were implemented in 2011, crime rates in Brixton Town Centre BTC, London, UK have decreased, while rates in other parts of England and Wales have increased. It lowers the overall costs of crime prevention when it is considered early in the design process and involves all stakeholders, particularly communities and space-user groups.
- Australia- According to (Wilson and Wileman 2005), the results of their experiments revealed that CPTED principles reduce crime along Australia's Gold Coast. The study team also saw CPTED as a proactive crime prevention method that could be used in residential areas, retail centers, housing estates, and parks. CPTED was cost-effective because it required no significant increases in new resources, but rather better and more judicious use of existing resources. One positive outcome of the study team's empirical work in developing a "Safe City" plan was strong evidence that crime and fear of crime could be reduced if the good design principles outlined in CPTED Theory were applied to existing urban and suburban projects.
- Republic of Korea-Kim et al., (2019) establish that CPTED elements installed in the target area positively reduced crime rates, which is consistent with the findings of a previous study on the first generation CPTED, which found that the CPTED elements reduced burglary crime rates (Jeong et al. 2017). CPTED principles, when correctly applied and enforced, discourage crime, improve quality of life, and reduce fear. For example, in Seoul, South Korea, adequate closed-circuit television, street lighting, and maintenance played a significant role in reducing crime fear (Lee et al. 2016).
- The Republic of Ghana- Gouveia et al. (2021) cite (Owusu et al. 2015) that CPTED principles were applied in Accra and Kumasi, Ghana, by creating 'security islands' (i.e., higher walls with burglar-proof windows and doors) with low community solidarity in middle- and upper-class neighborhoods (Owusu et al. 2015).

3.3 Crime Prevention through Environmental Design (CPTED) Short Comings

Although first-generation CPTED has proven effective in several cases, it has several drawbacks. First, "irrational" offenders—those under the influence of drugs or alcohol—may be less likely to be deterred by first-generation CPTED strategies. Second, negative socioeconomic and demographic dynamics can reduce the effectiveness of CPTED strategies: on the one hand, social conditions can foster fear, reduce the desire to intervene and result in an individual withdrawing into a heavily fortified home (Merry, 1981). It is to become more focused on reprogramming the urban space through digital means and becoming more sustainable while maintaining the first generation's principle of surveillance and control and the second generation's principle of effective physical design and socio-cultural diversity (United Nations Interregional Crime and Justice Research Institute (UNICRI) and (MIT 2011). According to Peeters and van der Beken (2017), more caution is needed because the relationship of CPTED characteristics to the risk of burglary is different in the city center than it is further away from the center. This implies that burglary prevention advice should be site-specific. As a result, burglary prevention advice should focus on the specific characteristics that are relevant to each house. Arabi et al. (2020) conducted a CPTED study in Iran for a historical project and concluded that the first generation of CPTED, which included only physical issues, was unable to protect and secure the historical project; the second generation did not fully conform to the historical project's social background. Furthermore, the failure of location-based factors has increased crime rates and resident dissatisfaction.

According to Cozens et al. (2018), basic methods are likely to improve the implementation of fundamental CPTED principles, whereas assessment, which includes temporal analysis and experiential user testing, may deliver greater levels of design insight and longitudinal validation opportunities. The need to investigate people's responses to yet-to-be-built environmental settings is a common problem for environmental psychologists, architects, urban designers, planners, and criminologists alike. Although some studies do not support the claim that CPTED is effective, many report that manipulating design factors were less effective than addressing other variables (such as bureaucracy, political will, multi-agency coordination, community engagement, support, and so on) rather than reporting no effectiveness at all (e.g., Judd et al. 2002). In two empirical studies, Taylor (2002) discovered that social, cultural, and economic factors were more important than design in explaining crime reduction (Donnelly and Majka 1996,1998). It is also argued that CPTED is frequently overlooked by built environment practitioners due to competing priorities during the design and planning processes (Colquhoun 2004; Schneider and Kitchen 2007; Paulsen 2012; Knapp 2013; Monchuk 2016). According to Fisher and Piracha (2012), the lack of cohesion among many of the key stakeholders, professionals, actions, and conceptual understanding of CPTED demonstrates the potential value for coordinated training programs that seek to engage the multiple agents involved in the design and maintenance of any given space at the same time.

According to Cozens et al. (2018), there is currently no discussion of how different types of CPTED analysis may be enabled using both BIM and VR technologies. There was no research that used video footage to investigate burglary or other types of crime. The ongoing development of video game engine technologies raises the intriguing prospect of criminal scenario testing of environments. According to (Cozens 2014), CPTED must constantly adapt to changes such as increasing urbanization, population densities, population diversity, new technologies and products, new ways of life, and emerging crime problems to maintain its popularity. It must also remain reflective and strive to evaluate and comprehend its successes and failures. It is no longer sufficient to be aware of generic CPTED solutions. It is necessary to move away from cookbook approaches and instead consider the specific characteristics of each situation (Cozens 2014). Mihinjac and Saville (2019) both seek to improve CPTED as a theory by returning to its foundations in Jacobs (1961), Jeffery (1971) and Newman (1972) to re-inspect and redefine CPTED. By developing a new theory that integrates human motivation and aspirations within a neighborhood Livability Hierarchy, the Third Generation of CPTED will be able to expand both the situational focus of First-generation CPTED and the neighborhood focus of Second-generation CPTED.

3.4 Future Direction: CPTED and Visualization

Visual representations of environments have been used in criminological research for a relatively long time. As new imaging technologies have evolved, they have been used to assess the perceived vulnerability of real or proposed environments to various types of crime, including burglary. Maps and diagrams; Physical models; Photographs; Video; Panoramic photography, Street View, interactive imagery; Game engines; and experiential testing are all supported by the literature.

Table 1. CPTED and Visualization

Visualization Technique	Citation	Purpose
Maps and diagrams	(Cozens et al. 2018); (Andresen 2014); (Kim and Shin 2014)	The mapping of crime "hot spots" enables more coordinated efforts for crime prevention and policing responses. Early theories were concerned with both where criminals lived and where crimes were committed. Environmental criminology research, crime map implementation, and GIS technologies are becoming mainstream.
Physical models	(Fisher 2005)	Building scale models could be used in crime scene investigations.
Photographs	(Bennett and Wright 1984); (Cozens et al. 2001, 2002b); (Nee and Taylor 2000); (Shaw and Gifford 1994); (Wright and Logie 1988).	Photographs have been used to stimulate perceptions of crime (including burglary) in a variety of housing studies.
Video	(Heft and Nasar 2000); (Huang 2004); (Orland 1993)	There have been few validity studies on the use of video simulation, but those that have been conducted generally suggest that video has better validity than static photographs.

Panoramic photography, Street View, and interactive imagery	(Cozens et al. 2002b, 2003, 2004); (Whitaker et al. 2004); (Park et al. 2008, 2010, 2011); (Toet and van Schaik 2012); (Tutt and Harty 2013); (Piroozfa et.al. 2019); (Shaw & McKay 1942); (Cozens et. al. 2018)	BIM offers an exciting opportunity to better integrate CPTED principles in residential buildings while also providing insights into the dynamic relationship between the built form and crime.
Game engines and experiential testing	(Cozens et al. 2018); (Wang et al. 2014); (Klepto Meerkat Gaming 2016); (Bereitschaft 2016).	Based on experimental testing, more complex video game simulations of how burglaries and fires might be managed are likely to yield more sophisticated crime management strategies. To that end, video games that specifically simulate committing residential burglaries are being developed.

4. Conclusions and Recommendations

The paper presents a review of the literature based on the PRISMA protocol. The purpose of this paper was to present the benefits and drawbacks of Crime Prevention through Environmental Design (CPTED), as well as to identify future research directions. The number of publications in this field has increased since the year 2000. It is easy to argue that the post-2000 era presented enormous challenges to the built environment's research and professional community in keeping building occupants "safe," in addition to other traditional requirements and expectations; with the United States serving as the primary focus of the research. It has been discovered that there is a lack of consistency in the use of CPTED vocabulary. The knowledge is currently progressing toward a more holistic third generation of CPTED; the groundwork had been laid by two previous generations who based their work on target hardening, defensible space principles, and social cohesion and companion guardianship principles. It should not be limited to a few countries; rather, there should be a global movement to learn from and adopt mature construction cultures' experiences. With the rising crime rate, a multifaceted approach is needed to combat the threat of crimes against the built environment. CPTED has been proven successful in most parts of the world, despite its limitations and challenges. The existing secondary literature documents the success stories as well as the associated challenges. Access control, reducing escape routes, improved signage, target hardening, improved lighting, CCTV, and nighttime security patrols has been found to be effective to reduce crime from the built environment's point of view. The introduction of the latest visualization techniques such as gamification, VR/AR, and BIM, as well as developments such as Digital Twin, etc; can be used to increase the efficacy of CPTED, with preliminary studies being conducted.

The limitations of the current study along with recommendations for future study are elaborated in the succeeding discussion. The limitations of the study are presented for i. Research Design: and ii. Analysis and Discussion. They are elaborated as follows:

- Research Design- The secondary literature for this study was obtained from Engineering Village and Web of Science (WoS). As a result, one of the limitations is the inclusion of a diverse range of databases. Although it can be argued that many manuscripts will be shared by the databases, it is still worthwhile to include several databases. Scopus, Google Scholar, The Lens, Journal Storage (JSTOR), Science Direct, ASCE Library, the American Society of Civil Engineers, and other research databases can be added. Grant and Booth (2009) can provide more detailed guidance for the design of Literature Review Papers. They compared and analyzed over ten different review types and associated methodologies. Based on their findings, an appropriate strategy that is comprehensive and specifically suits the broad Civil Engineering domain with a focus on Building Construction, Building Science, Construction Management, and so on can be devised.
- Discussion and Analysis- The discussion and analysis focused on CPTED studies conducted for the commercial built environment. However, ample literature is also available for public places such as parks, bus/train stations, and so on. The current study employed Bibliometric Analysis; as future work, the analysis can be carried out in the manner described by Zhong et al. (2019), in which the authors conducted a scientometric analysis of a construction-related topic of interest (as an example). Data obtained from a diverse database should be subjected to Bibliometrics, Scientometrics, Webometrics / Cybermetrics, Informetrics, and Altmetrics analysis, according to Chellappandi and Vijayakumar (2018).

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