

# A Systematic Literature Review of Crime Prevention Through Environmental Design Principles Against Banks ATM Physical Security Effectiveness

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## Abstract

*Technology development never sleeps, humans creating more high-tech devices for society to use. Swift movement of technology growth has changed the conceptual design of the physical security control, location landscape, human behaviors factor, and perimeter controls are the factors to determine the security posture of the location. Hence, the rise of the new financial digital banking ecosystem has raised significant new concerns to bank consumers. In order to study the control measurement of current banking industry effectiveness by using the systematic literature review (SLR) to conduct the research that published in the digital library through world wide web. In short, maintaining the principle, policy guideline, and standard framework shall continue review periodically to identify the control measurement effectiveness.*

**Keywords:** ATM, Physical Security, Perimeter Protection, Access Control, Bank, CPTED, Premises

## 1. Introduction

Nowadays, most corporations and individuals might not have much awareness of creating a secure workplace. Especially some traditional workplaces like entering office with access cards, the office is monitor by CCTV, fire or theft alarm system and a security guard if it is affordable by the company. Somehow people do neglect the implementation design of these security systems, and then people simply installed those security components then caused various problems such as high maintenance cost, compromise to threat, and no standards in managing the physical access control of the company. There are many frameworks and standard practices that have been introduced in the market that to manage the access control of an organization through the information security management system (ISMS). A framework such as NIS SP800-30, International Organization for Standardization (ISO) 27001/27002/27005/31000/9001, Australia Standards and New Zealand Standards (AS/NZS) 4360, and Control Objectives for Information and Related Technology (COBIT). All of these frameworks have different types of key

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controls nature and business measures that deliver different security controls that benefit the business. As a result, the purpose of the study is to review the principles of crime prevention through environmental design effectiveness and compare them with framework, standards, and practices that in the Banking Industry.

## **2. Problem Background**

An area's secureness is based on the security control level established from the environmental design. Where the conceptual design of the physical security, location landscape, human behavior factor, and perimeter controls are the factors to determine the security posture of the location. However, the concept of crime prevention through environmental design (CPTED) has never been standardized as a mandatory guideline or policy in Malaysia. Where the situation exists in Malaysia's physical security environment. There are significant misalignments in planning, building design, security measures, policies, and general awareness that lead to the point of careless neglect in security aspects[1].

On the other hand, technology development and evolution will never stop swift forward. Humans creating more and more high-tech devices for society to use. Due to the swift movement of technology, human techno behavior will be turned into another new living lifestyle that technology creates a new sophisticated environment. Therefore, in an urban setup, security complexity has become more intertwined with networks of urban expansions, hardware and software aspects[1]. People may become safer if using the right technology is in place with a good Criminal Prevention Through Environment Design CPTED concept and regulation or standards in place.

Policy, Standards, and Framework have never been easy to integrate between each and others. While the development of digitalization and globalization that swift faster than policymaking, the cybercriminal issue has also become more advanced than ever. This causes the process of policymaking and integration with international standards on framework genericization to become more complex and difficult than ever before. The rapid development of technology and the emerging e-activities pose challenges for the law[2]. Therefore, a policy is often easily out-of-date, or the policy and international standards are limited to merge that due to the problem of culture or technology limitation.

The rise of a new financial digital banking ecosystem has raised several of new concerns, stated that which included service access, the health of the service providers, and consumer privacy despite providing consumers with tremendous alternatives as well as opportunities[2]". Therefore, the problem never sleeps and it keeps on transform and evolve. But the policy, standards, and framework merging remain a challenge to the stakeholder of the relevant industry.

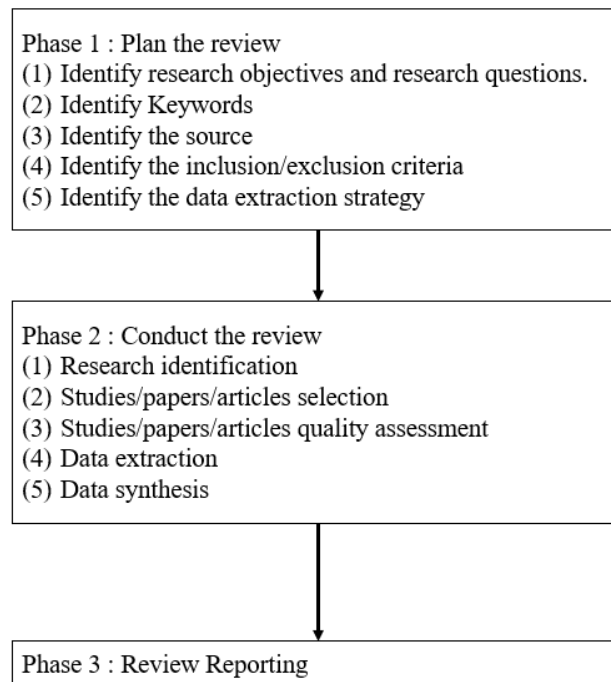
An expert paper highlighted that to know whether a regulation works, governments need reliable indicators that will measure the full range of outcomes, positive and negative, caused by that regulation, and they need to analyze those indicators using careful research designs that either rely on randomized experiments or use sophisticated statistical techniques that can control for confounders [3]. This shows the expert found that a design of regulation must carefully analyze those indicators, where each problem must carefully handle and if the design of new regulation founds conflict against those standards and framework then those standards practice no long being treat as a mandatory control for an organization.

### **3. Systematic Literature Review**

A Good research foundation is based on the literature review activity to construct. A good literature review can deliver a good scope of study and comprehensive analysis while reviewing the selected journal papers, articles, reference books, and related study material. The worldwide web has brought humans together people sharing information over the internet, therefore many study resources are available on the world wide web nowadays. Due to such circumstances, many research papers that lack quality being selected as a research reference and it has caused the person who conducts the study becomes difficult during the analysis stage, and it also wasted the researcher's time during the literature review that the paper did not shows any relevant key knowledge. As a result, selecting a good-quality paper to perform a literature review is important.

### **4. Selected Method of Systematic Literature Review: Kitchenham**

Systematic literature review (SLR) in this paper is applied the Kitchenham approach. Kitchenham's method allows a researcher to understand the research problems and enable a study to collect available resources from various academic sources. There are three stages of review phases according to Kichtenham's approach which is planning, conducting, and reporting. Figure 1 outlines the three phases with the steps to be performed in each stage of the SLR.



**Figure 1 - Kichtenham's approaches**

#### 4.1. Identify Keywords

Based on the chapter 1 research question stated, the most relevant keywords that the research could use to perform a search are Banking ATM Premise Security, CPTED Principles, Bank's CPTED, Regulation, Policy, Guideline, Controls. Some of the keywords are further derived to the similar meaning of

- i.CPTED Principles - > CPTED Models, CPTED Framework, CPTED Concept, CPTED Approaches,
- ii.Premise -> Area, Environment, Place, Perimeter, Zone
- iii.Policy -> Controls, Rules, Management, Practice, Strategy
- iv.Sabotage -> Hack, Breach, Attack, Denial of Service

After the search keywords are identified, the keywords will be compiled into a search string used in the source searching process. In this paper, the operator "AND" is used to link different keyword searches into the search string. The operator "OR" is used to group various synonyms or similar spellings of the search keywords. Thus, the formulated keyword search is as below: -

**((("Malaysia")) OR ("Bank")) AND ("Physical Security") AND ("Regulation" OR "Model" OR "Principle" OR "Framework") AND ("CPTED"))**

#### **4.2. Identify the source**

The sources are based on the worldwide web's online academic databases, and use the search engine to identify the source of the material. Meanwhile, based on identification of the research resources to ensure the search completeness.

Below listed is the online academic database that is listed to perform literature searching based on the analyzed keywords in section 4.1

- i. Emerald
- ii. ScienceDirect
- iii. SpringerLink
- iv. Google Scholar

#### **4.3 Identify the inclusion and exclusion criteria**

There are 2 levels of inclusion and exclusion that has been defined for this process.

In the first level, the paper filtering will be based on the below criteria: -

Inclusion:

- i. Any studies with the keywords as mentioned above.
- ii. Any studies in English.
- iii. Full-text papers
- iv. Review papers and while papers

The Exclusion of papers is filtering under the second level.

Exclusion:

- i. Any studies without any of the mentioned keywords.
- ii. Any studies not in English.
- iii. Any studies which are found to be repeated.

#### **4.4 Review Process**

After the review planning stage has been done and finalized, the paper review process will be started in section 4.7, including research identification, research selection, and assessing the paper quality, data extraction, and synthesis.

#### 4.5 Study Identification

Based on the identifying search keyword, journals and papers searching via online academic databases search result as Table 1 below.

**Table 1 – Identified Result via Onlie Academic Database**

Digital Library	Search Result
Google Scholar	308
Emerald	5
ScienceDirect	77
SpringerLink	17

#### 4.6. Article and Journal paper study material selection

The search process was not restricted during the research study. A collection of inclusion and exclusion criteria was used to narrow down the number of considered and defined studies in section 4.3 Initially, each retrieved paper was selected by reading the title, abstract, and keywords, and studies that did not meet the inclusion/exclusion criteria were omitted. The title and abstract of a paper did not include enough detail to make a decision. The full text was consulted, and the decision was created using the inclusion/exclusion criteria.

#### 4.7 Paper Quality Evaluation

Based on Kitchenham's proposal, it is mandatory to have a consistent checklist of the SLR. This is to determine the article studied and analyzed if there any biases and validity problems that arise during different stages of scientific research. The Table 2 is the Quality Assessment Questions which is one of the assessment methods with measurement: that base question shall Yes, No, Partially to determine and examine the paper quality.

**Table.2 Quality Assessment Questions**

No	Questions
Q1	The objective of the study did it the scope stated clearly?
Q2	Does the research result being carry out scientifically?
Q3	Does the research scoped accurately and based on the subject matters detailedly shows the context of research?
Q4	Does the finding base on scientific research method to conduct?
Q5	Does the researcher summarize the conclusion in a clear and state?
Q6	Does the researcher list the outcome of analysis clearly?
Q7	Does the study able to meet research hypothesis or clearly explained the research question.

The total number of studies retrieved was specified in section 4.5 and the folders were named after the source database/search engine from which the study was downloaded in Mendeley. All studies were listed, along with their authors and publication year. For reference on the data extraction method, each of the primary studies included was given a unique identification number (i.e., ID). An ID was applied to the file name if there were several publications in the same year, following the first author's completion of the data extraction process. The second author was to cross-check the extracted data.

#### **4.7 Comparative of Analysis and Result**

After the process in section 4.6, below are the 14 selected journal articles for this study and most of them are origin from Google Scholar. A limitation during the searching via the digital library, whereby found most of those quality journals or article required to pay for access and the fee was not cheap as in calculating in US dollar or Euro or British Pound. Due to research budget constraints, it was limited to access to read on those fine quality journals or articles. Table 3 shows the summarized articles.

- i. Various methods are used to improve and enhance the existing method/model/framework in CPTED.
- ii. The comparative of the method/model/framework in CPTED against ISO 27001.
- iii. Analysis between ISO 27001 Physical Access Control against CPTED principle on top of the Bank Environment Practice Basis.

**Table 3. Summarized Journal/Articles Selected**

ID	Title	Year	Author	Journal/Publisher	Study Area
Ar1	The Impact of Design and Placement of ATM Deployments on Perceived Safety in India[4]	2016	C. Hannah, T. Srinivas, and G. Subbaiyan	International Journal of Criminal Justice Sciences	Research on ATM placement while using the CPTED concept in India.
Ar2	Framework Development of Security System Assessment for Retail Outlets[5]	2017	Marina Syromyatnikova	St Petersburg State University Graduate School of Management	Research on Developing of Security System for Retail Outlets base on the method of CPTED
Ar3	Enhancement of Physical Security Control for Data Centre and Perimeter in Banking: A Case Study of Central Bank of Sudan (CBOS)[1]	2018	Fathi Ibrahim Salih, Hafiza Binti Abas, Azizul Azizan, Salwani Mohd Daud	Open International Journal of Informatics	Base on a case study to explore Central Bank of Sudan Physical Security Control for Data Centre and Perimeter in Banking Domain.
Ar4	High Aesthetics/Low Incivilities: Criminal Victimization and Perceptions of Risk in a Downtown Environment[6]	1998	Matthew B. Robinson	Journal of Security Administration,	Research on CPTED implementation in the downtown area and the improvement that could help reduce risk on criminals and the rate of victims



Ar5	Assessment of Building Security Cost Determinants Effects[7]	2015	Anifowose Opeyemi Maroof , Ilias Said and Radzi Ismail	Asian Research Publishing Network (ARPN).	This study explores and assesses the effects of the cost factors of building security cost within the built environment, using mixed methods sequential exploratory research design
Ar6	The thoughtful security practitioner: Exploring reflective practice in security risk management[8]	2017	Alexander Nikolaus Hasenstab	University of Portsmouth	Its main aim was to fill a gap in the body of knowledge on reflective practice and security risk management and contribute to security risk management practice by providing practical information about the application of reflective practice in the discipline
Ar7	Crime Prevention[9]	2000	Graham Farrell	Research Gate	The research explores the nature of crime prevention draws parallels between how animals protect and defend themselves and the techniques used to prevent crime in human society.
Ar8	Techno-Mediated Safety: Social Atomization and the Growth of Residential Security in Recessionary Japan[10]	2020	MISHA BYKOWSKI	Stanford University	The paper was discussing japan criminal rate and between Tokyo Olympic reason japan need to improve the security, hence the research exploring on going beyond securitization as a technological shift, through locks, sensors, intercoms and access control systems, it shows how techno-mediated safety encompasses a changing worldview tied to the reimagination of the Japanese family and community.

Ar9	Aspects of Deviance Crime and Prevention in Europe[11]	2009	Milton Keynes	ICCCR – Open University	Report of the Final Conference to discuss and report about the aspects of deviance, crime and method of prevention in Europe.
Ar10	Cityscape: A Journal of Policy Development and Research[12]	1996	Michael A. Stegman	Office of Policy Development and Research, U.S. Department of Housing and Urban Development (HUD).	The journal found it is about the constitution and the partial inventory of its resources. such as “Universities and the Urban Challenge,” “Community Colleges and Urban Development,” and “Higher Ground: Faith Communities and Community Building” discuss ways in which local institutions, traditionally regarded as inward-looking, can become engaged in community renewal
Ar11	A Review and Current Status of Crime Prevention through Environmental Design (CPTED)[13]	2015	Paul Cozens Terence Love	Journal of Planning Literature	The article reviews the current status of the concept of Crime Prevention through Environmental Design (CPTED). It provides an overview of its history and origins and defines how it is commonly understood and conceptualized
Ar12	The Development of a Criminological Intervention Model for the Rosslyn Industrial Environment in Tshwane, Gauteng, South Africa[14]	2015	William Lyon Pretorius	University of South Africa	The research is to find out further on those intended crime prevention model has been designed in such a way that it addresses the entire environment of crime that prevails in the Rosslyn area involving both the offender and the victim. This design is rooted in the ontology of Environmental Criminology and more specific on the applied epistemology of Crime Prevention Through Environmental Design (CPTED).

Ar1 3	Development of a Landscape Vulnerability Assessment Model in a Heightened Security Environment [15]	2003	Christine G. Sena	Virginia Polytechnic Institute and State University	The author idea is to provide landscape architects with a broad understanding of security objectives and design options. The author also highlighted that security objectives can only be met if the client, engineers, architects and landscape architects work together as a team
Ar1 4	Security planning for malls in relation to site design case study sarit centre shopping mall[16]	2015	George Kariuki Njoroge	University of Nairobi	The author believe that careless design and development strategies cause negative effects on the environment. Hence the author would like to begin a reach with shopping malls and people's interactions with other urban elements such as the CPTED concept.

## 5. Recommendation

ATM or known as a self-service terminal (SST), has become demanding in society. This is due to the convenience of cash collection, performing digital banking activation, instance transfer, mini statement, bill payment, hire purchase repayment, setting loan standing instruction, and other banking services. In this aspect, ATMs have become more powerful than those good old days but the security concerns persist always, due to criminals also keep improving their technical skills in stealing money away from the ATM without damaging physically it. A case study, from [17] stated that a total of RM 530,600 was stolen from 2 ATMs machines, based on the CCTV cameras at the bank recorded there were 3 suspects and believed to be from South America. Although there are no people get harm from this incident, but this issue has raised as an alarm to the society where the hacker able to physically steal money and nobody able to recognize them. Based on this incident, adopting CPTED may be able to avoid,

based on 3 of the CPTED principles which are Territoriality Control, Access Control, and Social Cohesion. Applying territoriality control such as establishing Bank Branch near a police station in between 3 to 5 KM radius may ease the police travel within a short period. On the other hand, enhancement on access control during night time after midnight for those Bank that did not have any security guards that onsite guarding the ATM premises shall use facial registration or biometric registration such as a thumbprint or retina registration before the customer proceed active the ATM and perform a transaction. Furthermore, the ATM shall implement a silent alarm system if there is any unusual issue happens it shall auto alert the nearest police command office that can dispatch the police officer to inspect onsite. Despite, Social Cohesion also can play as a tactic by the Bank, and Bank may use Big Data Analysis on neighborhood customers and non-neighborhood customers during night time, the customer entered the ATM room, and thru CCTV facial recognition that shared with the district police department also maybe a success factor to reduce crime. In a nutshell, CPTED is very practical in sense of the overall concept, with the technology today CPTED can do it better than in old times. Making CPTED principal extension onto ISO 27001 and implement into Banking policy shall be a good strategy and practice for Bank to reduce criminal risk.

## **6. Future Works**

An idea of using the technology of facial recognition can be further study as to understand the concept and feasibility of the system implementation. Where to study the implementation of the ecosystem into the Banking environment between the Law and Enforcement, and those legal issues in data sharing between Law and Enforcement Agency also can be further explored. Despite, the issue of dumpster diving also can be another stand-alone topic to research as to find out if there any relevant factor that led to ATM crime. On the other hand, identifying the issue on stress testing and limitation on 3 of the control measures can be conducted through researching in the compliance rules stress level that how many people willing accept on those controls' measurements.

## 7. Conclusion

Physical security issue persists in every industry domain and dimension. People suffer fear, loss of finances, loss of life, rapes, and other kinds of crime issues that due to neglect of physical security controls of premises. Although, many agencies and the local regulator have been taking the effort to study human interaction and physical security design to create a more secure environment for the public. In addition, the government also enforcing a premises security policy for that custodian or landlords to ensure the effectiveness of physical security is well established. Hence, the Banking Security policy has been enforced on Banks as be the part of compliance regulation to assure the Banking Services' availability and integrity to the public. Despite, the International Organization Standards also introduced ISO 27001 as an international practice of Information Security Management System (ISMS) to the global leader and practitioner, accordingly to [18] analysis found that there is a significant increment from 25000 to 34000 since the year 2015 to the year 2016 and the growth is continuous by year-on-year basis. Although there is ISMS by using ISO 27001 ISO also introduced ISO 22341 in the year 2021 that was just released in January of the year, which ISO 22341 is the practice of CPTED known as security resilience on protective security, hence CPTED has been demonstrated as an important access control concept and ISO starting to make it as a standard practice to encourage people to take up such standard to make the public more secure friendly. On the other hand, the research conducted to find out the effectiveness of ISO 27001, Bank Policy, and CPTED is meaningful were the result of the analysis through those sampled data from employees that work in the Bank found that the security level of ATM is exceeded the par, but still, people think that there is significant improvement can be done on the ATM physical security. In a nutshell, the research finds the standard guideline of ISO, BNM RMIT policy, and CPTED is effectively implemented and physical security is maintained in a fair acceptable manner, however, continuous improvement shall be kept ongoing and periodic review on those implemented concepts should stay insight always.

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