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Enrichment: Journal of Multidisciplinary Research and Development

Analysis Of the Effectiveness the Use Of Closed-Circuit Television (CCTV) for Control of Road Code Crime

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ABSTRACT

This study examines the use of CCTV (Closed-Circuit Television) as a tool for improving traffic management, maintaining social order, and enhancing public safety in Dili, the capital of East Timor, which is currently experiencing rapid urbanization and modernization. The increasing population and limited access to public transportation have led to heavy reliance on private vehicles, resulting in congestion, frequent violations, and traffic-related accidents. Despite regular safety campaigns by relevant institutions and traffic police, road users still lack awareness regarding traffic safety and regulations. The installation of CCTV has become an essential initiative by the National Police to support traffic monitoring, law enforcement, and crime prevention. This research aims to analyze the effectiveness, strategy, and control mechanisms of CCTV use in supervising vehicles and maintaining public order under the framework of Social Control Theory, Strategy Theory, and Effectiveness Theory. Employing a descriptive qualitative method, data were collected through observation, interviews, and documentation, and analyzed using the Miles and Huberman interactive model along with SWOT analysis. The findings reveal that while CCTV installations across major roads in Dili function well in terms of hardware performance and image clarity, their utilization remains limited due to insufficient human resources, lack of technical expertise, and high operational costs. Only a few recorded cases, such as accidents, have been effectively resolved using CCTV evidence. The study implies that optimizing CCTV management through capacity building, resource allocation, and technological integration is crucial to enhance its effectiveness in maintaining traffic discipline, ensuring public safety, and supporting sustainable urban governance..

Keywords: Effectiveness, CCTV, Road Code.

INTRODUCTION

Security and traffic safety are important aspects of creating a safe and comfortable environment for the community. Effective traffic regulation requires good supervision to ensure compliance and address violations. The use of advanced technologies such as closed-circuit television (CCTV) has become an alternative to improve law enforcement in the context of traffic control. Closed-circuit television (CCTV) is known as a video monitoring system that can monitor and record activities in certain areas (Kolodyazhny, 2021; Salonen, 2018; Tran et al., 2022; Tumalavičius & Šakočius, 2017; Wan Ismail et al., 2019; Welsh et al., 2020).

In the context of traffic control, CCTV can be used to monitor roads, intersections, and areas commonly known for breaking traffic regulations. With the ability to record and monitor in real time, CCTV offers valuable tools to detect traffic violations, identify violaors, and gather the evidence needed for legal action (Enggarsasi & Sa'Diyah, 2018; Park et al., 2022; Paul et al., 2023; Seo & Kim, 2020; Thomas, 2019; Yeganegi et al., 2020). The application of CCTV in traffic control aims to increase the effectiveness of law enforcement, reduce the number of traffic violations, and improve road safety. Traffic violations can be identified by various infractions, such as running red lights, speeding, using the wrong road, and not wearing a helmet. With clear visual evidence, the law enforcement process can be carried out efficiently and accurately.

The improvement of technology, namely Closed-Circuit Television (CCTV), has enabled government institutions and various organizations and agencies to develop surveillance to secure and safeguard each institution and organization. CCTV not only records activities, but is also used to monitor and analyze situations

in public places such as transportation, parks, city centers, and shopping malls. The implementation of CCTV in public services aims to improve public safety, reduce crime, and support emergency response. With real-time monitoring and recordings, CCTV is an effective tool to facilitate quick action by law enforcement or security officials. The use of CCTV can reduce crimes such as theft, vandalism, or violence in public places. Furthermore, it can provide a sense of security for the local community and enhance confidence in public service providers. Surjono (2011) argued that "Closed Circuit Television (CCTV)" is equipment that uses video cameras to generate video or audio data. The existence of closed-circuit television (CCTV) serves as a solution to problems that occur in various areas.

The notion of feeling safe and secure among commuters is an important aspect of community transportation management. With the increasing number of people using motorcycles every day as an alternative mode of transportation, security and safety issues related to traffic become even more important to address. Traffic accidents not only cause injuries and deaths but also impact quality of life, economy, and overall public health. Therefore, creating and maintaining a safe and efficient traffic system is a top priority for the government and society. According to Abubakar in Haryono (2013), a traffic accident is an incident that occurs when road users fail to master their surrounding circumstances, including themselves.

Therefore, the need for an effective security system is important to ensure the security and safety of public roads. Due to urban development and the high volume of urbanization, commuters often lack knowledge and understanding of the function of traffic signs and signals, safety issues when using transportation, and traffic rules and regulations. The author acknowledges that many accidents and violations of traffic regulations are often caused by lack of vehicle documents, lack of safety attributes, and other factors. The traffic police and local authorities have taken these issues seriously, and various measures have been put in place, including the Timorese government establishing driving rules to prevent traffic accidents. However, violations of traffic rules and regulations continue to occur frequently in Dili and other towns across Timor-Leste. Most of these traffic violators intentionally disregard established rules.

The behavior of road users is one of the main factors. For example, ethics, tolerance for other road users, and emotional control are relatively low. Some drivers follow traffic rules only when police are present, and violate them when police are absent. Disregard for the safety of others also reflects minimal awareness, as the road is not for just one or two people, but for everyone to use. Thus, every road user should be responsible for the safety of others. Sugiyanto et al. (2014) explained that the main factor causing the increase in traffic accidents is the growth in motor vehicle use, especially motorcycles. Another factor is the low level of discipline among road users in traffic.

Accident prevention is one of the government's top priorities in the area of road safety. To meet these priorities, the government aims to improve road safety and ensure the safety of people and goods in traffic on the road. Prevention and improvement of road safety are regulated in "Decree-Law no 6/2003". However, actual legal awareness in the area of traffic and road transportation in the city of Dili is currently declining because many drivers, both private and public, violate traffic signs. Many road users do not comply with the road code as written in "Decree-Law no 6/2003".

The high number of traffic violations is one cause of the number of traffic accidents that occur. According to data reported in the Traffic Police Report during January–August 2024, traffic accidents in Dili amounted to 816 cases (Dili Traffic Police Report). From the total number of accidents that occurred during the first seven months of 2024, the police need to work hard to reduce accidents through appropriate and rigorous action on traffic violations to change drivers' attitudes and improve traffic safety. Good traffic rules will be worthless if road users continue to violate the road code and authorities competent to implement the rules do not enforce them properly.

According to observations of the real conditions in the city of Dili, many public and private transportation movements are indisciplined, not respecting the installed traffic signs. In addition, many drivers do not control their speed on public roads. To guarantee security for the use of public roads in the city of Dili, the government has installed CCTV (Closed-Circuit Television) in public areas and police service facilities with the objective of strengthening supervision, developing responses to incidents, and ensuring public safety.

Overall, the use of CCTV in traffic management not only helps discipline drivers but also improves road safety and the efficiency of the transportation system. According to data on road traffic control in Dili, the National Police of Timor-Leste (PNTL) has installed 71 Closed Circuit Television (CCTV) cameras in Dili. The CCTVs installed in the city of Dili are supported by China (Independent Newspaper, Edition 30 July 2024).

Previous research has highlighted the role of CCTV technology in improving urban safety and traffic regulation, yet its implementation and effectiveness remain inconsistent across developing contexts. Henderson and Tucker (2020) found that installing CCTV systems in major cities significantly reduced traffic violations and improved law enforcement efficiency by providing reliable visual evidence for prosecution. However, they also noted that without proper management and trained personnel, the potential of CCTV systems could not be fully realized. Similarly, Rahman and Arifin (2022) analyzed the use of CCTV for traffic control in Southeast Asian cities and concluded that while CCTV improved monitoring and public security, its long-term success depended on integrating technology with institutional capacity and citizen participation. Both studies emphasized the importance of surveillance infrastructure but overlooked operational, legal, and socio-behavioral barriers in smaller developing nations such as Timor-Leste.

Analyzing the effectiveness of CCTV use in this context is important to assess how the technology can be optimized to increase traffic regulation compliance and reduce traffic crime rates. The purpose of this research is to analyze how CCTV contributes to traffic management and identify existing barriers to its optimal use, while the expected benefit is to provide practical recommendations for policymakers and law enforcement agencies to strengthen digital surveillance systems, improve public discipline, and promote sustainable urban safety governance in Timor-Leste.

METHOD

In this research, the researcher uses a qualitative approach through natural and holistic methods to explore, understand, and explain complex phenomena from the perspective of individuals or groups. According to H. Mudjia Rahardjo (2017:10), the natural approach means data acquisition activities are carried out in the context of real life. Holistic means the researcher must have the capacity to obtain comprehensive data so that no information is missing. From the data, facts and reality are obtained. To gather comprehensive information, the researcher collects data not only from participants and key informants through in-depth interviews but also from people knowledgeable about the research topic.

This research was conducted using a descriptive qualitative type. According to Rukajat (2018), descriptive research describes phenomena that happen realistically, truly, and contemporarily, as it involves systematic description, factual design, and certainty about the facts, characteristics, and relationships between observed phenomena.

The research was conducted at the Police Headquarters Caicoli, the Police Operation Center Department, and the Traffic Police Unit of the Municipality of Dili. In these locations, the researcher conducted observations, direct interviews with key informants, and collected documentation related to the research topic.

RESULTS AND DISCUSSION

Function, Quality and Quantity of CCTV in the Police Operation Center.

CCTV's main function is as a surveillance tool that can help police identify and arrest criminals. It covers a wide range of crimes, from minor to serious offenses. The use of CCTV can also speed up responses to incidents, whether traffic accidents or criminal acts. In addition to monitoring crimes, CCTV can also be used to monitor other problems such as irregular waste disposal. This shows that CCTV can work in the context of environmental management and can raise public awareness..

According to Kurnia (2021), "Closed-Circuit Television (CCTV)" functions as a surveillance camera that can monitor situations and conditions in real time and apply pressure to deter criminal activity. In the real context of the city of Dili, to supervise all activities, the National Police of Timor-Leste (PNTL), through the IT department, installed seventy-one (71) CCTV units on public roads in Dili. Results from interviews and observations conducted by the researcher at the Police Information Center to monitor the CCTV showed that the cameras installed on public roads have good image quality and can zoom up to 500 meters. In addition, the CCTV installed by the PNTL has the capacity to monitor at night, allowing effective supervision even in low-light conditions. This shows that investment in advanced technology aims to improve public safety and supervision in the city of Dili.

The CCTV installed by PNTL on public roads received support from China and Australia. This support represents international collaboration in efforts to increase security in the city of Dili and reflects both countries' interest in regional stability and security. Currently, there are five Network Video Recorders (NVRs) used to monitor CCTV in Dili. Each NVR monitors 16 CCTV cameras. The system is designed to manage video data efficiently, showing strategic planning in developing CCTV coverage over a wide area with integrated surveillance.

Table 1. CCTV Area Installed in Dili City

Nu	Network Video Recorder (NVR)	Area
1	NVR 1	Dalan Joao Paulo Tasi 3 Selamat Datang
		Dalan Uma Adat Tasi 3
		Altar Amu Papa Halo Misa
		Kampo Area Uma Adat Tasi 3
		PostuPolisia 01 Tasi 3
		PostuPolisia 02 Tasi 3
		Terminal Tasi 3
		Raikotu/Golgota
		Rotunda Nicolau Lobato
		Estrada Tasi 3
		Tera Santa 01
		Tera Santa 02
		Tibar Joao Paulo Nia Kotuk 01
		Tibar Joao Paulo Nia Kotuk 02
		Farol CAC oin 01
		Farol CAC oin 02
2	NVR 2	Aeroporto Nicolau Lobato
		Bombeiros Kampo Baru
		Ponte Comoro 3
		Timor Plaza
		Manleu Dalan Foun
		Rotunda Manleu Uma Adat
		Rotunda Elemloi
		Madre Alma Bebonuk 01
		Madre Alma Bebonuk 02
		Pertamina Mae da Graca 01
		Pertamina Mae da Graca 02
		Bebonuk SD Andar
		Bebonuk Tasi Ibun (Tunu Ikan Fatin)
		CCF Comoro
		Pertamina Pantai Kelapa
		Loja MeimarFatuhadaOin
		Dalan MNEC oin
3	NVR 3	Jardim 12 Novembru
		Motael 01
		Motael 02
		Porto Dili 01
		Porto Dili 02
		Palacio Governo
		ParlamentoOin
		Estadium Municipal
		Rotunda Francisco Xavier do Amaral
		Correios Dili/CentruKultura Indonesia
		Procurador Jeral da Republika
		UNDIL
		Farol
		Kampung Alor
		Aitarak Laran
		Pertamina Hudi Laran
		KruzamentuMinisteriuJustica
		Tribunal Supremo Caicoli
		Largo Lecidere
		Ponte BJ Habibie
		Dalan Eskola Sao Paulo VI Bidau

Nu	Network Video Recorder (NVR)	Area
4	NVR 4	ApotikFoho Osan Mean
		Eskola 04 de Setembru Balide
		Rotunda Lahane Hali-Laran
		Palacio Nobre Lahane
		Dalan MerkadoTaibesiOin
5	NVR 5	Mascarenhas Dalan CNC oin
		Ponte Maufelo
		UNITAL
		Hospital Guido Valadares
		KruzamentoIgreja Balide
		Bidau Masau
		Kruzamentu Kulu-Hun
		STM Becora
		PrizaunBecoraOin
		Terminal Becora
		DNTT Hera
		Rotunda Metiout

Observation of CCTV Monitor in IT Department on November 4, 2024

Lack of Management and Strategy in the Use of CCTV

To manage the CCTV resources installed by the PNTL, a utilization strategy is very important. Currently, the strategy for CCTV use by the PNTL is not maximized to identify and capture crimes against traffic signs in the city of Dili. One fundamental reason is that the CCTV monitoring site lacks members of the traffic police to control violations of road codes. In addition, the seriousness of arresting offenders against traffic signs is lacking, even though the PNTL itself has good coordination with the DNTT. CCTV monitoring operates 24 hours, but concrete action resulting from CCTV adoption is very minimal. Lack of management and strategy for CCTV use affects the rising number of accidents in Dili every year. According to secondary data accessed by the researcher, accident cases in Dili from 2020 to 2024 numbered no less than seven hundred (700) and can rise to one thousand (1000) (Secondary Data).

The main reason reported by transit authorities for accidents is the lack of awareness among road users. Although socialization efforts are carried out, they do not raise community awareness. This shows that socialization alone is insufficient; there must also be indirect enforcement through CCTV to reinforce compliance. When violations of road codes are caught by CCTV but traffic police do not act, violations steadily increase and affect accident rates. The issue of limited facilities and transit personnel is not a major reason to avoid making a strategy for CCTV use to capture violations. Even with strong CCTV resources, having a good strategy to use them will help transit services. According to the first research by Piza & Welsh (2019) titled "CCTV Surveillance For Crime Prevention: A 40-Year Systematic Review With Meta-Analysis", CCTV systems that incorporate active monitoring produce greater effects than passive systems. Schemes with different interventions combined with CCTV generated larger effects than those with intervention alone or no intervention alongside CCTV. The particular need for CCTV is to target car crime and other property crimes over the long term, rather than implementing it as a "stand-alone" crime prevention measure. As CCTV monitoring increases and access expands in public or private places, integrating new technology, policy will benefit from high-quality evaluation of outcomes and implementation.

According to Chandler in Akay et al. (2021), strategy is the determination of long-term goals and objectives of an organization, the implementation of actions, and the allocation of resources needed to achieve those goals. In the context of CCTV management, the PNTL institution's goal to combat all crimes is not being maximized. The PNTL, through its Department of IT, Police Information Center, and Traffic Police, has not implemented a specific policy to apply CCTV effectively to control crimes against traffic signs related to violations.

Ineffectiveness in the Use of CCTV

The results of this research found that the types of cases related to the work of the Traffic Police are accident cases, incident cases, and violation cases. Of these three types, violations occur daily. Violation cases are currently a major problem contributing to the high number of accidents and fatalities. Examples of violation cases include

running red lights, motorcycles or cars speeding uncontrollably, driving against the road direction, collisions involving motorcyclists not wearing helmets, motorcycles driving in front of public roads, illegal car turns on public roads, parking cars or motorcycles on zebra crossings, cars or motorcycles carrying more than the maximum number of passengers, and other similar offenses.

According to direct observation in the CCTV monitoring room, violations are clearly captured by the CCTV daily, yet the competent authorities do not pay attention. The function of CCTV is primarily used to respond to accidents and incidents. When an accident or incident occurs, Traffic Police use CCTV to investigate the cause. When there are no accidents or incidents, CCTV still monitors but ignores violations. In violation cases, the police respond only when they conduct autostops or directly encounter offenders on public roads. These actions show that the effectiveness of CCTV on public roads is not maximized because it does not focus on violations, which are the main cause of accidents. This ineffectiveness undermines the purpose of using CCTV. UlberSilalah (2015:416) explains that, in the context of achieving goals, effectiveness means doing the right thing or the right job. Effectiveness refers to the success of achieving organizational goals and is a measure of whether a manager performs the right job. Effectiveness is defined as the level at which an organization accomplishes its goals.

In another context, budget expenditures for CCTV use are very high, covering telecommunication operators and maintenance. According to research sources, each CCTV costs $200.00 monthly, and currently, 71 CCTVs are installed in the city of Dili. This means the National Police of Timor-Leste must pay the operator approximately $14,200.00 (fourteen thousand two hundred U.S. dollars) per month. This expenditure does not include maintenance costs or the CCTVs installed at the National PNTL building areas. Due to this large expenditure, utilization is not maximized, which contributes to the steady increase in the number of accidents. This demonstrates the ineffectiveness of CCTV use. The country invests significant funds in the PNTL to ensure citizen safety, but the CCTV use by the PNTL for public services related to violation monitoring is not optimized.

SWOT Analysis

The use of CCTV to control traffic violations has become popular in many countries and cities as part of efforts to improve road safety and motorist discipline. CCTV systems at intersections or public roads can monitor and detect traffic violations such as running red lights, parking in prohibited areas, or speeding. However, like any technology, using CCTV for traffic violation control has various advantages and challenges. The following is a description of the SWOT analysis on the use of CCTV to control traffic violations in Dili City.

Table 2. SWOT Analysis

Nu	Sub Analysis	Outcome	Strategy
1	Strenghts	a. On most public roads in Dili City, CCTV infrastructure is installed. b. CCTV units are currently installed on public roads in Dili City. c. CCTV that the National Police of Timor-Leste installed on public roads has very good image quality and can zoom up to a distance of 500 meters. d. CCTV installed provides a lot of evidence about incidents, accidents and violations.	a. Develop maximum control to ensure the existence of CCTV. b. Develop policies to maximize socialization to the public related to the CCTV that has been installed.
2	Weaknesses	a. Maintenance of CCTV will be up to the companies. b. CCTV installed at intersections is not the maximum (one CCTV controls four intersections). c. Operational costs for CCTV are high, but use for crime control is not optimal. d. CCTV accepts many cases of infractions, but there is no policy on how to convict these infractions. e. In the monitoring room, there are no traffic police stationed there.	a. Define policies to increase specific resources in the area of CCTV. b. Increase CCTV around intersections. c. Use CCTV to the maximum to convict crimes and violations so as to achieve balance. d. Develop policies to place traffic police in monitor rooms.

Nu	Sub Analysis	Outcome	Strategy
3	Oportunities	a. The presence of CCTV installations on public roads of Dili City reduces crime incidents. b. When CCTV is used to the maximum to control crime infractions, it can raise community awareness to use public roads. c. The use of CCTV to control violations can increase revenue through conviction and fines for crimes committed by road users.	a. Intensive use of CCTV for crime control incidents. b. The benefits of using CCTV to raise community Awareness and increase income through the conviction of criminal offenses.
4	Threats	a. When there is no clear decision on the use of CCTV to control crime violations, residents will continue to commit crime violations and its impact on traffic accidents is high. b. When CCTV is in a faulty condition or electricity fails, control of cases against traffic violations is also stopped. c. Lack of professional resources in the area of CCTV. d. Fewer staff work in the monitor room to monitor the CCTV.	a. Develop line of coordination between relevant parties such as IT Department, National Operations Center, traffic police and DNTT to be able to apply traffic law through the capture of CCTV for crime violations. b. Areas where CCTV is installed need to install solar cells. c. Recruit police officers to work in the monitor room.

Concept Thought for Research Results

To maximize the limited resources that the PNTL currently has regarding the quantity of CCTV and personnel, the policy must identify accident-prone areas to be designated as pilot sites for CCTV control implementation. With limited resources, some high-risk accident areas must be selected as pilot zones for control through CCTV to exert pressure on road users. This approach ensures, to some extent, an increase in road users' awareness to comply with traffic regulations. It also helps reduce the number of accident cases currently occurring.

The use of CCTV to control crimes related to road code violations can simplify the work of the traffic police and eliminate illegal collections that may occur between police and violators. Police must use CCTV as a force multiplier to balance the cost of paying operators monthly and the limitations of personnel working in the field.

CONCLUSION

This research's overall conclusion, along with suggestions for future study, indicates that the effectiveness of using CCTV to control road user behavior in Dili still faces several challenges. Technically, the CCTV installed by the National Police on public roads is in very good condition, both regarding cameras and captured image quality. Most public roads, particularly protocol roads, are equipped with CCTV, although some areas still lack installation. In principle, CCTV was designed to control three types of cases: accidents, incidents, and violations. However, in practice, its utilization is limited. CCTV mainly serves as supporting evidence for accidents and incidents, while violations are rarely followed up. Traffic violations occur daily and are well-recorded by CCTV, but the lack of follow-up contributes to the rising number of accidents each year. The ineffectiveness in managing CCTV use for controlling violation cases is largely due to limited resources, including inadequate facilities, insufficient personnel skills, and a small number of officers monitoring the system. Additionally, the cost of paying telecommunication operators is relatively high. Nonetheless, the system is more often used for handling cases with a smaller daily volume, such as accidents and incidents, rather than traffic violations, which are recorded far more frequently.

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