



Faculty of Technology Management and Technopreneurship

**FACTORS AFFECTING THE EFFECTIVENESS OF CLOSED
CIRCUIT TELEVISION SURVEILLANCE IN THE UNITED ARAB
EMIRATES**

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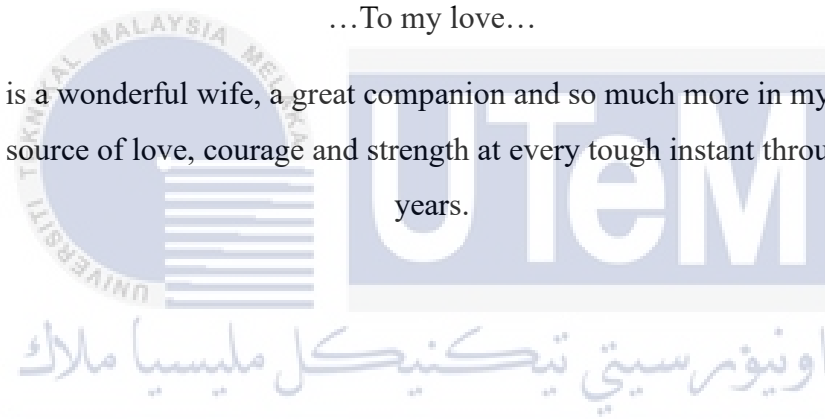
2024

DEDICATION

This work is dedicated to the inspiring person towards my life... my dear father and my dear mother who always want me to have the best, for her love, the prayers that she made for me.

...To my love...

My wife is a wonderful wife, a great companion and so much more in my life. She is always a source of love, courage and strength at every tough instant throughout these years.



...To my son...

Rawad, he pushed to my objectives, complement my happiness.

...To my great guide...

My dear supervisor, Assoc Prof. Dr. Norain Ismail.

ABSTRACT

The United Arab Emirates governmental institutions are now developing innovative methods to employ smart devices like surveillance cameras to deliver improved services to its inhabitants that are conveniently accessible, precise, prompt, high-quality, and information-rich. Closed-Circuit Television cameras are widely employed in Abu Dhabi to maintain surveillance in order to support law enforcement and aid in crime control at UAE public institutions. The usage of CCTV cameras faces three key difficulties: a lack of awareness of how CCTV works, a lack of understanding of IT security, and an incorrect understanding of the responsibilities that various stakeholders play in preserving public safety. These reasons have stoked contentious discussions regarding the viability of CCTV surveillance rising public discomfort. The effectiveness of the CCTV surveillance system framework in the city and the role of technology in preserving public safety in the United Arab Emirates are the key topics of this thesis. This study investigates the effectiveness of Closed-Circuit Television (CCTV) surveillance systems in crime prevention in the United Arab Emirates. Utilizing a mixed-methods approach, the research combines quantitative and qualitative analyses to offer a comprehensive understanding of the impact of CCTV systems on public safety and crime deterrence. The quantitative component, comprising a survey distributed to 428 participants from various UAE governmental organizations, examines factors influencing CCTV effectiveness. These include location, institutional framework, social value, policy, centralized monitoring systems, technical capacity, authority control, and privacy. Structural Equation Modeling (SEM) is employed to analyze the relationships between these factors and the effectiveness of CCTV installation. Complementing this, the qualitative aspect involves semi-structured interviews and observations, targeting key personnel involved in CCTV operations. This approach provides deeper insights into the practical application and challenges of CCTV surveillance. The thematic analysis of qualitative data elucidates the nuances of public perception and operational effectiveness of CCTV systems. The findings reveal that several factors significantly impact the effectiveness of CCTV surveillance in crime prevention. Notably, technical capacity, policy, and location emerge as critical determinants. The study also uncovers the importance of a supportive institutional framework and public engagement in enhancing CCTV effectiveness. The research contributes to the field by proposing a comprehensive framework for CCTV surveillance in crime prevention, tailored to the UAE context. It highlights the necessity for a balanced approach that incorporates technological, policy, and human factors. The study's limitations and future research directions are also discussed, providing a pathway for further exploration in this evolving field.

FAKTOR YANG MEMPENGARUHI KEBERKESANAN PENGAWASAN TELEVISYEN LITAR TERTUTUP DI EMIRIAH ARAB BERSATU

ABSTRAK

Institusi kerajaan UAE sedang membangunkan kaedah inovatif untuk menggunakan peranti pintar seperti kamera pengawasan untuk menyediakan perkhidmatan yang mudah diakses, tepat, pantas, berkualiti tinggi, dan kaya dengan maklumat kepada penduduknya. Kamera CCTV secara meluas digunakan di Abu Dhabi untuk menjalankan pengawasan bagi menyokong penguatkuasaan undang-undang dan membantu dalam pengawalan jenayah di institusi awam. Tiga cabaran utama penggunaan kamera CCTV : kekurangan kesedaran tentang bagaimana CCTV berfungsi, kekurangan pemahaman tentang keselamatan IT, dan pemahaman yang salah mengenai peranan yang dimainkan oleh pelbagai pihak berkepentingan dalam memelihara keselamatan awam. Sebab-sebab ini telah menimbulkan perbincangan yang kontroversi mengenai keberkesanan taktik pengawasan CCTV dalam menghadapi. Keberkesanan kerangka sistem pengawasan CCTV di bandar dan peranan teknologi dalam memelihara keselamatan awam di Emiriah Arab Bersatu adalah topik utama tesis ini. Kajian ini menyiasat keberkesanan sistem pengawasan Televisyen Litar Tertutup (CCTV) dalam pencegahan jenayah di Emiriah Arab Bersatu. Dengan menggunakan pendekatan kaedah campuran, kajian ini menggabungkan analisis kuantitatif dan kualitatif untuk memberikan pemahaman yang komprehensif mengenai impak sistem CCTV terhadap keselamatan awam dan pencegahan jenayah. Komponen kuantitatif, yang merangkumi tinjauan yang diedarkan kepada 428 peserta dari pelbagai organisasi kerajaan UAE, mengkaji faktor-faktor yang mempengaruhi keberkesanan CCTV. Ini termasuk lokasi, kerangka institusi, nilai sosial, dasar, sistem pemantauan berpusat, kapasiti teknikal, kawalan kuasa, dan privasi. Pemodelan Persamaan Struktur (SEM) digunakan untuk menganalisis hubungan antara faktor-faktor ini dan keberkesanan pemasangan CCTV. Melengkapi ini, aspek kualitatif melibatkan temu bual separa berstruktur dan pemerhatian, menyasarkan kakitangan utama yang terlibat dalam operasi CCTV. Pendekatan ini memberikan wawasan yang lebih mendalam tentang aplikasi praktikal dan cabaran pengawasan CCTV. Analisis tematik data kualitatif menjelaskan nuansa persepsi awam dan keberkesanan operasi sistem CCTV. Penemuan menunjukkan bahawa beberapa faktor mempengaruhi keberkesanan pengawasan CCTV dalam pencegahan jenayah dengan ketara. Kapasiti teknikal, dasar, dan lokasi muncul sebagai penentu kritikal. Kajian ini juga mendedahkan pentingnya kerangka institusi yang menyokong dan penglibatan awam dalam meningkatkan keberkesanan CCTV. Penyelidikan ini mencadangkan kerangka komprehensif untuk pengawasan CCTV dalam pencegahan jenayah, disesuaikan dengan konteks UAE. Ia menekankan keperluan pendekatan yang seimbang yang menggabungkan faktor teknologi, dasar, dan manusia. Batasan kajian dan arah penyelidikan masa depan juga dibincangkan, menyediakan jalan untuk penyelidikan lanjut dalam bidang yang berkembang ini.

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LIST OF ABBREVIATIONS

AC	-	Authority control
ATM	-	Automated teller machine
AVE	-	Average variance extracted
CCTV	-	Closed-circuit television
CMS	-	Centralized monitoring system
CR	-	Composite reliability
DVR	-	Digital video recorder
EE	-	Effort expectancy
EFA	-	Exploratory factor analysis
GDP	-	Gross domestic product
GIS	-	Geographic information systems
GoF	-	Goodness of fit
IF	-	Institutional framework
IT	-	Information technology
KBV	-	Knowledge-based view
L	-	Location
ONVIF	-	Open network video interface alliance
P	-	Policy
PE	-	Performance expectancy
PLS	-	Partial least squares
Pr	-	Privacy
PSIA	-	Physical security interoperability alliance
QLF	-	Quality loss function
RBV	-	Resource-based view
SCP	-	Situational crime prevention
SDG	-	sustainable development goals
SEM	-	Structural equation modelling
SPSS	-	Statistical package for the social science
SQC	-	Statistical quality control
SV	-	Social Value
TRA	-	Telecommunications Regulatory Authority
UAE	-	United Arab Emirates
UTAT	-	Unified theory of acceptance and use of technology
VCR	-	Video camera recorders
VIF	-	Variance inflation factor
VRIN	-	Valuable, rare, inimitable, and non-substitutable

LIST OF PUBLICATIONS

Journal with Impact Factor

Al Ashkari, A.S and Ismail, N., 2024. Framework for Assessing the Impact of CCTV Surveillance Systems on Crime Prevention. *International Journal of Academic Research in Business and Social Science*, 24 (4), 1735-1745.

Al Ashkari, A.S and Ismail, N., 2024. Effectiveness of CCTV Surveillance System on Crime Prevention: A Proposed Framework. *International Journal of Business Society*, 8 (4), 904-913.



CHAPTER 1

INTRODUCTION

1.1 Introduction

This chapter starts with the research background, a brief introduction of Closed circuit television (CCTV) cameras in United Arab Emirates (UAE). The problem statement regarding the topic described is presented, followed by research questions and research objectives. The significance of the study, scope, and limitation are also mentioned. The chapter ends with the structure of the research.

1.2 Background of the study

Closed-circuit television (CCTV) monitoring has been a widely utilised crime prevention tool worldwide in recent decades. Its development may be attributed to Great Britain, where programmes including CCTV received three-quarters of the home Office funding from 1996 to 2018 (Armitage, 2022). Over four million CCTV systems were installed in Britain in less than two decades, up from only about 100 in 1990 (Piza, 2018a) as a result of such governmental initiatives (Piza et al. 2019). Cities around the USA have also made large expenditures in CCTV during the past ten years.

Based to the most latest numbers, 87 percent of municipal police departments in the United States that serve populations of 250,000 or more use CCTV, up from 49 percent overall (Reaves, 2015). Given the growing number of surveillance cameras in public spaces, academics now view CCTV as a "banal good" that has permeated society, is widely accepted, and receives no media criticism (Goold et al., 2013; Piza et al. 2019).

Many academics ascribed the rapid and persistent growth of CCTV during its early development to popular excitement and political drive. According to Painter and Tilley (1999), the popularity of CCTV in the United Kingdom stemmed from the policy's "surface plausibility" and the political benefits authorities anticipated from "being thought to be doing something apparent to public concerns about crime." Pease (1999) similarly criticised legislators' apparent unwillingness to consider scientific evidence when deciding whether to use CCTV, writing, "one is inclined to question where rigorous criteria went into the wild rush to CCTV deployment."

Despite the fact that there used to be little research on CCTV, this is no longer true. Over time, a lot more CCTV examinations have been performed. Furthermore, while studies of CCTV have gradually adopted rigorous designs, public surveillance research in general has been described as methodologically inadequate in the past, with more than 55 percent of studies adopting less than a similar experimental control area design (Piza et al. 2019). In recent years, various randomised field experiments have investigated the effectiveness of video surveillance cameras as a single crime deterrent or as a component of proactive place based patrol strategies (Piza, 2018b; Piza, Caplan, Kennedy, and Gilchrist, 2015). In the absence of randomization, some researchers have employed complex matching procedures to assist guarantee statistical parity between the treatment and control conditions (Piza, 2018a; Piza et al., 2017). When CCTV deployment is linked to unobserved factors that promote crime, researchers have also taken advantage of opportunities afforded by naturally occurring social events to mitigate ongoing issues (Alexandrie, 2019). The CCTV literature has become much more rigorous, and this has provided much more guidance for policy and practise.

UAE is one of the nations that continues to be a leader in the Gulf and Arab regions and has recently been ranked as one of the most improved global economies (World Bank, 2018). It is one of the Middle East, North Africa, and Gulf region's fastest-growing economies, with the aim of being ranked as one of the world's top service-oriented economies (Dubai economic outlook, 2020). With a workforce of more than 180 nationalities, each with an own culture, religion, and ethnicity, the economy of the UAE is very varied and includes tourism, manufacturing, logistics, banking, and finance (Jabeen et al., 2018).

The adoption of Closed-Circuit Television (CCTV) systems in the United Arab Emirates (UAE) is a strategic response to the need for enhanced security measures in an era where safety and crime prevention are paramount. This approach is supported by a growing body of literature that underscores the significance of technological solutions in the management and deterrence of crime (Aldhaheri and Xia, 2022; Alam et al., 2020).

Recent crime statistics per hundred thousand people in the UAE, as depicted in Figure 1.1, provide a quantifiable backdrop against which the effectiveness of CCTV systems can be assessed. From 2016 to 2022, the data shows a complex pattern of criminal activity, ranging from theft and drug offenses to willful murder and human trafficking. This data, sourced from the Ministry of Interior (2023), is crucial in identifying the trends that inform the deployment of surveillance technologies.

The role of surveillance systems extends beyond mere observation; they play a pivotal role in the analytical assessment of social behaviors, contributing to pattern detection and contact tracing, as evidenced in the contexts of pandemics (Abraham, 2023). Similarly, advancements in spatial-context-aware technologies have enhanced the capability of CCTV systems to adapt and respond to varying environmental conditions, increasing their effectiveness in diverse settings (Abdelraouf et al., 2022).

Moreover, the integration of big data analytics with video surveillance has opened new avenues for proactive security measures and real-time crime prevention (Alam et al., 2020). The evolving landscape of smart facilities and user-centered performance attributes further illustrates the potential for CCTV systems to contribute to the overall safety and functionality of public spaces (Abisuga et al., 2020).

While the UAE has seen a general decline in certain types of crime, the nuanced and variable nature of crime rates necessitates a comprehensive evaluation of surveillance impact. This study seeks to provide an empirical investigation into this matter, drawing parallels with global insights on surveillance, accountability, and public perception in various socio-technical contexts (Ahn and Wickramasinghe, 2021; Akintoye et al., 2021).

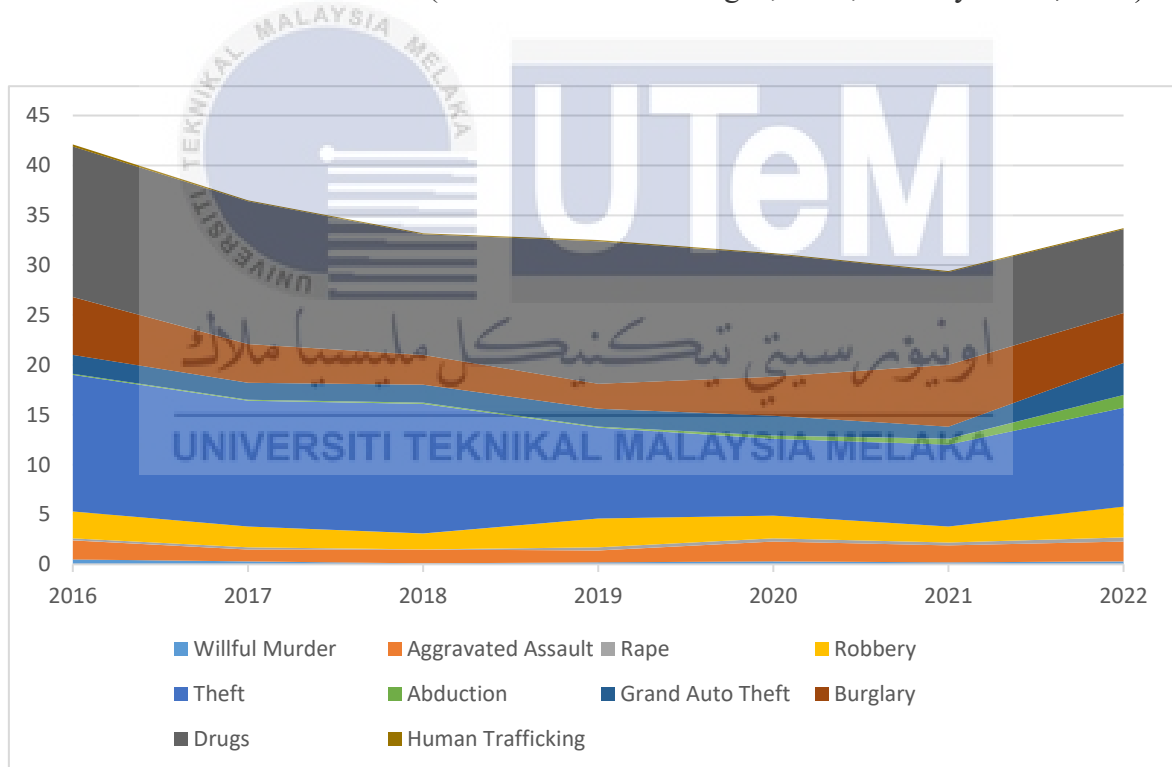


Figure 1.1: Major Crime Statistics - Per hundred thousand people in the UAE
Source: Ministry of interior (2023)

In terms of innovation capacity, the UAE is ranked 15th out of 137 nations in the most recent Global Competitiveness Report (2018). When compared to Arab and surrounding nations, it is clear that the UAE is miles ahead of them, particularly Saudi Arabia, which is ranked 64th and looks to be one of the world's largest oil exporters. Also falling behind the UAE, Qatar is ranked number 34 out of the 137 nations examined for this research (Alshamsi et al. 2019; Dubai economic outlook, 2020). The UAE is a leader in the Arab world and the area when it comes to the effectiveness of the labour market, the standard of the overall infrastructure, the ranking of innovation, and the capacity for innovation.

The UAE has been increasing the deployment of surveillance cameras over the past ten years, which helps to ensure security and safety measures and follow any illegal occurrences wherever and at any time. There are only roughly 30,000 in Dubai, and only about 3,000 of them are in the airport (Hilotin, 2013). Additionally, Abu Dhabi indicated interest in deploying the surveillance cameras in its 2030 vision in the Safety and Security Planning Manual (SSPM) (Vision 2030, 2017).

Law No. 24 of 2008 established a regulatory framework for surveillance cameras and made it mandatory for both the public and private sectors in Dubai, particularly in commercial zones, to install them. The law also specifies recommendations for service providers and users on how and when the cameras should be installed (Taylor-Wessing, 2014). Another new legislation, No. 10 of 2014, was released to update the provisions of the prior law, No. 24 of 2008, which allowed building owners to install surveillance cameras during a three-month grace period in order to broaden the realm of security and safety to encompass residential units and towers (Siassios and Tamimi, 2014). In order to improve security in the area, the legislation No. 10 of 2014 urged a wider distribution and installation of closed-circuit television (CCTV) cameras throughout the UAE.

The actual data on CCTV crime prevention under this law, however, has not yet fully covered all issues. The purpose of this study is to demonstrate the value and effectiveness of CCTV cameras in reducing crime in the UAE area. The usefulness of CCTV surveillance systems on crime prevention looks to be growing in the UAE in light of the aforementioned two regulations (Belhoul, 2018). While discovering numerous patterns relevant to the usefulness of CCTV in crime prevention is yet unknown, increasing monitoring is one part of situational crime prevention that is of the highest importance. Therefore, more extensive research is needed to identify the many factors directly or indirectly related to such events.

As a result of increased demand for surveillance camera purchases and the necessity for a standardised CCTV installation procedure that takes into consideration surveillance camera standards, a considerable market for selling unregulated and inferior security camera system equipment has emerged. There is no clearance process for surveillance cameras, despite the fact that the Telecommunications Regulatory Authority (TRA) is the sole organisation that may approve any telephone, mobile, or smart phone for sale in the UAE market (Hilotin, 2013). Therefore, it is crucial to establish and control the standard operating practises for CCTV system installation in the UAE region. As a result, the study aims to comprehend how typical CCTV system installation affects the efficiency of CCTV systems in reducing crime in the UAE.

The application of surveillance technologies in urban environments is a central theme in contemporary security discourse, with a particular emphasis on the effectiveness and efficiency of these systems in preventing crime and enhancing safety. In the context of the United Arab Emirates (UAE), the deployment of Closed-Circuit Television (CCTV) systems in public agencies is reflective of a global trend towards leveraging technology for the betterment of communal security.

Recent advancements in visual surveillance technologies have shown promising results in various domains, from the enhancement of personal safety in public places (Badiora et al., 2020) to the management of residential property and the deterrence of break-ins (Badiora and Adebara, 2020). The innovative diffusion of such surveillance technologies has also been observed to impact investment dynamics, as seen in the student housing market in Ghana (Appau et al., 2023).

The integration of sophisticated analytical tools with CCTV, such as weapon detection algorithms using deep learning (Bhatti et al., 2021), has contributed significantly to the real-time capabilities of these systems, thus enhancing their preventative potential.

This technological progression aligns with the principles of innovation diffusion which have substantial effects on investment and operational patterns (Appau et al., 2023). From the perspective of technology deployment and privacy concerns, the balance between effective surveillance and individual rights is a delicate one, as examined within the scope of the EU General Data Protection Regulation (Asghar et al., 2019). The surveillance system's design and its spatial context also play crucial roles in optimizing visibility and efficiency, as explored in the study of optimal camera placement (Brévilliers et al., 2018).

Moreover, the implications of surveillance extend to the management of intellectual capital in educational institutions, highlighting the importance of securing vital assets while respecting individual privacy (Bongiovanni et al., 2020; Bates and McLoughlin, 2019). The integration of face recognition technologies with surveillance systems further illustrates the sophistication of security measures that are becoming prevalent in the modern urban landscape (Bindu, 2018).

In the UAE, the efficient and effective use of CCTV surveillance has been essential in enhancing residents' satisfaction with property management services, as evidenced by the satisfaction derived from mobile applications in property management (Basit et al., 2023).

Such satisfaction is a testament to the importance of effective technology in ensuring the safety and well-being of communities. The amalgamation of technology and its application in the realm of public safety is a subject of increasing importance and scrutiny. This study aims to contribute to the body of knowledge by examining the effectiveness of CCTV surveillance systems in the UAE's public agencies, with a particular focus on crime prevention and the improvement of service quality within the nation's public sectors.

Many factors must be considered while installing a surveillance camera system, including as camera position, lens type, camera quality, storage capacity, and codecs programmes, to ensure the efficacy of the CCTV system for the public and law enforcement agencies. Many aspects, such as camera placement, lens type, camera quality, storage capacity, and codecs programmes, should be addressed while installing a surveillance camera system to ensure the CCTV system's efficiency for the public and law enforcement agencies.

These components are not separate from each other, but rather should complement one another based on the surveillance camera's role. When introducing a new camera to an existing system, for example, extra changes in storage spaces are required, as well as the average of recorded photos from each camera (APTA, 2011). Technical issues that reflect the importance of properly installing these devices in order for them to be effective for their intended purpose, as well as a lack of standard and clear instructions, are the most difficult challenges that users face in surveillance camera systems, especially given the rapid changes in surveillance camera technology (Honovich 2008). In addition, surveillance cameras can generate problems such as insufficient coverage, design system failures and low tape quality, incorrect usage, lack of maintenance, and user neglect. These technological limitations limit the effectiveness of surveillance camera systems, and many of them have yet to be resolved or even detected (Carli, 2008).

The standard establishes minimum standards and makes suggestions for surveillance cameras placed for security purposes. It establishes the minimal performance and functional standards that must be agreed upon by the customer, installer, and, if necessary, law enforcement agencies (Frois, 2013). The standard also applies when a single security application, like an intrusion alarm system, shares detection, triggering, interconnection, control, communication, or power supply with the system.

It does not include the specifications for designing, organising, installing, testing, operating, and maintaining (Qureshi, 2013). The installation of remotely controlled, detector-activated video surveillance is likewise prohibited by the rule. This standard, in particular, highlights some of the fundamental characteristics that any good surveillance camera system ought to have, such as excellent image export capabilities and an easily replayable data format, both of which are necessary if the images are to be used as evidence in an investigation (Frois, 2013 and Cumming, 2015). Adopting open standards, which encourage innovation and product quality while also allowing for flexibility in finding solutions for a wide range of cameras, is the best way to safeguard consumers' investments and future-proof their security camera systems. Companies must create standards-based video integration platforms if they want to survive the trend toward consolidation and achieve long-term, profitable development (Lim et al., 2016). The primary benefit of using fully open standards is that the source code for camera drivers is always and freely available. In-house or outside developers can address issues and concerns immediately away without having to rely on a vendor, whose goals and resources might not always line up with clients. Even though the UAE region's CCTV infrastructure has been rapidly installed and expanded, concerns are being raised about potential effects on the effectiveness of CCTV systems generally and crime prevention specifically due to the lack of clear guidelines from governments and public agencies and the rapid adoption of standards.