MONASH University

Design and Development of Stations and Terminals
Swissotel, Sydney Australia
Weds 28th June 2017

A New Station Design Audit Tool for Personal Safety Using Crime Prevention Through Environmental Design (CPTED)

Prof Graham Currie
Public Transport Research Group
Monash Institute of Transport Studies
Monash University

PTRG PUBLIC TRANSPORT RESEARCH GROUP
GROUP OF EIGHT AUSTRALIA
MONASH INSTITUTE OF TRANSPORT STUDIES

MONASH University

- Introduction
- Context
- Approach
- Application
- Results
- Next Steps

This paper describes a new method to measure station safety design quality; and research program of which it is a component

- This is the work of PhD Student Mustafazir Rahaman and Supervisors; Prof Graham Currie, Dr Alexa Delbosc and Dr Carlyn Muir
- Published as a research paper:
  - Rahaman M Currie G Muir C (2016) 'Development and Application of a Scale to Measure Station Design Quality for Personal Safety' TRANSPORTATION RESEARCH RECORD No. 2540 pp 1-12

Development and Application of a Scale to Measure Station Design Quality for Personal Safety

Mustafizur Rahaman, Graham Currie, and Carlyn Muir

Crime on public transport is a major concern for society and authorities, and many security measures have been adopted in public transport facilities, like stations, to reduce crime and improve the perception of passenger safety. However, a scale to measure the design quality of public transport facilities on the basis of crime prevention through environmental design (CPTED) principles has not yet been developed. This paper presents the results of a research program to develop a unified measure of the overall design quality of train stations in terms of the main elements of CPTED: surveillance, access control or target hardening (deterring access to potential targets; a term used in the security industry), maintenance, territoriality, and activity support. In this study, a scale has been developed and applied to four stations in suburban Melbourne, Victoria, Australia. The scores illustrate the overall station design quality and highlight elements of the stations that could be improved to enhance safety. Areas for future research and implications for practice are explored.

The perception of personal safety is one of the factors that most influence the ridership and overall quality of urban transit systems (*1*, *2*). Many studies explore the factors that influence safety perceptions and fear of crime on urban transit. Fear of crime and perceptions of safety have been correlated in numerous studies with actual crime, overall design quality, the surrounding environment, and the situational crime prevention features of transit facilities (*3–9*). However, little research in transit has focused on the concept of crime prevention through environmental design (CPTED), which underpins approaches to the mitigation of crime in the criminology literature. Measures of CPTED have been implemented in other fields of research (e.g., in housing developments to measure the design quality of different sites). However, a measure of the design quality of train stations has not been attempted to date.

This paper develops a new scale to measure the overall design quality of train stations from the perspective of CPTED. Five principles that underpin the CPTED concept are considered in developing the scale. These principles are surveillance, access control or target hardening (deterring access to potential targets; a term used in the security industry), territoriality, maintenance, and activity support. Aspects such as the architectural and security features, situational crime prevention measures, and surrounding areas of a station are quantified to provide a benchmark of the overall design quality of train stations in relation to personal safety.

The paper is organized as follows: the next section describes the background of the studies related to the developed scale framework. Then, the proposed scale framework is presented in detail, and finally, results are described and conclusions drawn.

RESEARCH CONTEXT

A range of factors has been identified and included in the proposed scale. These factors are explored from the context of existing research related to CPTED, crime, and factors that affect crime on the public transport system. A synthesized review of CPTED, influential factors, and measures found effective in previous studies to deter and prevent crime on public transport is presented.

Crime Prevention Through Environmental Design

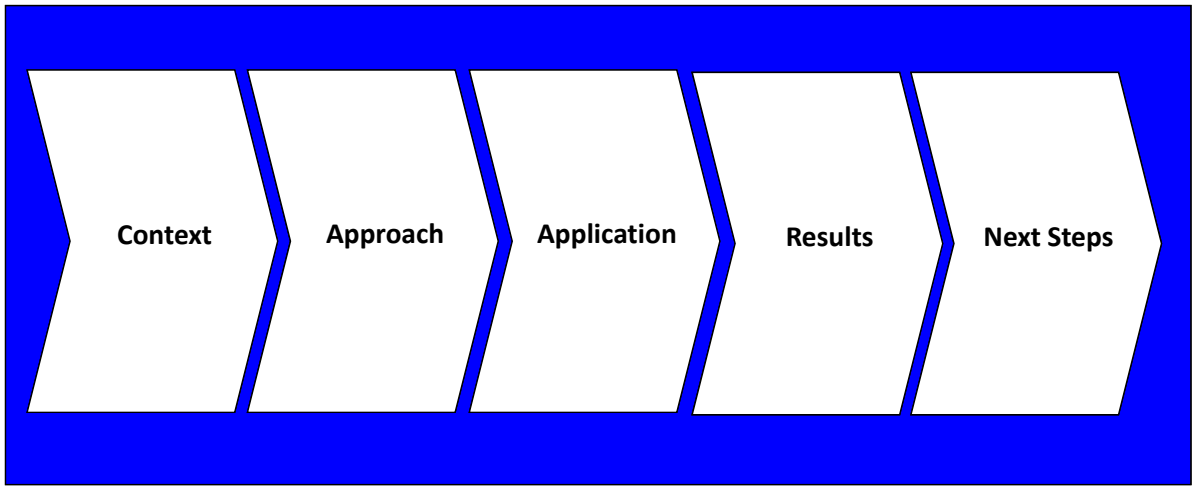
CPTED is based on the proposition that proper design and effective use of the built and surrounding environment are effective at deterring crime. CPTED can be defined as "the proper design and effective use of the built environment" and can lead to "a reduction in the fear and incidence of crime, and an improvement in the quality of life" (*10*). CPTED deals with the physical environment, the behavior of people in relation to their physical environment, and the redesign or more effective use of existing spaces.

Several elements of CPTED—namely, surveillance, territoriality, access control or target hardening, maintenance, and activity support—support the concept. Surveillance refers to the improvement of visibility and observation (*11*). Surveillance can be natural or formal (*11–13*). Territoriality is a design concept that produces a sense of ownership and proprietary concerns for a territory (*11–13*). Territoriality delineates the boundaries between public, semiprivate, and private property and encourages specific functions and the legitimate use of a space. Access control or target hardening focuses on reducing crime opportunities by deterring access to the potential targets and places. The practice heightens risk perception in offenders and thus deters them from committing criminal acts (*13*, *14*). The routine maintenance of the dwelling area and built environment improves user perception of safety and reduces crime. Activity support encourages the intended use of the public place through the aid of design and signage (*13*).

M. Rahaman, Institute of Transport Studies, and G. Currie, Public Transport Research Group, Institute of Transport Studies, Department of Civil Engineering, Monash University, Building 60, Clayton, Victoria 3800, Australia. C. Muir, Monash Injury Research Institute, Monash University, Building 70, Clayton, Victoria 3800, Australia. Corresponding author: G. Currie, graham.currie@monash.edu.

Transportation Research Record: Journal of the Transportation Research Board, No. 2540, Transportation Research Board, Washington, D.C., 2016, pp. 1–12.
DOI: 10.3141/2540-01

...and is structured as follows



MONASH University

Introduction

Context

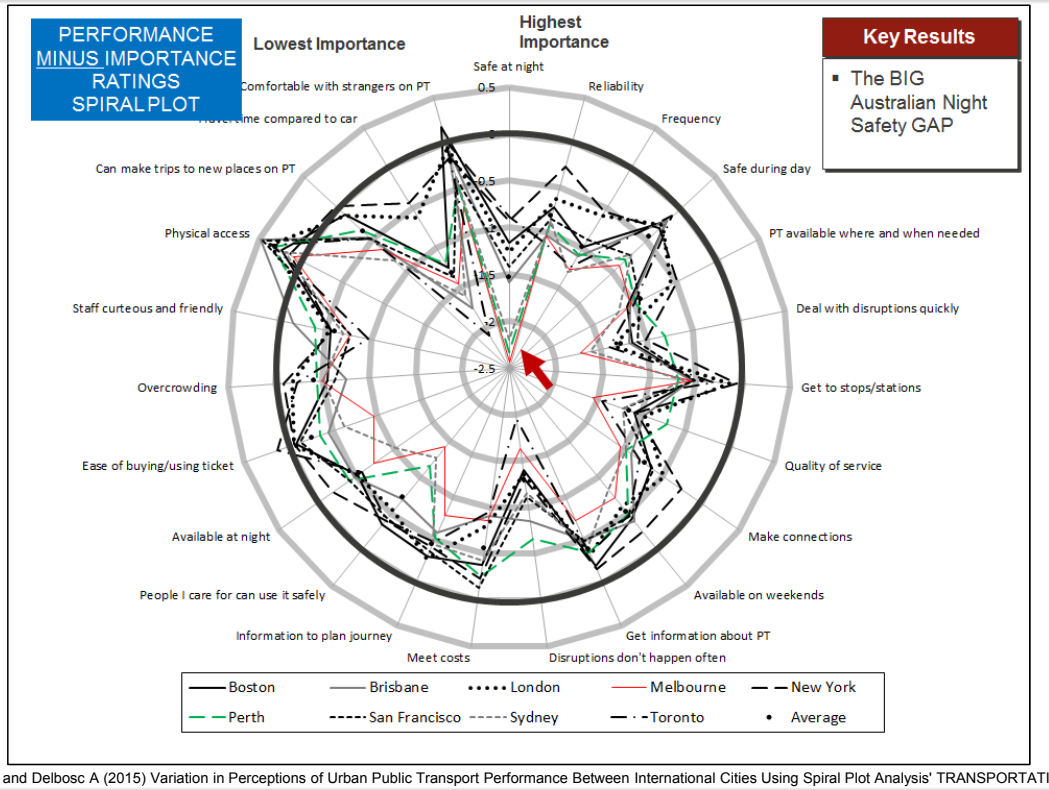
Approach

Application

Results

Next Steps

Personal safety is the major concern of PT users; particularly in Australia...



Source: Currie G and Delbosc A (2015) Variation in Perceptions of Urban Public Transport Performance Between International Cities Using Spiral Plot Analysis' TRANSPORTATION RESEARCH RECORD No. 2538 on pages 54-64

...as evidenced by research and media

- Research Context:
  - 10.5% more rail trips in UK would be generated if people felt safer on trains and at stations (Crime Concern 2002)
  - Car users in inner LA claimed they'd use the bus if they were safe and clean (Loukaitou-Sidaris 1999)
  - 40% of non-users of PT in New Zealand cited strong safety concerns as a barrier to night time use (Booz Allen Hamilton 2007)

There is a big difference between Actual crime and Fear of crime but it is perceptions that is driving passenger behavior

PTRG research has found psychological barriers to travelling with strangers is a more significant predicator of POS than actual crime…

Factors Explaining Feelings of Safety on Public Transport

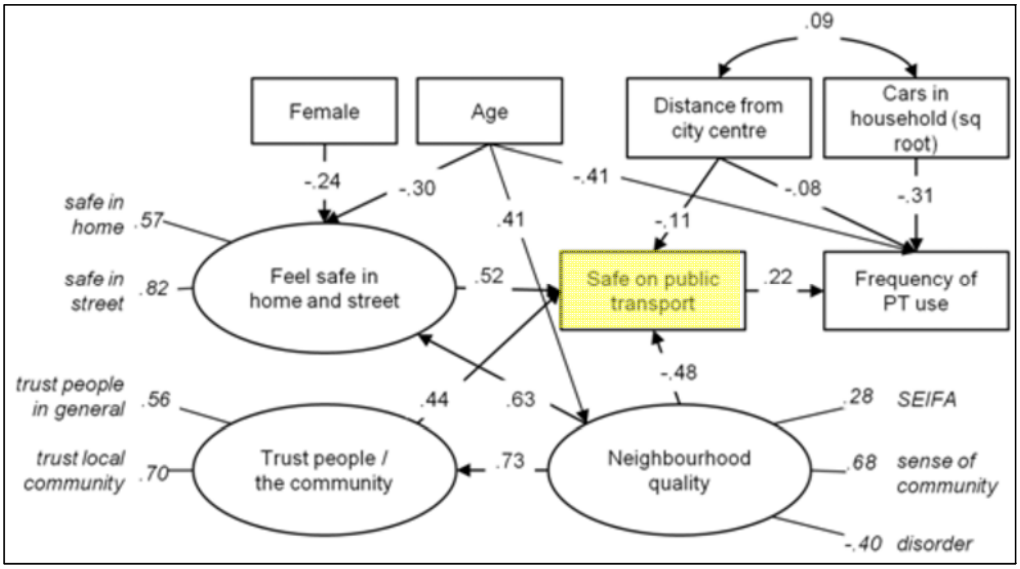
Key Explanatory Factors	Model 1		Model 2		Model 3	
	F	Effect size	F	Effect size	F	Effect size
Ever attacked/threatened	3.4[b]	.04				
Ever witness attack/threat			5.0[a]	.06		
Ever felt threatened					4.0[a]	.05
Gender	3.5[b]	.05	4.9[a]	.06	7.0[a]	.09
Comfortable with people you don't know	36.7[a]	.33	34.7[a]	.32	35.4[a]	.33

[a] *Significant at p < .01*
[b] *Significant at p < .05*

Source: Currie, G., Delbosc, A and Mahmoud, S. (2010), "Perceptions and Realities of Personal Safety on Public Transport for Young People in Melbourne", 23rd Australasian Transport Research Forum, Canberra Sept 29th -October 1st 2010

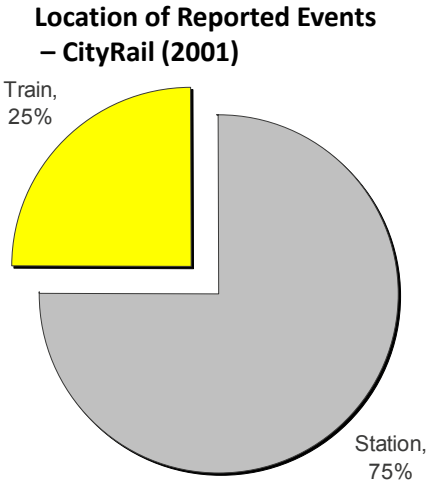
…also that general concerns about safety, feelings of trust and neighbourhood quality affected POS on PT

Modified model predicting feelings of personal safety on public transport



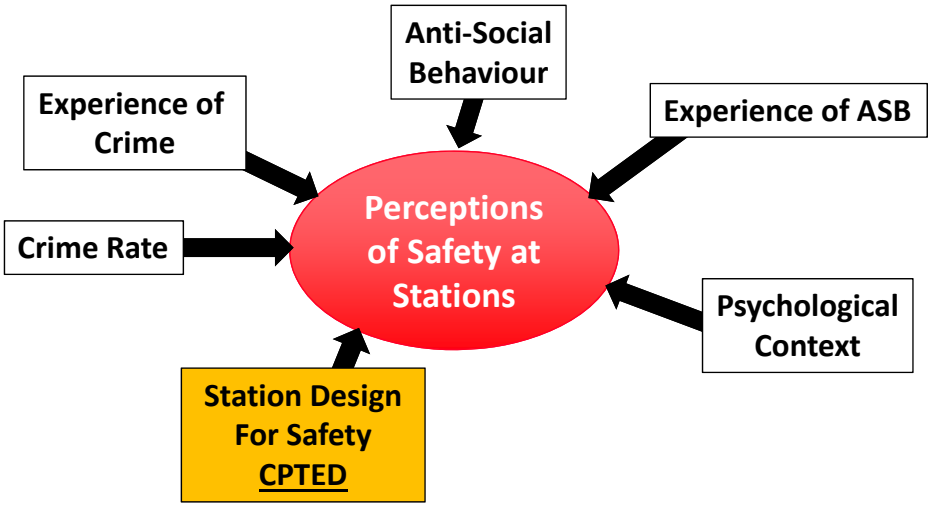
Source : Delbosc, A. and Currie, G. (2012) 'Modelling the drivers and impacts of personal safety perceptions in public transport ridership', TRANSPORT POLICY, Volume 24, November 2012 pp. 302-309

Stations are a key focus of Crime on Public Transport; so this was an area PTRG has sought to focus on in its current research program on this topic



Source: Auditor-General's Report (2003) Performance Audit State Rail Authority

This research seeks to explore POS at Stations in relation to crime rate, anti-social behaviour, experience of crime/ASB and design quality



PhD Research Program – Student Mustafizur Rahaman; Supervisor: Professor Graham Currie Co-Supervisors: Alexa Delbosc and Carlyn Muir

Research on crime has highlighted that design can influence perceptions of safety which is behind the development of CPTED

Literature in general context (Criminology, Sociology)

↓

Design Element and Built *Environment* Influence crime and perception of safety

In the **design** of facilities, inclusion of **various physical elements** can assist to **design out crime** (Tilley and Britain 1993, Painter 1996, Abdullah et al. 2012b)

CPTED; Crime Prevention Through Environmental Design

"the *proper design* and *effective use of the built environment*, which lead to a reduction in ***incidents of crime*** and **the *fear of crime***" (Crowe 2000,p46).

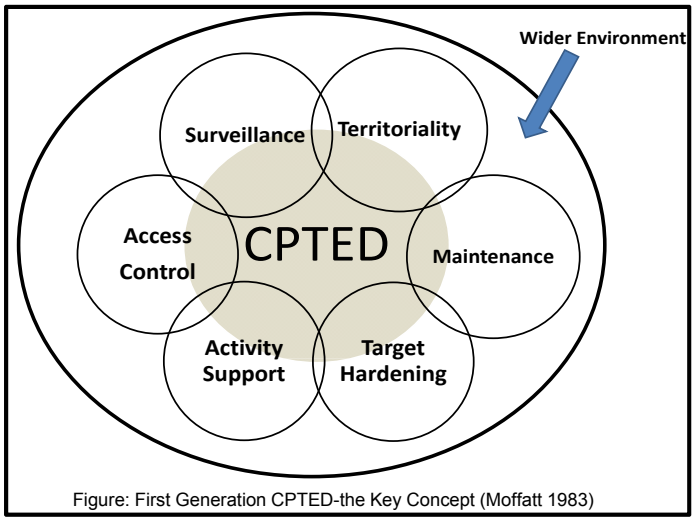


Figure: First Generation CPTED-the Key Concept (Moffatt 1983)

But CPTED Studies have focussed on Housing Design; not Rail

- CPTED Housing Research:
  - Investigated the effectiveness of the CPTED principles for reducing crime and robberies in residential areas and streets.
  - Measured and validated the components of CPTED.
  - Explored the relationship of CPTED with fear of crime of the residents

(Poyner 1988, Armitage et al. 1999, Clarke et al. 1991, Minnery and Lim 2005, Hedayati Marzbali et al. 2012a, Hedayati Marzbali et al. 2012b)

MONASH University

Introduction

Context

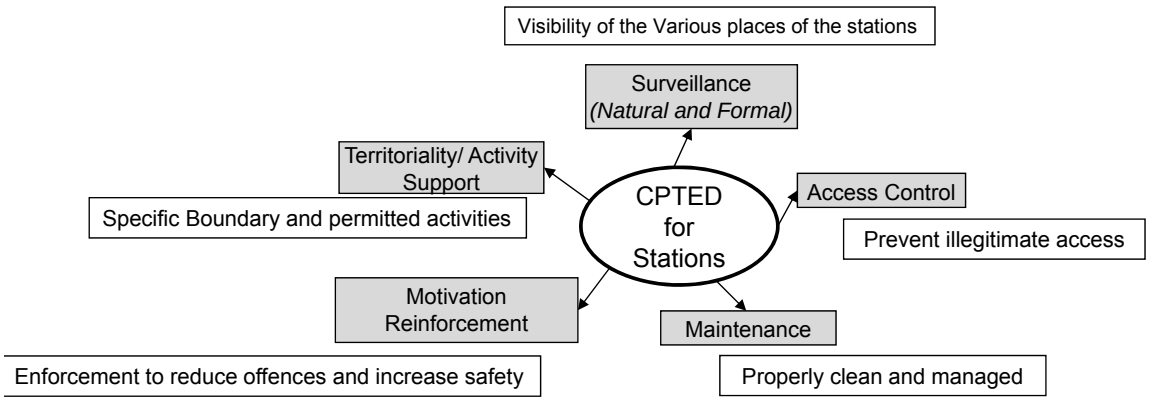
Approach

Application

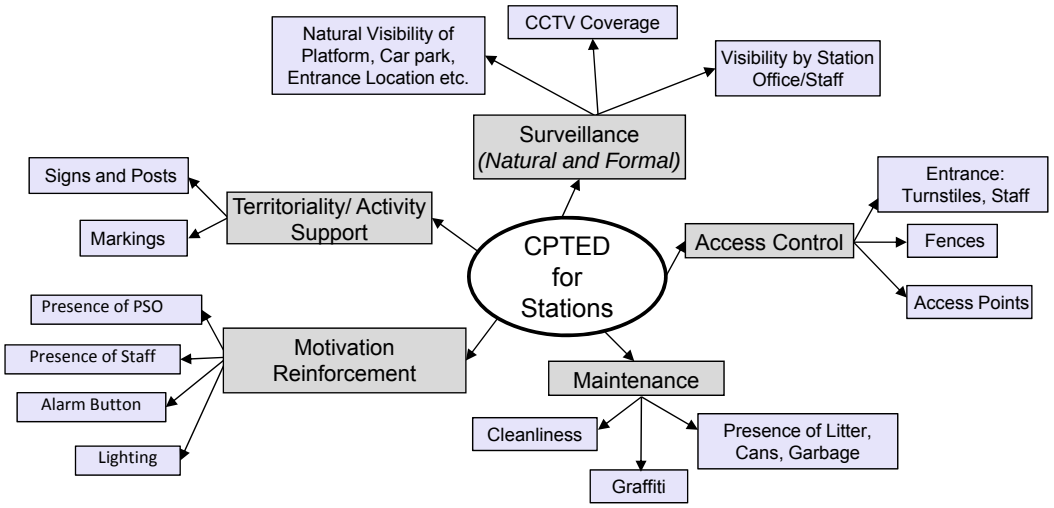
Results

Next Steps

The Tool measures 5 dimensions of station design based on CPTED principals

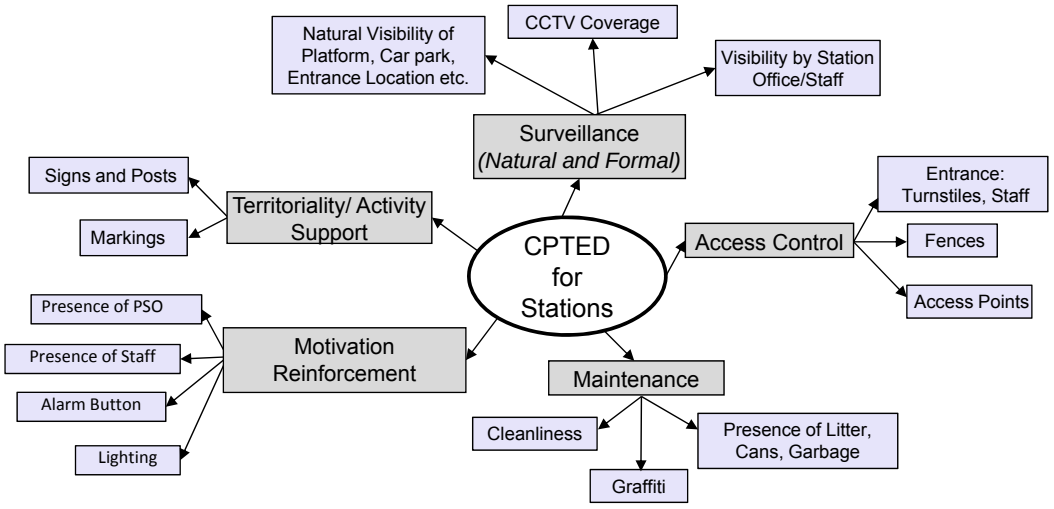


Individual indicators act as components to each of the 5 CPTED dimensions



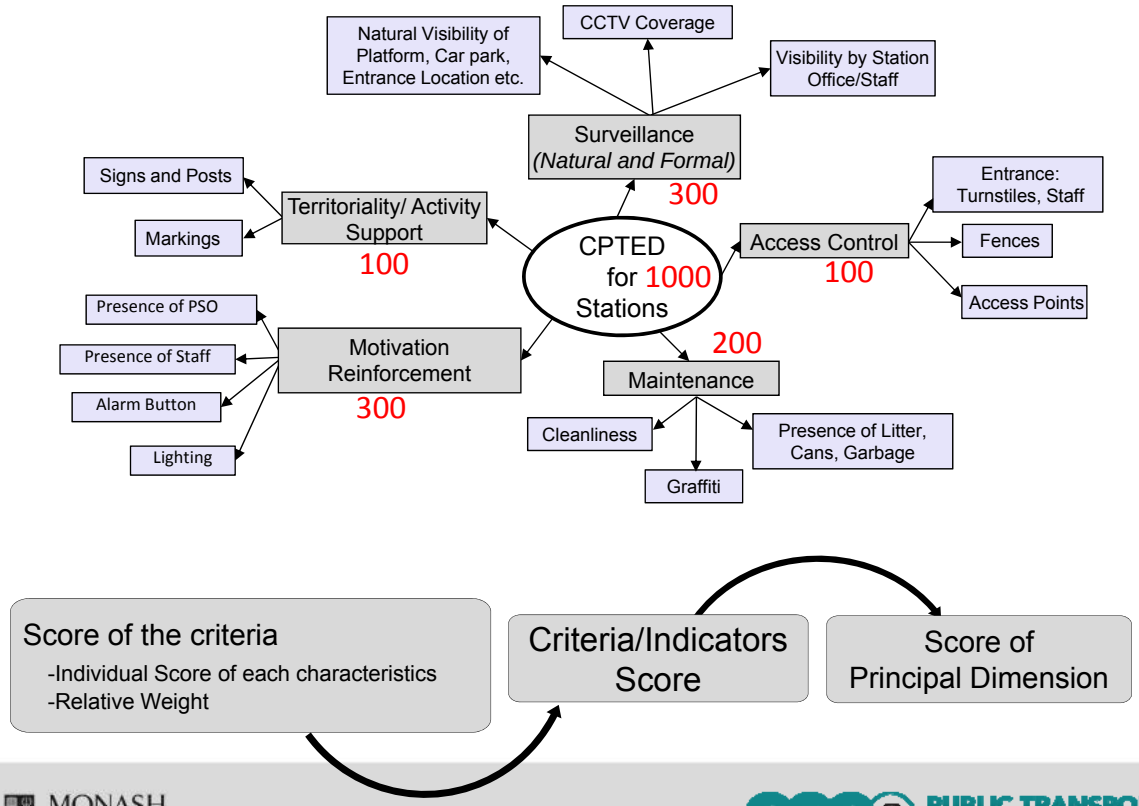



Scoring is done using a site survey…






Scoring is done using a site survey…with a maximum value of 1000



Formal Surveillance

TABLE 1 Scale to Measure Formal Surveillance Dimension

No.	Location	Scale	Score	Weight	Maximum Score
Criterion: CCTV					
1	Platforms	Not present	0	na	na
		No. of platforms covered	1–10	2	20
		Area covered	1–10	2	20
Maximum weighted score for platforms					**40**
2	Ticketing area	Not present	0	na	15
		No. of ticketing areas covered	1–10	1.5	
	Entrance and exit point to the station	Not present	0	na	10
		Area covered	1–10	1	
3	Entrance and exit point to the platform	Not present	0	na	10
		No. of platforms covered	1–10	1	
4	Waiting area	Not present	0	na	20
		Area covered	1–10	2	
Maximum total weighted score for CCTV					**95**
Criterion: Station Office					
5	Platforms	Length visible	1–10	1	10
6	Car park	Proportion visible	1–10	0.5	5
7	Waiting area	Proportion visible	1–10	1	10
Maximum total weighted score for station office					**25**
Maximum possible score for formal surveillance					**120**

NOTE: na = not applicable.

Natural Surveillance

TABLE 2 Scale to Measure Natural Surveillance Dimension

No.	Criterion	Scale	Score	Weight	Maximum Score
Location: Parking Lot					
1	Type	0 = not surface parking	10 = surface parking	0.5	5
2	Business development (within 20-m radius)	0 = absent 5 = facing 1 side	7.5 = facing 2 sides 10 = facing more than 2 sides	0.5	5
3	Residential development (within 20-m radius)	0 = absent 5 = facing 1 side	7.5 = facing 2 sides 10 = facing more than 2 sides	0.5	5
4	Visibility from platforms	0 = not visible 2.5 = more than 25% 5 = about 50%	7.5 = about 80% 10 = entirely visible	0.5	5
5	Visibility from waiting area	0 = not visible 2.5 = more than 25% 5 = about 50%	7.5 = about 80% 10 = entirely visible	0.5	5
6	Visibility from entrance points	0 = not visible 2.5 = more than 25% 5 = about 50%	7.5 = about 80% 10 = entirely visible	0.5	5
Maximum weighted score for parking lot					**30**
Location: Platforms					
7	Visibility from parking lot	0 = not visible 2.5 = more than 25% 5 = about 50%	7.5 = about 80% 10 = entirely visible	1.5	15
8	Visibility from outside	0 = not visible 2.5 = more than 25% 5 = about 50%	7.5 = about 80% 10 = entirely visible	1.5	15
9	Visibility from other platform	0 = not visible 2.5 = more than 25% 5 = about 50%	7.5 = about 80% 10 = entirely visible	2	20
Maximum weighted score for platforms					**50**
Location: Circulation or Station Area Entrance and Exit Points					
10	Visibility from waiting area	0 = not visible 2.5 = more than 25%	7.5 = about 80% 10 = entirely visible	0.5	5

Access Control

TABLE 3 Scale to Measure Access Control Dimension

No.	Criterion	Scale	Score	Weight	Maximum Score
Location: Platforms					
1	Turnstiles	0 = not at entry	10 = present at entry	2.5	25
2	Staff	0 = not at entry 10 = present at entry	5 = present at office	4	40
3	Entrance–exit	0 = more than 3 locations 5 = 2 locations 10 = 1 location		1	10
Maximum weighted score for platforms					**75**
Location: Station Area					
4	Entrance–exit at each side	0 = more than 3 locations 10 = 1 location	5 = 2 locations	.5	5
5	Fencing	0 = not present	10 = present	2	20
Maximum weighted score for station area					**25**
Maximum total weighted score for access control					**100**

Motivation Reinforcement

TABLE 4 Scale to Measure Motivation Reinforcement Dimension

No.	Location	Scale		Weight	Maximum Score
Criterion: CCTV					
1	Notification	0 = not present	10 = present	1	5
2	Platforms	0 = not present	10 = present	1.5	15
3	Waiting area	0 = not present	10 = present	1.5	15
4	Circulation area	0 = not present	10 = present	0.5	10
5	Entrance–exit	0 = not present	10 = present	0.5	5
Maximum weighted score for CCTV					**50**
Criterion: PSO					
6	At station	0 = not appointed 5 = appointed on weekdays or weekends	10 = appointed 7 days	5	50
Criterion: Police Booth or Station					
7	At station	0 = not within 0.5-km radius 5 = within 0.5-km radius	7.5 = visible from platforms 10 = located just outside	1.5	15
Criterion: Railway Staff					
8	At station	0 = not appointed 5 = appointed on weekdays	10 = appointed 7 days	4	40
		5 = during office hours	10 = until last train	4	40
Maximum weighted score for railway staff					**80**
Criterion: Alarm Button					
9	At platform	0 = not present 5 = not near entrance	10 = present 10 = located near entrance	1.5 .25	15 2.5
10	At waiting area	0 = not present	10 = present	.75	5
Maximum weighted score for alarm button					**25**
Criterion: Lighting					
12	At platforms	0 = dark places (>9 spots)		2	20
14	At parking lot	2.5 = dark places (7–9 spots)			20
16	At circulation area	5 = dark places (3–6 spots)			20
18	Access and egress routes	10 = dark places (0–2 spots)			20
Maximum weighted score for lighting					**80**
Maximum total weighted score for motivation reinforcement					**300**

Maintenance

TABLE 5 Scale to Measure Maintenance Dimension

Location	Indicator	Scale of Measure		Weight	Maximum Score
Platforms	Seats	0 = discolored 0 = scratches 0 = damaged 0 = graffiti present	10 = not discolored 10 = no scratches 10 = not damaged 10 = no graffiti	0.25	10
	Floor	0 = graffiti present 0 = garbage	10 = no graffiti 10 = no garbage	0.5 0.5	10
	Walls	0 = graffiti present	10 = no graffiti	1	10
Maximum weighted score for platforms					**30**
Around station	Trees	0 = height exceeds platform	10 = height does not exceed platform	1	10
Parking lot	Walls	0 = graffiti on all sides 10 = no graffiti	5 = graffiti on at least 1 side	1	20
	Floors	0 = garbage (>70% area) 5 = garbage (15%–69% area)	10 = no garbage	0.5	
	Signs	0 = not intact	10 = intact	0.5	
Waiting area	Seats	0 = discolored 0 = scratches 0 = damaged 0 = graffiti present	10 = not discolored 10 = no scratches 10 = not damaged 10 = no graffiti	0.25	10
	Floor	0 = graffiti present 0 = garbage	10 = no graffiti 10 = no garbage	0.5 0.5	10
	Walls	0 = graffiti present	10 = no graffiti	1	10
Maximum weighted score for waiting area					**30**

(continued)

Territoriality and Activity Support

TABLE 6 Scale to Measure Territoriality and Activity Support

No.	Criterion	Indicator	Scale	Weight	Maximum Score
1	Control marking	Border	0 = not clear 10 = clear (fencing)	2	20
		Station name	0 = no signboard 10 = by signboard	1	10
			0 = absent at entrance 10 = present at entrance	2	20
		Station car parking	0 = no signboard 5 = defined by signboard 10 = at entrance with signboard	1	10
Maximum weighted score for control marking					**60**
2	Usage		0 = presence of nonpassengers (homeless or young group) 10 = only passengers	2	20
Maximum weighted score for territoriality					**80**
3	Activity support	Markings and signs	Provide clear idea and use of 10 = restrooms 10 = circulation area 10 = platforms 10 = waiting area	0.5	20
Maximum total weighted score for territoriality and activity support					**100**

MONASH University

Introduction

Context

Approach

Application

Results

Next Steps

Application is to four (un-named) suburban stations

- The scale was applied to four Suburban Stations in Melbourne
  - ❖ Unstaffed Station
    - -**Station A**
    - -**Station B**
  - ❖ Staffed/Premium Station
    - -**Station C**
    - -**Station D**
- The name of the station was not provided to avoid **stigma**.




MONASH University

Introduction

Context

Approach

Application

Results

Next Steps

Scores were 540 (low) to 864 (high); all stations had room for improvement

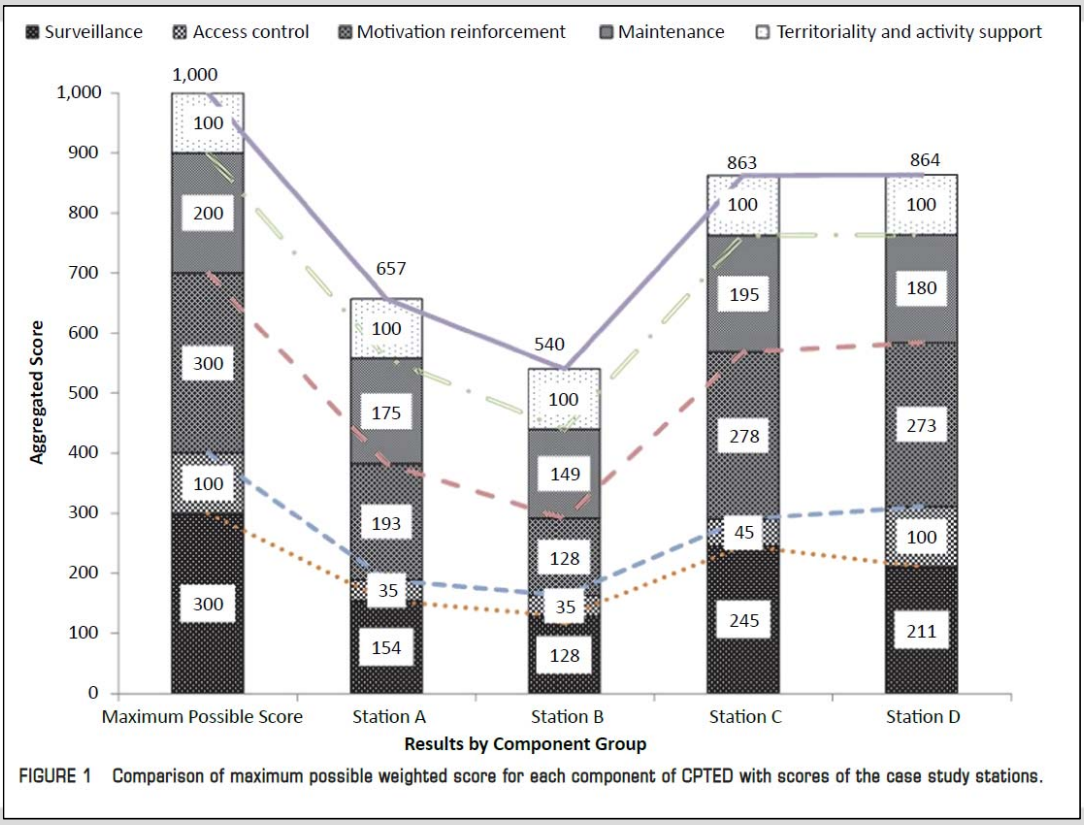


FIGURE 1 Comparison of maximum possible weighted score for each component of CPTED with scores of the case study stations.

Stations with Staff had much higher (+44% better) performance

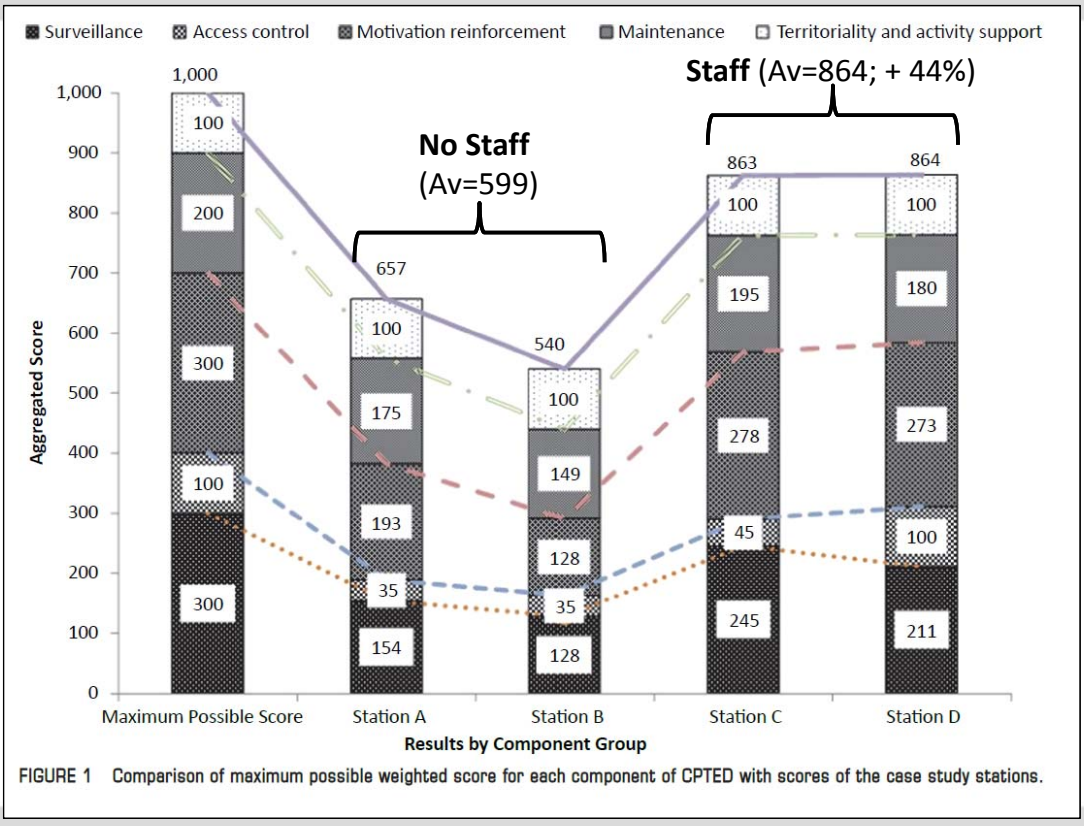
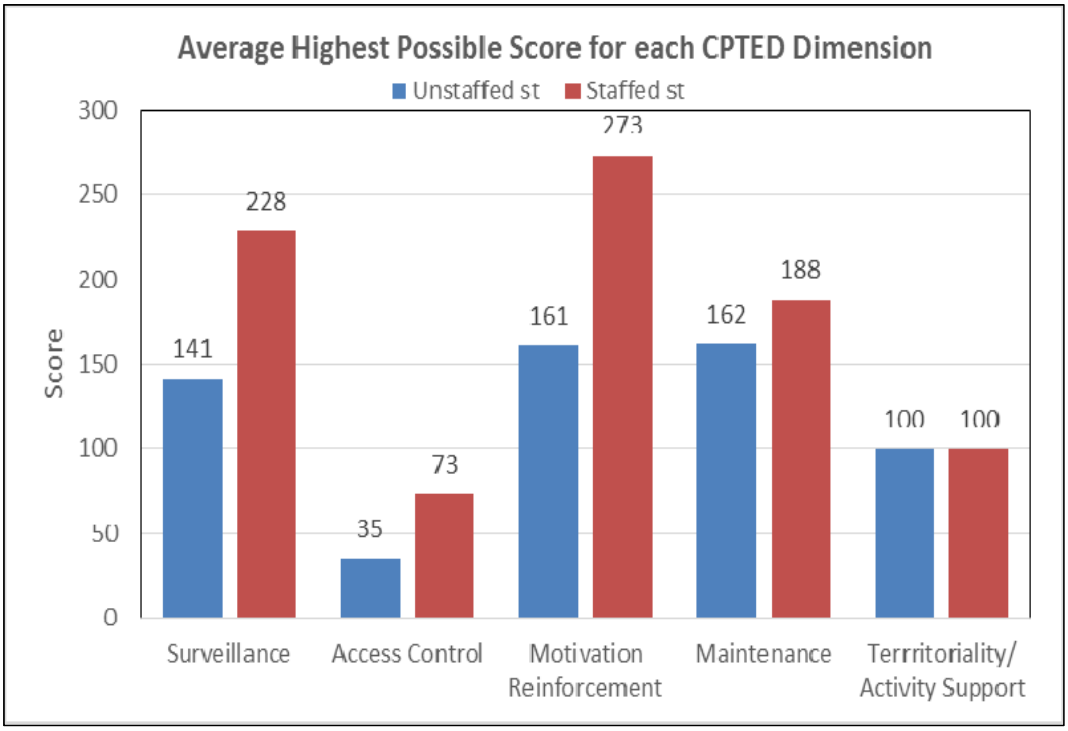


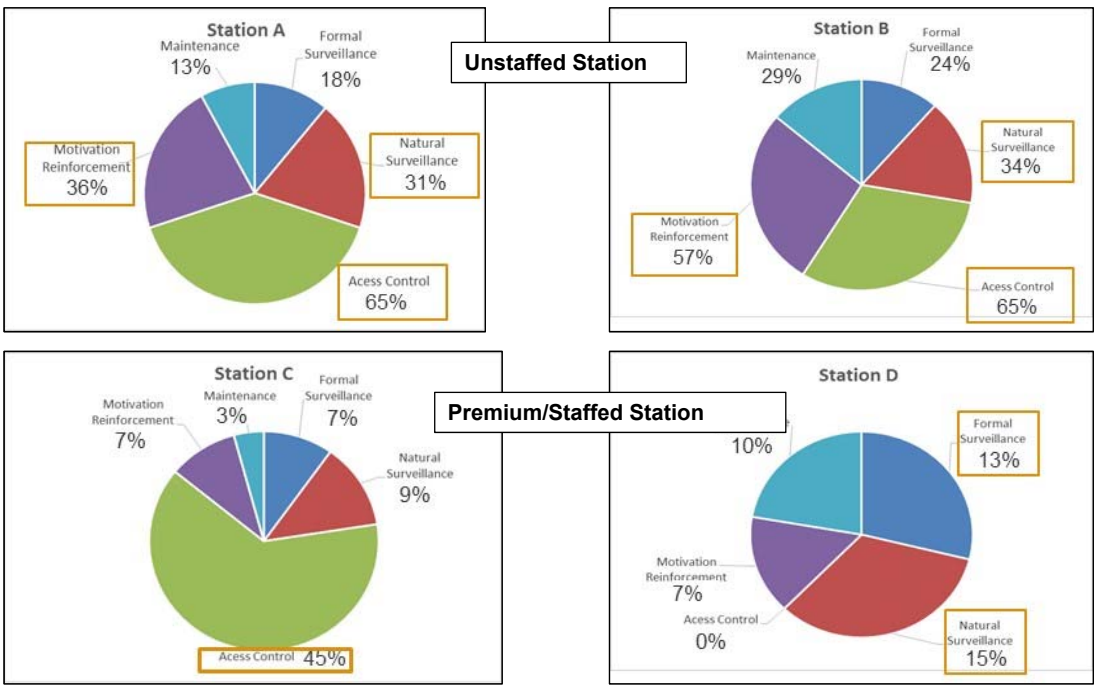
FIGURE 1 Comparison of maximum possible weighted score for each component of CPTED with scores of the case study stations.

Staffed Stations also had +61% Surveillance, +52% Access control, +70% Motivation Reinforcement, +16% Maintenance scores



The approach also establishes the scale of improvement possible; and which specific measures to target

% improvement of the Score of each Dimension Possible at each Station



MONASH University

Introduction

Context

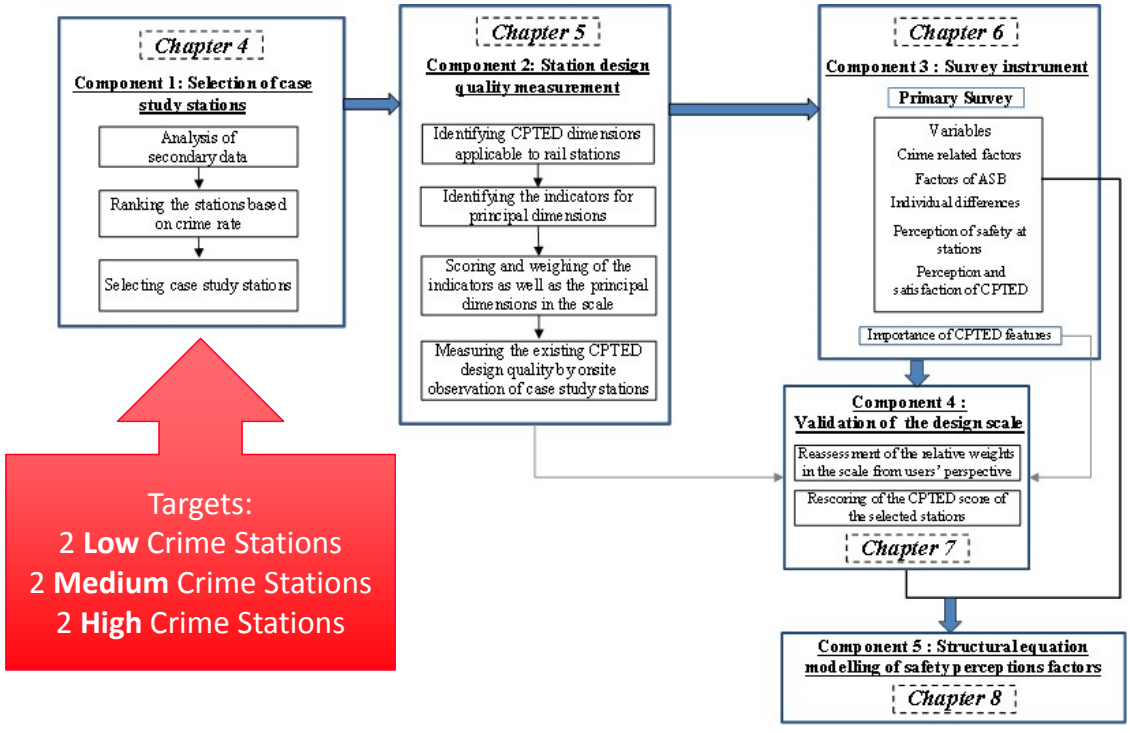
Approach

Application

Results

Next Steps

The method is a part of a wider research program to measure perceived safety links to actual crime, anti-social behaviour as well as station design



Key research components and related tasks

Design Measures Found INVERSE results – high crime stations had better design – due to targeted investment

Preliminary

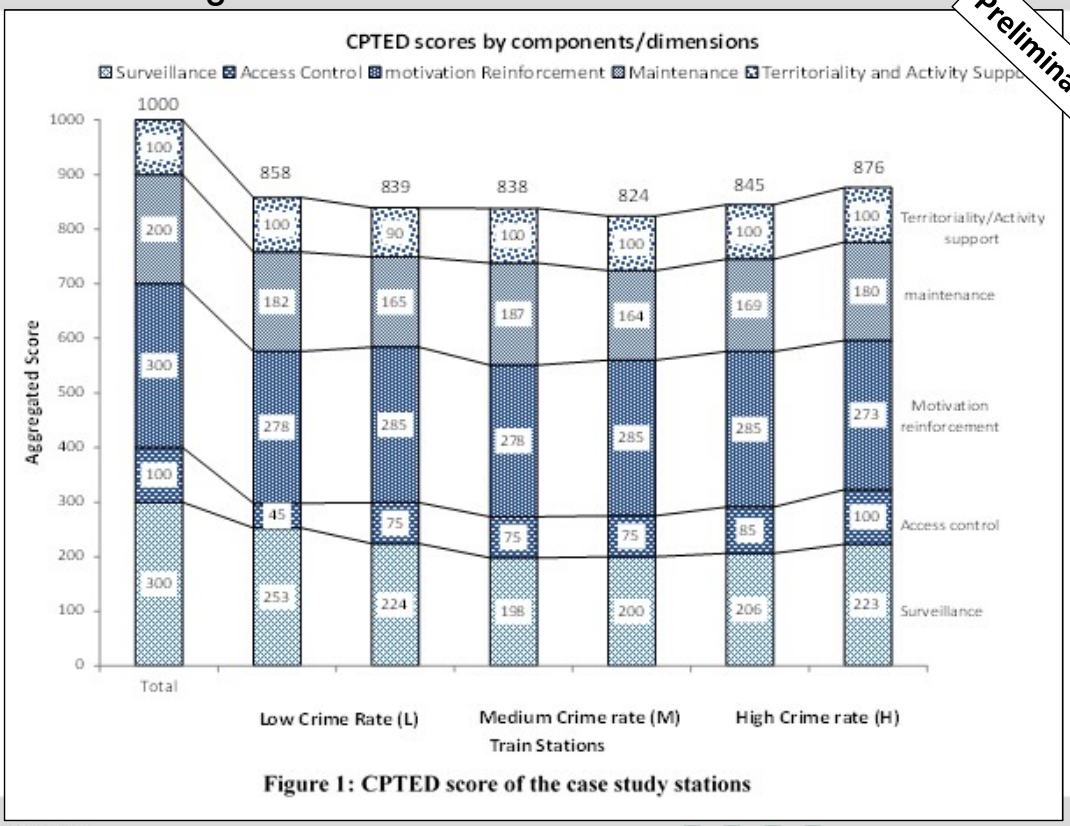
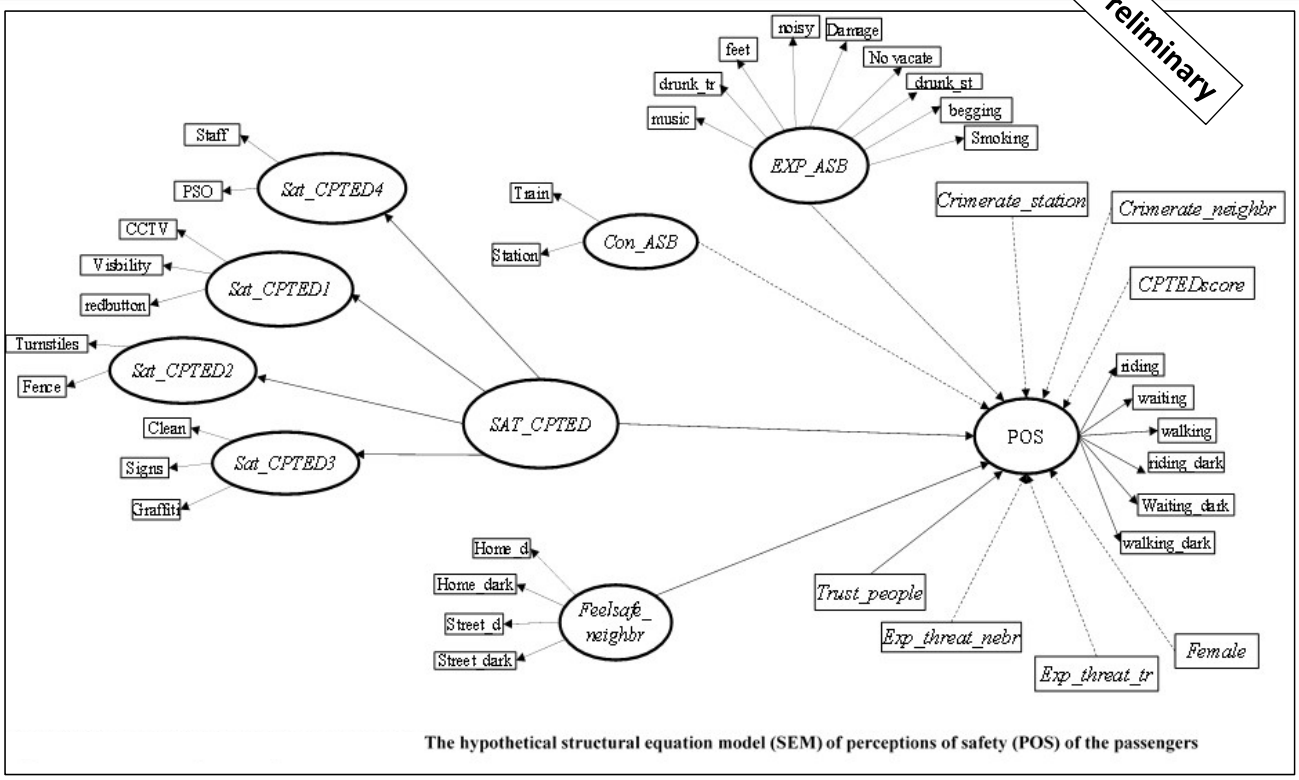


Figure 1: CPTED score of the case study stations

We expected safety perception (POS) modelling to link to CPTED quality, crime and concern for anti-social behaviour

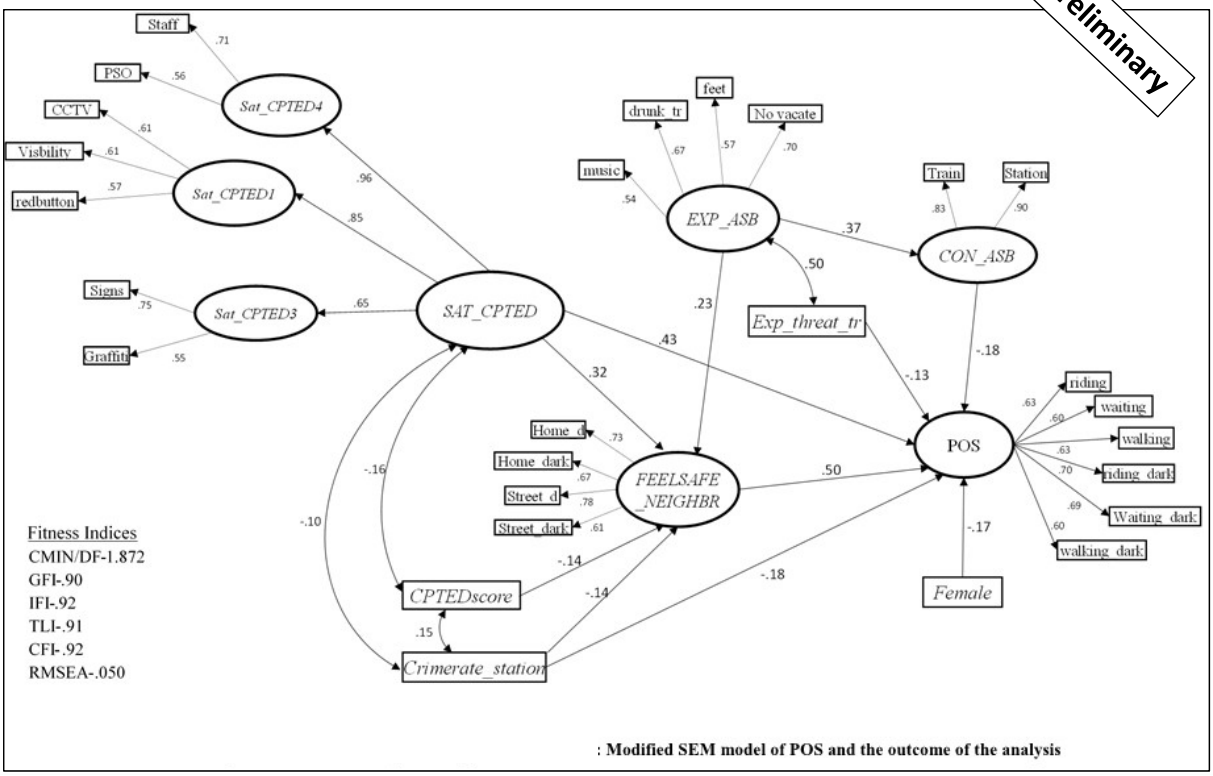
Preliminary



The hypothetical structural equation model (SEM) of perceptions of safety (POS) of the passengers

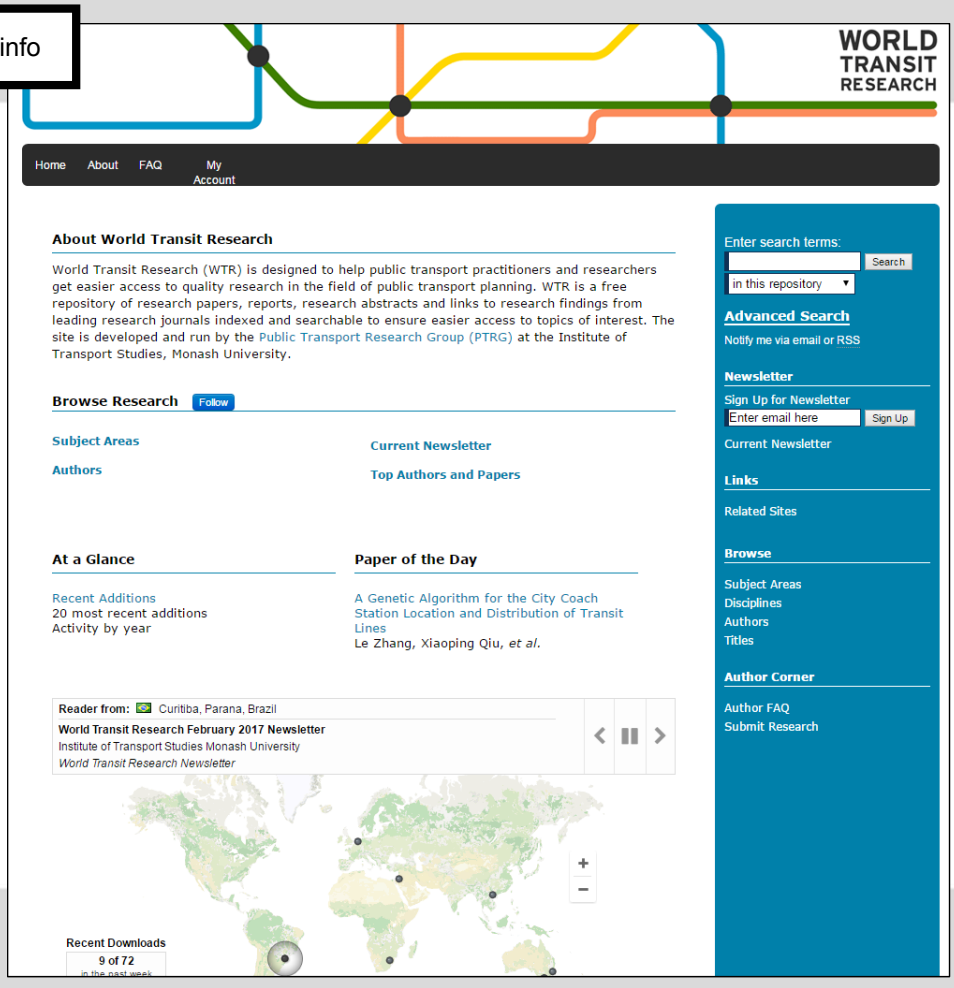
Results found CPTED links but Neighbourhood Safety was more important ; multi-factors affect POS; crime rate impact is small

Preliminary



: Modified SEM model of POS and the outcome of the analysis

www.worldtransitresearch.info



2025=PTx2

UITP Showcase Award Winner

PUBLIC TRANSPORT RESEARCH GROUP

Connecting cities through our research.

ABOUT OUR TEAM BENCHMARKING GRIP PROJECTS OUTPUTS PARTNERS NEWS & EVENTS CONTACT

CONNECTING CITIES

Public Transport Research Group WEBSITE PTRG.INFO

PTRG is the name for researchers at Monash University who are engaged in research on public transport systems, users, planning and policy.

DISCOVER MORE

50	24	48	18	6190	170
PROFESSIONAL RESEARCHERS	PHD RESEARCHERS	MASTERS STUDENTS	CURRENT PROJECTS	RESEARCH PAPERS	COUNTRIES

Join the **ITS (Monash)** LinkedIn group to keep informed of our activities

MONASH INSTITUTE OF TRANSPORT STUDIES

LinkedIn