

Safe City Monitoring System : GIS Web Based Application in Crime Monitoring in Malaysia

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Abstract

Safe City Monitoring System or SCMS developed on GIS Web Based Application on enterprise scale, is the nerve centre to enhance the sharing of crime data and information, and to monitor the effectiveness of crime prevention measures undertaken by the Royal Malaysian Police (RMP), Local Authorities (LA), Ministry of Home Affairs (MOHA), Ministry of Housing and Local Government (MoHLG) and other related agencies. SCMS integrates two major existing systems at two major Government agencies vis-a-vis the Police Reporting System (PRS) at RMP with mapping system on GIS platform at the Federal Department of Town and Country Planning (FDTCP). It was a break-through exercise, towards more systematic approach in crime data management, archive and analysis, thus enabling the identification of existing and potential crime patterns and hotspots for strategic implementation of crime prevention measures. This holistic crime prevention action has made Malaysia a safer place.

1. Introduction

The purpose of this paper is to give an overview of development process, issues and outcome of Safe City Monitoring System (SCMS) as a GIS Web Based Application. The objectives of SCMS development are to improve crime data sharing among the crime prevention agencies and to monitor the effectiveness of crime prevention programmes through the provision Geographic Information System (GIS) Crime Mapping facilities to the Royal Malaysian Police (RMP) and Local Authorities (LAs).

2. Background of Safe City Monitoring System (SCMS) development

Background

The Safe City Programme was first established in 2004 and was tailor-made to prevent property crimes i.e. snatch theft, robbery, motorcycle theft, car theft, van/lorry/heavy machinery theft, break-in (night and day). It introduced three (3) strategies and twenty-three (23) crime prevention measures for local authorities' (LAs) implementation. In 2010, it was streamlined to 15 measures to facilitate and enhance its implementation at the local authority level.

Government Transformation Program (GTP) 1.0 and National Key Result Areas (NKRA) 2010-2012

In 2010, Government of Malaysia introduced the Government Transformation Programme (GTP) Roadmap to achieve the goals of Vision 2020 vis-a-vis to be a developed and high-income nation. It detailed out a bold and unprecedented programmes to transform the Government, and to renew the Government's focus on delivering services to the rakyat. In this context, seven National Key Result Areas (NKRA) were introduced: 1. Fighting Corruption; 2. **Reducing Crime**; 3. Improving Student Outcomes; 4. Raising Living Standards of Low-income Households; 5. Improving Rural Basic Infrastructure; 6. Improving Urban Public Transportation; and 7. Addressing the Rising Cost of Living (introduced in 2011). Under NKRA Reducing Crime, 55 initiatives have been endorsed by government to achieve two simultaneous goals: to reduce crime in the country and to restore public confidence in their own

personal safety. A Yearly 5% reduction in overall reported crime index and annual street crimes reduction by 20% based on the 2009 street crimes index were set; and safety perception was to be increased from 45% in 2009 to 57.3% in 2012.

In the effort to achieve the above mentioned targets, the Ministry of Housing and Local Government (MoHLG) is to reactivate and expand the existing Safe City Programme from 39 LAs to all the 151 local authorities nationwide - focusing on reducing street crimes in crime hot spots areas identified by the Royal Malaysian Police (RMP). One of the safe city programme measures i.e. **The establishment of GIS mapping for crime and Safe City Programme** has been identified as deemed important to be implemented immediately along with other measures: separation of pedestrian walkways from motorised lanes; lighting, installation of CCTV; safety mirrors; safety alarms; motorcycle locking facilities, and crime prevention signage in order to give fast results in reducing street crimes in hotspots areas.

Police Reporting System (PRS)

Prior to GTP 1.0, crime prevention in any forms rested solely on RMP and information sharing on crime data with relevant agencies and the public was at minimal level. Crime data and information are regarded too sensitive to be revealed as it could compromise on the security the country. Though computerised Police Reporting System (PRS) was launched on 25 March 2002, it could only provide crime indices in the form of textual data, and visualisation of crime locations, distribution and patterns were done manually using the infamous pin-maps hung on the wall of District Police Departments' meeting rooms and not to be shared by others. Often the pin-maps were discarded or misplaced, leading to loss of valuable informations.

Having recognized the importance of crime data sharing, and crime prevention is also the responsibility of at least 20 agencies including the public, to deliver a more coordinated and intelligent crime prevention actions the **GIS-Crime Mapping** was then recommended to be developed immediately by the government.

SCMS development was carried out in phases starting from 2010. On the eve of 2011, SCMS was made accessible to 12 LAs and 50 Police Stations, labelled as crime hotspots. The areas concerned were chosen as

top priority and were categorized as hotspots by Royal Malaysian Police due to 70% of crime index contribution in Malaysia. By the end of 2012, the system had reached optimal development and has the capacity to be expanded to all 151 Local Authorities and 764 police stations nationwide. Currently, SCMS is being accessed by 35 LAs and 217 Police Stations from 14 States in Malaysia. ~~development~~

3. SCMS : GIS Web Application

SCMS is a web application, accessed by registered users bounded only within Malaysian networking environment. Users are predominantly police personels at all levels of police stations (local, districts, state and headquarters) and 35 participating LAs. Currently, there are 677 registered users (617 police personnels and 70 users from LAs), and the system is not accessible to the public for security reason.

The function of GIS Web application is to centralise crime data development and maintenance, administered by one agency. In this context is the Department of Town and Country Planning (FDTCP), Ministry of Housing and Local Government (MOHLG). SCMS architecture is designed to respond and correspond seamlessly between the application of GIS software and hardware (server) to achieve optimum system performance and to cater for high concurrent accesibilities by users.

ArcGIS Web Server serves as the prime platform and engine to SCMS in creating and managing web service, application and data management. Graphic User Interface (GUI) uses Flex Adobe for more variation in enhancing visuals and interactivity. Relational Data-based Management (RDBM) uses Microsoft SQL Server. Currently, ASP.net is used to support simple multi-tasking and other functions (service, statistics, administration settings, etc.).

4. Integrating SCMS with Police Reporting System (PRS) and data collection

The initial idea of GIS-Crime Mapping was to capture crime locations gathered from the PRS onto the GIS maps. However given the challenges of an added task to monitor the effectiveness of the Safe City Programme at the LAs, the limited funding and time given to accomplish the time-

consuming crime data capturing onto GIS maps, and more importantly the availability of the latest information technology in the market, the NKRA Safe City Unit, Federal Department of Town and Country Planning comprised of town planners, the polices, programmers, network experts and GIS experts decided to establish the Safe City Monitoring System (SCMS).

In early 2010, through smart partnership, an agreement was made whereby, the RMP, agreed FDTCP to leverage on the PRS through integrating GIS maps onto the PRS. The exercise facilitates crime data capturing as when crime victims make police reports using the PRS at the participating police stations. Thus the time taken to complete the development of SCMS has been shortened within 5 months. Under normal circumstances, such a complex task involving a major system protected by RMP under Secrecy Act would need between two to three years to complete.

Simply, SCMS is a system acting as nerve centre integrating two major existing systems at two major Government Agencies vis-a-vis the PRS at RPM with mapping system on GIS platform at the Federal Department of Town and Country Planning Malaysia. It was a break-through exercise, transforming the pin-map approach to digital form for more systematic approach in crime data management, archives and analyses, thus enabling the identification of existing and potential crime patterns and hot spots for RMP. SCMS enables crime index data to be geo-coded accurately as when the crime victims made police reports at the participating police stations. Simultaneously, the crime data analyses and findings can be shared with the participating LAs, strategising the implementation of Safe City measures and monitoring the effectiveness of safe city implementation measures.

Crime Data Capturing Tool (CDCT) was developed in the SCMS mainframe to provide the means to map crime incidents with coordinates (WGS 84). Connection network between SCMS and PRS servers enables the local police stations to use CDTC tool to map crime incidents during making police reports in PRS. CDCT is easily accesible in the PRS by adding an interactive button to facilitate Enquiry Officer (EO) to map crime locations as informed by the victims. Using CDCT, the crime locations with coordinates can be altered to ensure accuracy upon site investigations and verification by the Investigation Officers (IO). Investigation Papers will be produced for further action while attributes

data including coordinates from verified Police Reports will be fed to SCMS server for archiving and analysis on weekly basis (Figure 1 and 2)



Fig. 1. Crime Data Capturing Tool (CDCT) interface. Black dot indicates crime incident location plotted by Enquiry Officer. Window pop-up shows coordinates for verification.

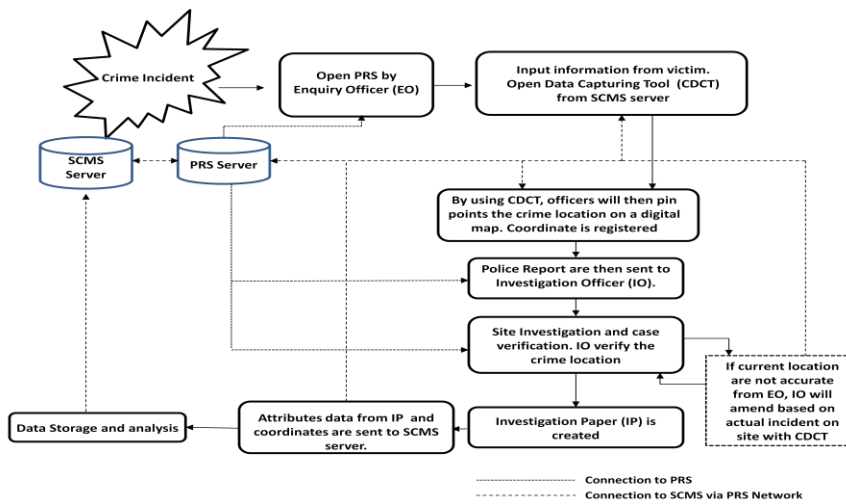


Fig. 2. Standard Operation Procedure (SOP) for crime data capturing and archiving by EO and IO.

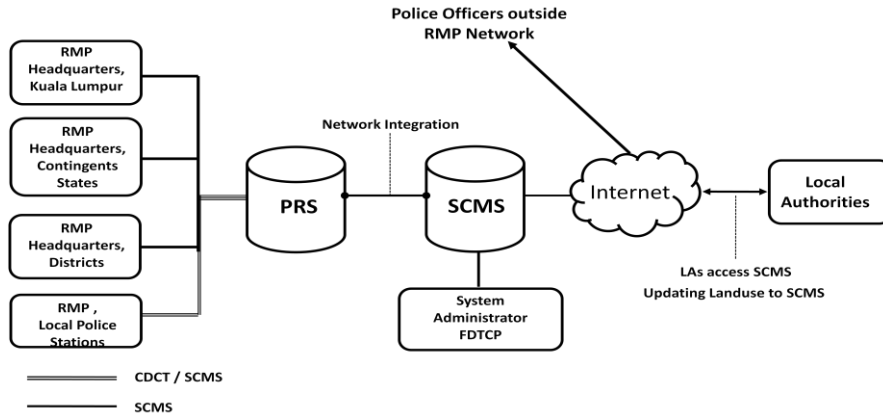


Fig. 3. Concept on Accesibility and Data Sharing in SCMS

5. SCMS : output and practicality

5.1. Functions

SCMS is designed with features to provide spatial information on crime index and patterns through series of spatial analysis and interactive statistics. To enable users particularly those with minimum GIS literacy, Graphic User Interfaces (GUIs) are made to be user-friendly and simple with well organized tools to navigate the map as shown in Figure 4.

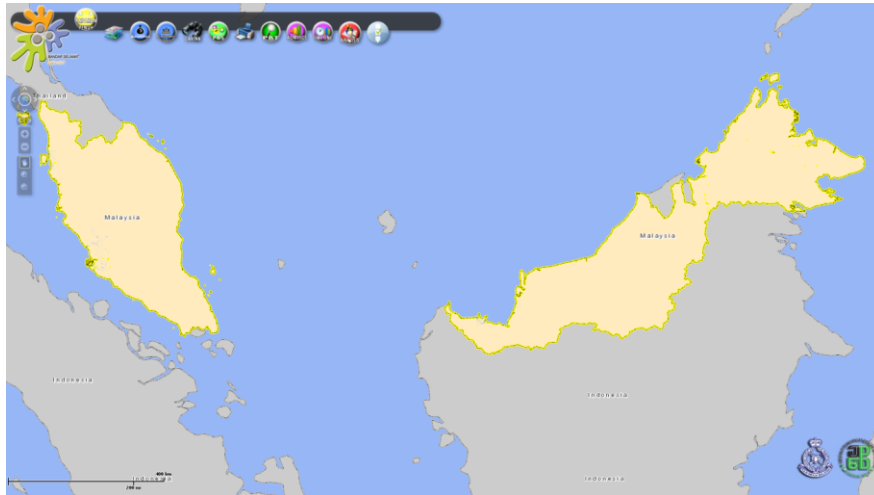


Fig. 4. Graphic User Interface. Simple and neat arrangement of Functions and Navigation tools for better map coverage view.

Geo-processing Analysis is an important function in SCMS to enable users to generate various options to determine crime patterns, hotspots and crime prone areas.

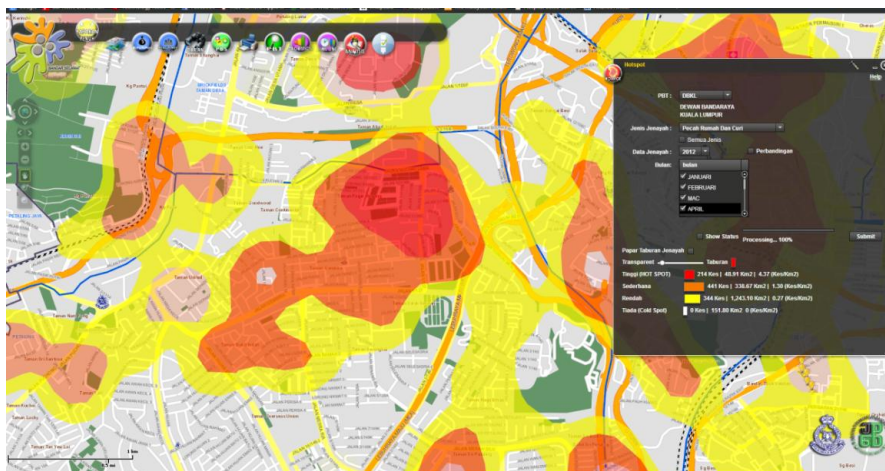


Fig. 5. Hotspot : Interactive information on density of crime cases per square km

i. Hotspot analysis

Objectives of this analysis is to enable users to identify crime hotspot areas indicated by coloured contours depict-

ing the crime densities and crime patterns as shown in **Figure 5** for the law enforcement agencies and local authorities to undertake strategic and cohesive crime prevention actions. Hotspots determination is assisted by Kernel Density is used as prime model to generate value of crime densities and Natural Breaks (Jenks) is to category densities (hot, medium, low spots).

ii. Repeat Location Finder (RLF) analysis

The purpose of this analysis is to identify crime points that occur repeatedly within a specified 50m radius from the affected area. Repeated crime occurrence is categorized into five levels, starting from lowest level at 2-3 repeats to the highest level with more than 10 repeated incidences. RLF model analysis is developed by the SCMS team, uses intersecting x and y coordinates for each crime points (within a buffer of 50m radius area) to indicate the point/ polygon (50-meter radius) based on categories of frequency repeated crimes as shown in **Figure 6**.

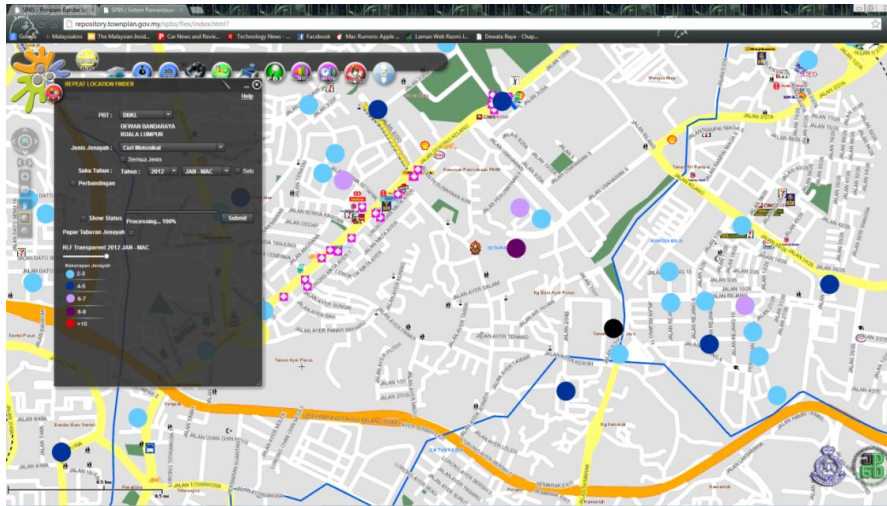


Fig. 6. Distribution of different levels RLF indicated by colour density in an area within 50-m radius

iii. Decision support tool - suitable location for police beats and patrolling

Decision Support Tool to indicate suitable location for police beats and patrolling has been developed for SCMS by the team in 2010 to identify areas needed to undertake crime prevention measures. However, the function of this tool has been further expanded to support RMP in identifying priority areas to establish police beat base and patrolling

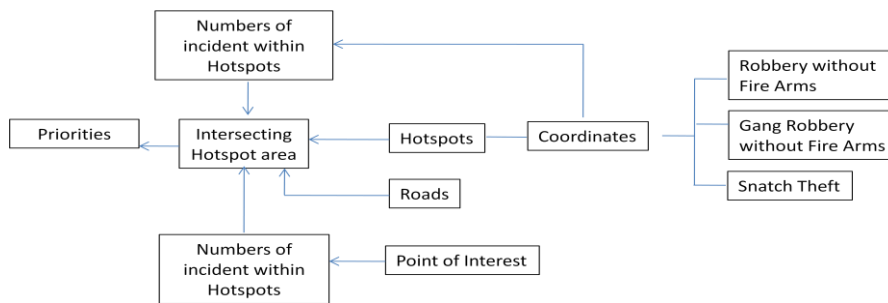


Fig. 7. Decision Support Tool - Criteria involved in the analysis of priority areas

Based on Figure 7 shows hotspots originated from crime points which is then intersected with other criteria like Point of Interest (Schools, Banks, 24/7 Outlets, Restaurants, Pawn Shop, Goldsmith and Petrol Station), Crime Point (street crimes) and Roads. Numbers of points (Point of Interest and Crimes) within Hotspot area are calculated for priorities base (the higher numbers of points the more priority) which is then visualized on highlighted road segments. The highest number of stars indicates high priorities for RMP to deploy officers for patrolling, establish police beat base or Omnipresence from other law enforcement agencies.

This exercise has to a certain extent addressed the problem inadequate manpower at the local police stations.

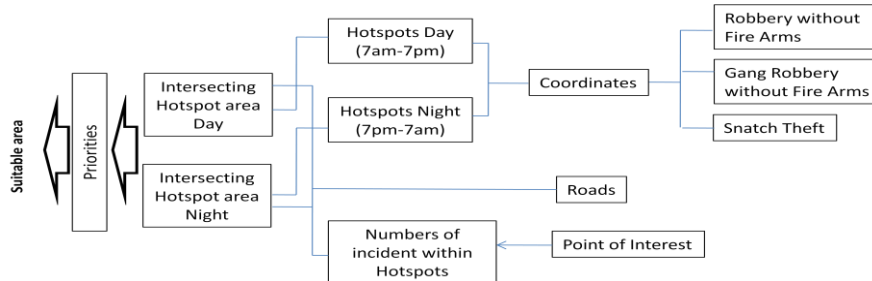


Fig. 9. Geo processing analyses determining priority areas for Safe City measures.

v. Aoristic and timeline analysis

Aoristic and Timeline are both analysis similarly to identify crime trend related to frequency of incidents at a specific times. Figure 10 shows example of frequent statistic of crime based on divided hour within 24 hours which are visualized on typical Bar Chart that interacts with Map to locate specific crime location at specific hour.

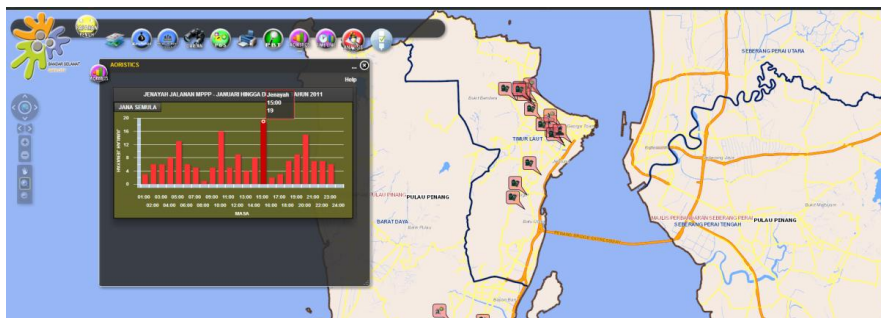


Fig. 10. Aoristic Output indicated in bar graph divided hourly interval of 24 hours and interactivity with map.

The figure 11 below shows Timeline tools are focused on identifying crime occurrence by extended range of time, by month or annually. Features of interactive are similar to Aoristic. For example Johor Bahru City, Johor, Malaysia has the highest rate of motorcycle thefts in the months of November and December coincide with school holidays and festival season.

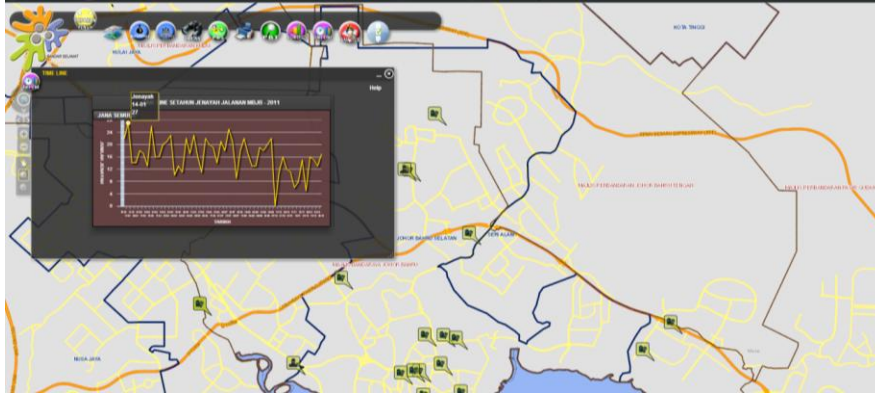


Fig. 11. Timeline analysis are based on extended and lengthy period (month or annual) on identifying crime frequency within specified period

5.2. Effectiveness in monitoring of crime

i. Royal Malaysian police

Crime Prevention Monitoring Committee has been established at each District Police level in Malaysia. SCMS findings are utilized in decision making process (Hotspots, Aoristic, Timeline and Repeat Location Finder analysis) for the deployment of Law Enforcement Personnel's on crime prevention activities such Patrol, Omnipresence, Neighbourhood watch, Identification Police Beat Based and Strategic Deployment.



Fig. 12. SOP in applying SCMS output/report to the Crime Prevention Monitoring Committee at Police District Level

To date, 24 Police Districts and 50 Local Police Stations which considered as Street Crime Hotspot areas within 12 Local Authorities have adopted the SOP above. It is currently monitored under to Secretariat (Re-

search and Development) of Inspector General of Police and will be handed over to Crime Prevention Department of RMP in July 2013 under a Commissioner of the which will see this SOP will be adopt by other District and Contingents Police in Malaysia.

ii. Local authorities

LA's has committed in holding monthly Committee Safe City meetings since January 2010 in monitoring and decision making on implementation of Safe City Programmes and other preventive programmes. Like RMP, SCMS provides outputs and reports for committee members to review and formulating steps on crime prevention inniatives.

6. Outcome and impact evaluation

6.1. Royal Malaysian police

Since operational in January 2011, SCMS has successfully transformed PRS using pin-map and textual output on to GIS platform. Crime data information can now be retrieved, visualised, analysed and administered systematically. This automation process helps to reduce crime data dispute by the public released by RMP. The number of participating Local Police Stations have increased to 217 (2012) making constant data feed, reporting, and application of GIS in their routine job has become more evidence now. Since its inception, the number of registered user have increase 224 users (2011) to 1,125 users (2012) at four levels of RMP administration.

The availability of Crime Data Capturing Tool and monitoring tools in the PRS surprisingly, assisted RMP to be more efficient in detecting the inefficiency of IOs at Local Police Stations in the opening of IPs. The result of this exercise the number of IPs have increased by 56.4% in 2011, from 2,382 IPs in 2010 to 5,464 IPs in 2011 as shown in Figure 13 as been reported by *Delivery Taskforce Committee (May 2012)*. On 2011 alone, Figure 13 also shows SCMS have been accessed more than 10,000 times.

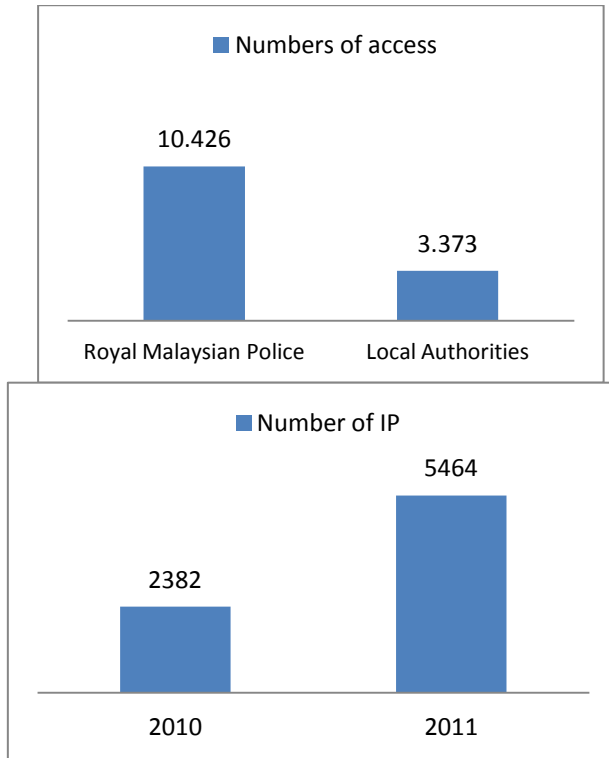


Fig. 13. SCMS access by Users from 1 Jan – 31 Dec 2011 and numbers of Investigation Paper opened from 2010 - 2011

The Inspector of General Police Malaysia and Ministry of Home Affairs supported the development of SCMS and recommended to expanded to Local Police Stations nationwide. By 2012, SCMS is capable to accommodate this expansion including the possibility of public access.

Due to success and benefits, Government of Malaysia has approve SCMS to be expanded to 413 or 54% from 764 Local Police Stations and 103 or 68% from 151 Local Authorities around Malaysia until the year of 2014 as shown in Figure 14.

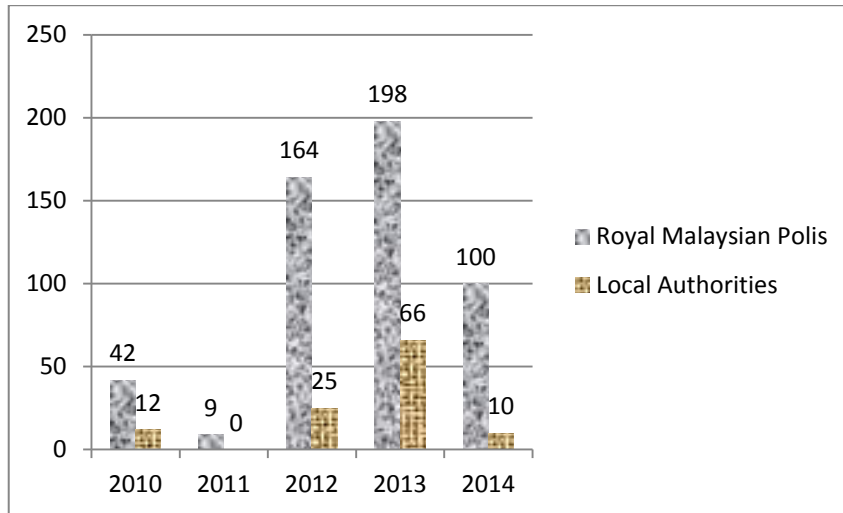


Fig. 14. SCMS expansion to Police Stations and Local Authorities from year 2010-2014

6.2. Local authorities

SCMS is being accessed by 70 registered users from 35 participating LAs in 2012. The findings of the SCMS analysis has helped the LAs to streamline and strategies the implementation of Crime Prevention through Environmental Design (CPTED) and the appropriate Safe City measures (CCTV, Lightings, Safety Mirrors, Separation of Pedestrian Footpath from motorways, Safety Alarms Motorcycle Locking facilities, etc.) at the right locations. Analytical Module in assessing the effectiveness of Safe City measures developed solely for the SCMS has proven that the Safe City measures undertaken by LAs and Ministry of Housing and Local Government to be effective in reducing street crime significantly as shown in Figure 15.

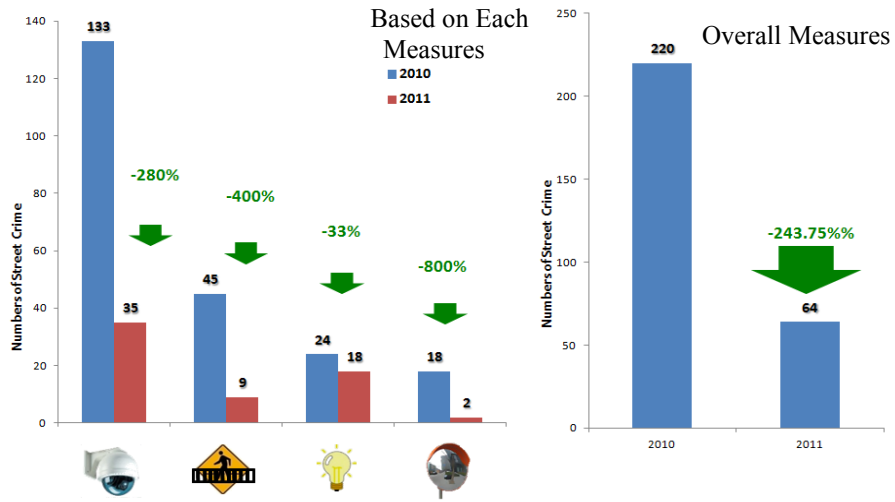
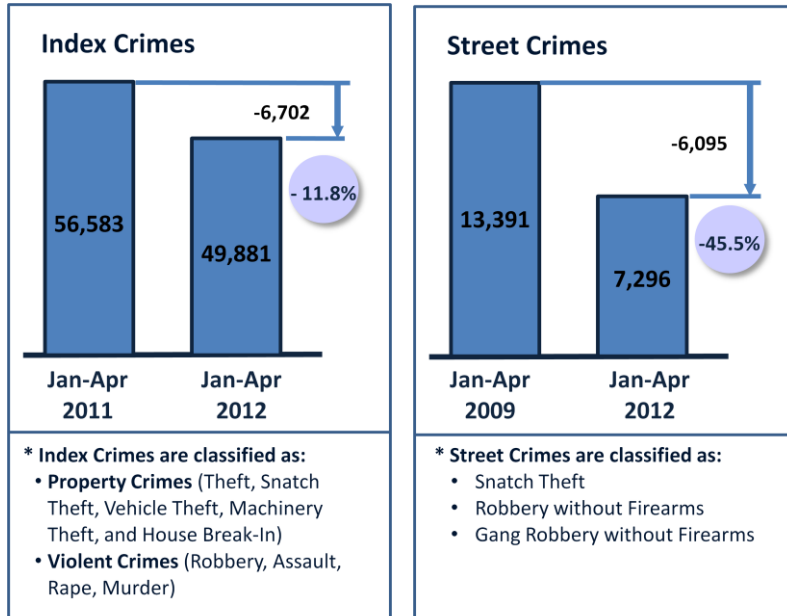


Fig. 15. Outcome of Safe City Measures on Crime prevention based on comparison of June-November 2010 and June-November 2011.

6.3. Impact

1. Holistic implementation of Crime Prevention program spearheaded by Ministry of Home Affairs, RMP and other agencies including FDTCP under Ministry of Housing and Local Government, street crimes reduction has successfully achieved the target by -45.5% in 2012 compared with 2009 street crime index, the overall reported crime index has been reduced -11.8% in 2012 compared to 2011 as shown in Figure 16.



Target: 5% reduction

Target: 45% reduction

Fig. 16. Statistic crime reduction 2011-2012 at the National level.

Validation from external associations or parties also concluded crime fighting in Malaysia since the beginning of NKRA Reducing Crime on 2009 has shown impact in terms of crime reduction and crime perception in Table 2 released by Delivery Taskforce Committee (DTF) .

Table 2. External Validation on Crime Fighting also echoing the success result under NKRA : Reducing Crime Efforts

| Nu. | Association/Agencies | Recognition/place |
|-----|--|--|
| 1. | World Justice Project | # 1 safest in 19 upper middle income countries and #12 safest overall, ahead of USA and Britain |
| 2. | Global Peace Index | #1 safest and peaceful in South East Asia, #4 safest and peaceful in Asia Pacific and #19 safest peaceful globally |
| 3. | Worlds Economic Forum - WEF Global Competitiveness | #63 in 2011, from #93 in 2010 and +30 improvement in ranking |

| Report | |
|--------|---|
| 4. | General Insurance Association of Malaysia (PIAM) 9.4% reduction of vehicle claims cases in 2010 vs 2009 |
| 5. | TNS - Fear of Crime Index Survey 9.6% reduction from 58.5% (Dec'09) to 48.9% (May '11) |
| 6. | International Islamic University of Malaysia Survey - Concern about Crime 12% reduction from 33% (2010) to 21% (2011) |

2. The availability of data sharing via SCMS has promoted smart partnership and enhanced the collaborative effort from RMP, LAs and other related Ministries to reduce crime in the cities. SCMS helps other agencies to understanding the crime prevention effort undertaken by the RMP and also the necessity to undertake pre-emptive measures under CPTED.
3. **Cost Saving**
Significant Cost saving in crime data capturing and development of GIS Crime Mapping for 103 LAs has been achieved between 2010-2013. Total cost of SCMS development was RM26.1 million compared with RM352.3 million if the SCMS is developed individually by each LAs.

6.4. Issues and challenges

1. A network infrastructure and capabilities in most part of the country has been the major challenges in Malaysia. Prior to SCMS development, network capabilities at all level of RMP was within of average of 128 – 512 Kbps bandwidth. Without upgrading this infrastructure, the time taken to download data transaction from SCMS server was 120 seconds. This scenario could not be tolerated as this could affect the efficiency of RMP to carry out the Crime Data Capturing. The SCMS targets 5 seconds to assess to the server. However this has been addressed partially by participating 50 Local Police Stations by upgrading 2 Mbps while upgrading to other Police Stations is ongoing. One of the major issues of upgrading this infrastructure is the cost itself whereby it is costly and provided by sole provider.
2. SCMS needs to migrate from Flash technology to a more compatible platform (example :Java script, HTML 5) for better flexibility,

optimization of performance (data processing), and users experiences. The migration will facilitate the application SCMS towards Mobile platform (IOS, Android, Window Phone) in the future.

3. There is the need to improve the literacy rates of police personnel in GIS towards achieving 90% targets on the use of SCMS by RMP. To ensure the sustainability of the system in RMP, SCMS should be made as the main part of police functions. All IOs and police administrators should trained and knowledgeable in GIS. Training of personal should be continuous and budget should be set aside for this purpose.
4. SCMS is a closed system and it is protected under the Official Secrets Act 1972 (Act 88) in Malaysia. However the Government of Malaysia the importance of pursuing accountability, transparency, public confidence on the crime data and crime prevention actions part of the SCMS information can be made accessible to the public.

7. Conclusion

SCMS development using Web GIS application has enhanced the sharing of crime data and information, collaborative and holistic effort of law enforcement agencies on crime prevention has reduced the overall crime index and street crime in Malaysia. The Government of Malaysia will continue to improve public perception on the fear of becoming victim of crime and believe that SCMS will accessible to the public in the future will increased transparency and credibility on Governments effort in crime prevention.

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