

Regional Customs Good Practice Series Report: No. 7

Application of Non-intrusive Inspection (NII) Scanners for Better Security and Facilitation



Australian Customs & Border Protection Service

Hong Kong Customs

WCO ROCB Asia Pacific

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Foreword

Modern technology supports Customs administrations to be more efficient and effective together with the application of modern procedures and practices laid down in the Revised Kyoto Convention (RKC). The international Customs community is confronted with the dual challenges of securing and facilitating international trade. To help member administrations address such challenges, in 2005, the WCO adopted the SAFE Framework and launched the Columbus Program to implement this key WCO instrument. Using non-intrusive inspection (NII) equipment has been incorporated as one of the four core elements in SAFE, aiming to enhance the inspection efficiency and effectiveness.

Within this context, many regional members in Asia Pacific have implemented or are planning to introduce NII equipments, especially scanners. In response to strong needs for capacity building, ROCB has organized two targeted workshops focusing on X-ray Scanner Image Analysis in Australia and Hong Kong respectively in 2008 and 2009. It is found that some members have installed sound facilities with well-established procurement, maintenance, training and operational systems. Nonetheless, the NII scanners are still new to some Customs administrations which may not have sufficient expertise. More experience sharing will be beneficial for our members.

With this spirit in mind, ROCB, in cooperation with the Australian Customs & Border Protection Service and Hong Kong Customs, has produced this report. It is believed that the report embrace rich, valuable, updated information on how to implement NII deployment project and follow-up application. Especially, the report is much meaningful for those members which are considering applying NII scanners in modernization program. While referring to this report, please keep in mind it is only for Customs officers use only.

I, on behalf of ROCB, would like to extend sincere appreciation to these two administrations. Especially, I would like to sincerely thank the concerned colleagues with Australian Customs & Border Protection Service and Mr. Hermes Tang as well as his team with Hong Kong Customs and Excise Department for their relentless efforts to bring forth this special report. I also thank my ROCB colleague Mr. Zhang Shujie, for his coordinating this project, also to Mr. Kelvin Wong, our new colleague from HK Customs for proofreading.



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Australian Government
Australian Customs and
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USE OF NON-INTRUSIVE INSPECTION SCANNERS: EXPERIENCE OF AUSTRALIAN CUSTOMS & BORDER PROTECTION SERVICE

A man with glasses and a beard, wearing a high-visibility yellow vest, is seated at a desk. He is looking at two computer monitors. The left monitor displays a large X-ray scan of a container, showing internal structures. The right monitor displays a smaller X-ray scan. The man's hand is on a computer mouse.

Technology and Enforcement Capability Branch
Australian Customs and Border Protection Service

1.1 Background

1.1.1 Historical background of NII application

The Australian Customs and Border Protection Service first deployed non-intrusive inspection (NII) scanners in 1976 when fluoroscopes developed by a Customs Officer were deployed in Postal Operations to scan letters for narcotics and revenue items. In 1991 the first commercially built cabinet x-ray machines were deployed at international airports to scan passengers' baggage and then gradually introduced to other areas. In 1995 the first mobile x-ray vans were introduced to examine air cargo and passenger hand-carry luggage. In 2002 the first pallet x-ray machines were deployed to examine deconsolidated sea cargo and in 2002-03 the first container x-ray systems were deployed at key port locations.

1.1.2 Drivers to implement NII scanners

The Australian Customs and Border Protection Service uses NII scanners to provide an effective and efficient tool to screen large quantities of cargoes in a timely and cost-effective manner. They assist in identification of threats and also in commodity confirmation.

1.1.3 Legal basis and considerations

Section 186 of the *Customs Act 1901* is the legislative basis for the Australian Customs and Border Protection Officers to operate NII scanners. The Customs Act has been regularly updated since its introduction in 1901. The most recent compilation was issued on 1 January 2011.

186 General powers of examination of goods subject to Customs control

(1) Any officer may, subject to subsections (2) and (3), examine any goods subject to the control of the Customs, and the expense of the examination including the cost of removal to the place of examination shall be borne by the owner.

(2) In the exercise of the power to examine goods, the officer of Customs may do, or arrange for another officer of Customs or other person having the necessary

experience to do, whatever is reasonably necessary to permit the examination of the goods concerned.

(3) Without limiting the generality of subsection (2), examples of what may be done in the examination of goods include the following:

(a) opening any package in which goods are or may be contained;

(b) using a device, such as an X-ray machine or ion scanning equipment, on the goods;

(c) testing or analysing the goods;

(d) measuring or counting the goods;

(e) if the goods are a document—reading the document either directly or with the use of an electronic device;

(f) using dogs to assist in examining the goods.

The operation of x-ray equipment by Commonwealth organisations in Australia is regulated by the *Australian Radiation Protection and Nuclear Safety Agency* (ARPANSA), which issues operating licences for all x-ray equipment used by Federal Government agencies including the Australian Customs and Border Protection Service. The conditions of this licence outline requirements for use of equipment, training of operators and disposal of equipment.

1.1.4 Organisational structure

The Australian Customs and Border Protection Service splits the responsibility for technology usage and policy/administrative issues. The Technology and Enforcement Capability Branch (TEC Branch), Enforcement and Investigations Division, Border Enforcement Program is responsible for policy issues related to NII scanners, procurement, training, maintenance contracts and regulatory licensing. In addition TEC Branch evaluates emerging NII technology and participates in liaison with international and domestic NII scanner forums.

Regarding the operational use of NII scanners by the Australian Customs and Border Protection staff, it is the responsibility of the operational divisions. Passengers

Division, Cargo Division and Enforcement and Investigations Division are responsible for how the deployed NII scanners are utilised within their operational areas. These Divisions consist of the key user groups that use the NII scanners and whose inputs are incorporated into the user requirements for NII scanners.

1.2 Major Issues

1.2.1 Scope for implementing NII scanners (number, and location)

The total number of NII scanners deployed by the Australian Customs and Border Protection is outlined in the following table:

Table 1.1: Types of NII Scanners

Technology	Total
Mobile X-ray (X-ray only)	18
Cabinet X-ray (includes towable)	72
Pallet X-ray	5
Container X-ray	4

Container and pallet x-ray systems are deployed at Sea cargo Container Examination Facilities in Melbourne, Sydney, Brisbane and Fremantle with an additional pallet system in Port Adelaide. Mobile systems are usually used in air cargo environments across Australia and cabinet systems used at international airports, international mail centres and some freight providers.

1.2.2 Brief on procurement

Procurement of NII scanners by the Australian Customs and Border Protection Service is conducted in accordance with government requirements under the *Commonwealth Procurement Guidelines*. Procurement is usually as a result of a competitive open tender process, or from a procurement panel that is developed using a competitive open tender process. Procurement is managed internally by TEC Branch.

In establishing performance standards for NII scanners used by the Australian Customs and Border Protection Service, advice was sought from other Australian government agencies including the Australian Nuclear Science and Technology Organisation; the Department of Infrastructure and Transport; and the Defence Science and Technology Organisation. Advice was also sought from independent scientific advisers contracted by the Customs and Border Protection Service, and from other Customs administrations.

1.2.3 Fees/charges on using scanners

The Australian Customs and Border Protection Service purchases NII scanners under a capital funding process, which sets out the installment payments be made at the time of contract signing, delivery/installation and acceptance testing. A separate maintenance contract is in place with each x-ray supplier that covers preventative maintenance and fault response. The cost of maintenance is generally about 10% per annum of the capital cost of the machine.

Currently, the Australian Customs and Border Protection does not charge the importer for the scanning of cargo consignments selected. Instead, a proportion of the Australian Import Processing Charge (IPC) is used to partly meet the cost of inspecting and examining sea containers. The IPC is charged on every import sea cargo container to help offset the costs associated with the NII scanning of sea containers as well as other administrative costs associated with processing sea cargo. The IPC is currently AUD\$50 per declaration for electronically lodged declarations.

1.2.4 Human and financial resources

A team of five staff in TEC Branch conduct procurement of NII scanners, manage maintenance contracts, oversee training policy and certify NII trainers to deliver training. A larger group of operational staff are trained to deliver NII training and conduct assessments of staff.

1.2.5 Technology employed

a. Container systems

The Australian Customs and Border Protection Service uses four Nuctech container x-ray units. These units are being upgraded in 2010-11 with dual energy 3 and 6 MeV switchable linear accelerators. This enhancement is improving penetration and image quality. In 2012 the software will be upgraded with a high energy materials discrimination capability. This NII scanner provides the ability to scan a high volume of sea containers. The unit has been successful in identifying several narcotic seizures as well as revenue items such as tobacco. The 6MeV energy level penetrates most commodities sufficiently to produce an image that can be used to decide whether to release or further examine a sea cargo container. A disadvantage of this system is that it is used in fixed locations near to major ports, rather than being incorporated closer into the logistics chain.



Nuctech MB1215 Container X-ray

b. Pallet

The L3 CX450P-DV pallet x-ray is used to scan primarily sea cargo in Sydney, Melbourne, Brisbane, Fremantle and Adelaide. The machine is at the 450 KeV power level and provides a dual view image, with materials discrimination. Each

unit costs approximately AUD\$2,000,000. The size of the tunnel (2m by 2m) and energy level allow most deconsolidated sea cargo to be scanned. However, the system has limited penetration, particularly on the side view for denser materials.



L3 CX450P-DV pallet x-ray

c. Cabinet

A range of cabinet scanners are deployed consisting of machines with tunnel sizes of 60x40, 75x55 and 100x100cm. They are usually between 140 and 240 KeV in power. Some machines are single view while others are dual view. Some machines are in fixed locations while others can be manoeuvred around the location where they are deployed. These machines are located at international airports, mail centres and at warehouses. They cost AUD\$70,000 – \$180,000 per unit.



Example of a Smiths 100x100 Cabinet X-ray

d. Mobile

A fleet of custom-made mobile x-ray vans have been developed specifically for the Australian Customs and Border Protection Service. The latest generation of these vehicles features a Fiat chassis with a Smiths 85x85 tunnel x-ray. These vans are able to operate using a generator if mains power is not available. The van compartment can accommodate three staff and a variety of search equipment including trace and substance machines. Each van costs about AUD\$375,000.



Interior of the Mobile X-ray with conveyor deployed

1.2.6 How the cargo/container to be scanned is identified and selected

The Australian Customs and Border Protection Service uses a risk-based intelligence-led approach to identify cargoes to be scanned. This selection is conducted by the Intelligence and Targeting Division using analysis and profiling techniques. The number of cargo consignments to be inspected is set each year by the Australian Government. During 2010-11, the Australian Customs and Border Protection Service expects to inspect 101,500 sea cargo shipments (out of an expected 2.6 million shipments). It also expects to inspect 1.5 million air cargo consignments (out of an expected 12.2 million shipments).

1.2.7 Database of scanned images

Each NII scanner is capable of keeping a limited number of images. Images are kept from time to time for evidentiary, training or reporting purposes. A library with a variety of scanned images from different environments is set up and can be accessed via a training network. In 2011, the Australian Customs and Border Protection Service is deploying a local area network for access to the x-ray image training system. This system will be used as a tool to aid in the training of image analysts and for the ongoing assessment of x-ray users.

1.2.8 Training and integrity issues

All staff operating NII scanners shall attend the training in radiation safety. This course provides an introduction to x-ray theory and meets the ARPANSA radiation safety training requirements. Currently this course is delivered in a face-to-face manner but later in 2011 it will be replaced by an online learning module.

An image analysis course equip staff with the knowledge and skill to interpret images and use the imaging software to enhance images. This course currently is delivered via PowerPoint but is to be upgraded in 2011 with access to a new online image training database.

In addition to this training, staff are also trained in the operation of the specific type of machine that they are yet to be operated. This training includes start-up, shut-down and fault procedures; how to use the tools on the machine; how to position cargo to the beam to get the best image; and more advanced image analyst training on the specific machine.

The Australian Customs and Border Protection Service has commissioned or conducted a number of studies over the past few years looking at how the image analyst function can be improved. This has included looking at environmental factors that may have impacts on image analysis; the skills and cognitive requirements to be an effective image analyst; and reviewing the training delivery model.

1.2.9 Safety issues

The ARPANSA dictates the standards in the operation of x-ray equipment that must be adhered to by the Australian Customs and Border Protection Service under its operator licence conditions. All operators of x-ray equipment must be trained in radiation safety and in the use of the machine that they are using. Radiation surveys of the equipment need to be conducted on a regular basis and the equipment must display warning signs to alert to the radiation hazard. The ARPANSA regularly audits the safety procedures at the Australian Customs and Border Protection NII scanner sites to ensure that the requirements are met.

In line with the ARPANSA guidelines, staff in the Australian Customs and Border Protection Service are not to be exposed to radiation above 5 microsieverts per hour. All NII scanners used by the Australian Customs and Border Protection Service conform to this safety standard by not allowing radiation levels to exceed 5 microsieverts per hour in areas where staff would be exposed. This is achieved by shielding, the use of lead curtains or exclusion zones.

There have been no significant safety issues with the procedures currently in place for the Australian Customs and Border Protection's NII scanning equipment.

1.3 Benefits

1.3.1 Benefits to Customs

The use of NII scanners has provided the Australian Customs and Border Protection Service an effective and efficient tool to inspect a greater volume of items in a timely and cost-effective manner. This use of NII scanners has improved the revenue collection and detection of prohibited items, facilitating legitimate trade and interdicting smuggling activities.

1.3.2 Benefits to trade

NII scanners are integrated into the logistics chain in Australia and internationally.

With the use of NII scanners, less physical inspection on cargoes is necessary and therefore shortens the time for cargo clearance. Some of the Australian Customs and Border Protection's NII scanners are used by freight forwarders to screen export cargoes to meet international security screening requirements, providing an additional benefit to trade.

1.3.3 Benefits to government

The Australian Customs and Border Protection Service has reported to Government in its 2009-10 annual report that intervention in the inspection and examination of air and sea cargoes had been lessened by focusing on an intelligence-led and risk based deployment of resources. This was resulted from a continued reliance on NII scanners to efficiently screen baggage and cargoes. Despite this reduction in intervention, comparable detection rates were maintained. This has also helped the Australian Customs and Border Protection Service meet government expectations of providing protection to the community at the border.

Table 1.2: 2009-10 Annual Report Government Performance Targets

Deliverable	Target	Actual
(1) Sea cargo		
– number of TEUs inspected<	101 500	101 822
– number of TEUs examined<<	14 000	14 175
(2) Air cargo		
– number of consignments inspected<	1 500 000	1 492 762
– number of consignments examined<<	**	66 821
(3) Mail		
– number of parcels/express mail system/registered items inspected<	18 000 000	20 696 957
– number of letter class mail items inspected<	40 000 000	41 512 725
– number of mail items examined<<	**	202 858

< Inspection may include the use of X-ray technology, detector dogs or physical examination.

<< Examination means physically opened by Customs and Border Protection.

1. 4. Challenges and Way Forward

1. 4.1 Main challenges/problems

One external challenge is getting NII scanners that meet the requirements of Customs administrations rather than the air security industry. The Australian Customs and Border Protection NII scanner users are after the best possible quality image and resolution. There is a need to be able to look for complex concealments, interpret the differences between organic and inorganic materials as well as be able to identify the commodity. Unfortunately some NII scanner vendors struggle to meet this varied requirements concentrating on the needs of the air security industry.

One internal challenge is trying to improve the cognitive abilities of image analysts to interpret NII scanner images and make correct decisions. This has resulted from improvements on training delivered to staff and the introduction of image library software.

1. 4.2 Lessons for other regional members

The Australian Customs and Border Protection Service believes that the most important consideration in using NII scanners (particularly larger container and pallet systems) is to focus on having good quality intelligence and targeting arrangements in place, to ensure that the highest risk items are the ones that are selected for NII scanning.

No significant problems have been identified by the Australian Customs and Border Protection Service for further action.

1.4.3 Future plans for improvement

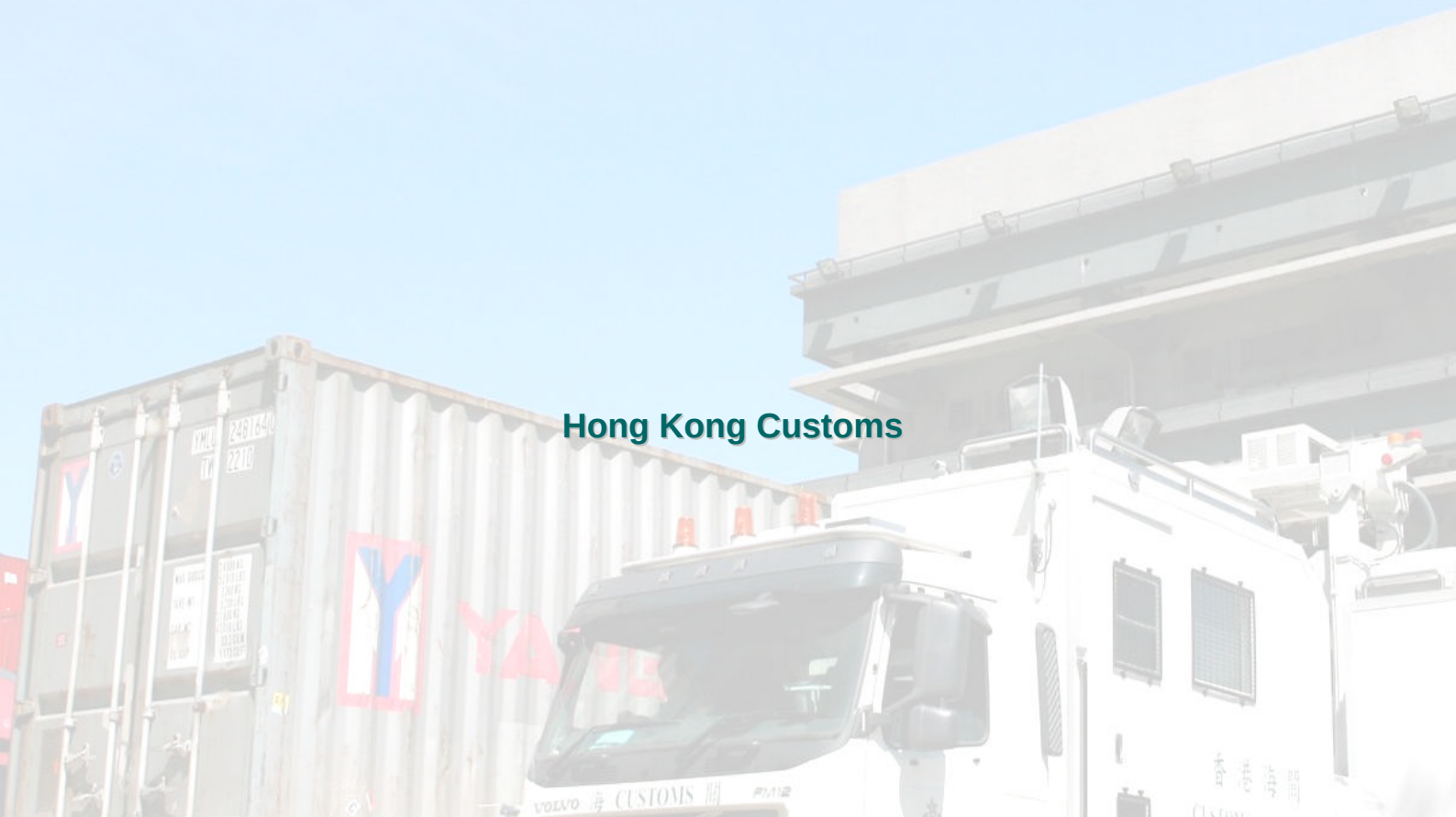
Given the current tight financial resources, the Australian Customs and Border Protection Service is focusing on upgrading or replacing existing NII scanner capability, rather than introducing new or expanded systems. There are, however, areas where future work to improve the use of NII scanners is being considered. This work includes:

- deploying internal body scanners at airports;
- developing a container x-ray test piece to assess the performance of container x-ray systems;
- improving the image analyst training given to staff;
- introducing a quality assurance regime regarding use of NII scanners; and
- introducing materials discrimination software for container x-ray systems.



Procurement and Management of Non-Intrusive Inspection Scanners for Containers in Hong Kong

Hong Kong Customs



2.1 Executive summary

This report discusses the use of Non-Intrusive Inspection (NII) scanners for customs clearance of containerized cargoes and vehicles in Hong Kong and the management process, which includes procurement, maintenance and training. The purpose is to share Hong Kong's experience and enable other Customs administrations in building up or enhancing their capability on the application of the equipment to cope with the challenges in the 21st century.

As an international transport, supply chain and logistics hub, Hong Kong handled over 23 million TEUs¹ in its container port, processed some 15.7 million vehicles and 240 million passengers passing through its entry/exit points in 2010. Manual mode of Customs clearance alone was not sufficiently efficient and effective in stopping illicit goods/contraband from entering/leaving the territory under such voluminous traffic. With the NII scanners, Customs officers are able to perform thorough and speedy examinations of vehicles and containerized cargoes, without having to resort to the costly, time consuming process of unloading cargo for manual searches, or intrusive examinations.

International trade is an essential driver for economic prosperity. Customs administrations are obliged to increase its contribution to the economic well-being of countries by expediting the clearance and release of goods. Hong Kong Customs has been using NII scanners for cargo and vehicle inspection since 2001 and finds the equipment enhance efficiency and effectiveness of inspection. At present, Hong Kong Customs are deploying totally ten NII scanners with X-ray technology at various entry/exit points in the territory to compliment the clearance service. The extensive application of NII scanners has helped safeguard cargo security and facilitate legitimate trade.

The application of NII scanners involves huge capital outlay of procurement and maintenance. To effectively manage the procurement, maintenance and training of the equipment, Hong Kong Customs adopts an integrative approach to conduct strategic and holistic management. We have established a Three-tier Management System to formulate, implement, monitor and evaluate the procurement, training and maintenance of inspection equipment.

Electrical and Mechanical Services Department (EMSD), which is a dedicated technical department of Hong Kong Government, will assist Hong Kong Customs in the procurement and maintenance of NII scanners. The EMSD will deliver professional consultancy services such as market research, tendering, contract management, testing and commissioning and acceptance inspection.

Hong Kong Customs has been actively engaged in overseas exhibitions/forums/meetings/workshops on NII scanners and is committed to providing efficient clearance services. With our dedicated efforts in the past decade, Hong Kong

¹ TEU refers to twenty-foot equivalent unit, i.e. the volume of a 20-foot long shipping container. The unit is used to define the capacity in container transportation.

Customs has fostered and will continue to maintain strategic partnership with vendors and counterparts to research advanced equipment and benchmark best practices for enhancing cargo security while facilitating international movement of goods.

2.2 Background

With the rapid development of economic globalization and regional economic integration, the scale, volume and efficiency of international trade have been on the rise in the past few decades. There is increasingly strong demand for higher efficiency of logistics industry. Trade facilitation has become a major agenda amid growing concern on cargo security in face of the terrorist threat. Being government organizations responsible for controlling and administering international movement of goods, Customs administrations are expected to provide efficient customs clearance services to facilitate the development of global trade and safeguard the international supply chain security.

In 2005, the World Customs Organization (WCO) adopted the SAFE Framework of Standards (SAFE Framework) which sets out 4 core elements and 17 standards to enhance security of international trade and improve ability of customs authorities in detecting high-risk consignments for inspection. One of the key standards is the application of NII equipment to examine high-risk containers or cargo speedily, without disrupting the legitimate trade.

Hong Kong Customs has been one of the forerunners in the application of NII scanners to refine the traditional clearance mode in container and vehicle inspection since 2001. In the past decade, the application of NII scanners did not only increase the efficiency and effectiveness of customs inspection, but also benefited the trade (especially the logistics industry) by enhancing their competitive edge on providing efficient delivery service. The benefits brought about by the NII scanners further authenticated their wide application in Customs inspection. Today, the NII scanner has become an essential equipment to reinforce Customs operation in the seaport and land border control points of Hong Kong.

2.3 Overview of the Application of NII Scanners in Hong Kong

2.3.1 Major drivers for application of NII scanners

Strategically located at the doorway of the Mainland China, Hong Kong has long been serving as an important logistics hub for international trade that bridges the time gap between Asia and Europe. Entering the 1990s, the volume and scale of import and export trade expanded significantly and Hong Kong Customs was confronted with the

consequential drastic increase in vehicle and cargo inspections.

While goods are shipped across land and sea borders of Hong Kong every day, there was a pressing need for Hong Kong Customs to adjust its strategy to adapt to the ever-changing external environment. In 1997, Hong Kong Customs proactively drew up a modernization programme listing out a series of initiatives such as the introduction of human resources management practice, comprehensive use of information technology, adoption of risk assessment system, establishment of central intelligence system, application of advanced technology, and so forth to equip the administration with all necessary skills and technology to meet the inherent challenges.

Manual mode of examination alone was not sufficiently efficient and effective in detecting contraband from voluminous vehicles and containers, not to mention the sophisticated and diversified methods in concealing the smuggled goods. After a long process of technology and market research, Hong Kong Customs acknowledged the benefits of NII scanners in clearance of containerized cargoes and introduced the first two NII scanners in 2001. In view of the growth in cross border traffic, the two advanced equipment were deployed to the land border control points between Hong Kong and the Mainland China to enhance work efficiency and enforcement capabilities.

The fast-changing global environment in the 21st century triggers greater demand for international supply chain security and logistics efficiency. Hong Kong Customs bears a stronger than ever obligation in countering terrorism and safeguarding Hong Kong's status as a logistics hub in the Pan-Pearl River Delta Region². Application of advanced NII scanners becomes more instrumental in safeguarding cargo security and facilitating movement of commercial goods. At present, a total of ten NII scanners are being deployed at various entry/exit points of Hong Kong to complement customs clearance operation. Four of the scanners are Fixed X-ray Inspection Systems while the other six are Mobile X-ray Vehicle Scanning Systems.

2.3.2 Types and technology of NII scanners

Fixed type and mobile type of NII scanners have their own distinctive functions and characteristics. Neither one has absolute advantage over the other. The NII scanners in Hong Kong employ two different scanning technologies, namely transmission technology and backscatter technology. Transmission technology can project images of objects loaded inside containers/vehicles through beaming X-ray to them. The backscatter technology will collect X-ray reflected from the objects under scanning and highlighted the images of organic items (such as drugs, explosives and plastic weapons) in eye-catching colour for easy identification. Optional radiation threat detection system can be integrated into the X-ray system to detect both gamma ray and neutron radiation, which is

² In 2010, Hong Kong is the world's third busiest container port and the sea container throughput reached 23.6 million TEUs which is more than 4 folds as compared with that in 1990. The annual vehicular throughput was 15 737 274 for land border crossings, which has been raised by 5.8% as compared with 2009. Detailed breakdown is at [Annex I](#).

capable of indicating the presence of a potential dirty bomb or fissionable materials inside the scanned vehicles.

The major features of the two types of NII scanners are summarized below:

Table 2.1: Comparison of Mobile and Fixed X-ray Scanners

Mobile X-ray Vehicle Scanning System	Fixed X-ray Inspection System
• X-ray scanner installed in a large truck fixed with a stretchable robotic arm swing out sideways from the truck • Scanning is conducted within a designated operating zone • High mobility • Relatively lower energy and penetration power • Mobility inevitably undermines system stability	• X-ray scanner installed in a fixed purpose-built building with walls up to two meters or even thicker and safety doors of 40 tonnes • Scanning is conducted within the building • Zero mobility • Relatively high energy and penetration power • Involve land acquisition for setting up the whole system

Both Mobile X-ray Vehicle Scanning System and Fixed X-ray Inspection System currently used by Hong Kong Customs have successfully helped detect many smuggling cases. Hereunder are some photos on the operation of the equipment and scanned images.



A Mobile X-ray Vehicle Scanning System scanned a container truck at Kwai Chung Customhouse, Hong Kong



X-ray scanning on a container truck by the Fixed X-ray Vehicle Inspection System at Lok Ma Chau Land Border Control Point, Hong Kong



Bottles of liquor mixed with general cargoes are revealed by a backscatter X-ray scan



Cartons of cigarette concealed in a false compartment of a container truck are revealed by a transmission X-ray scan

The ten NII scanners currently used by Hong Kong Customs are deployed to the land border control points and container port with distribution as below:

Table 2.2: Deployment of NII Scanners in Hong Kong

Location ³ (Commencement of Service)	No. of System	Technology Employed
Mobile X-ray Vehicle Scanning System		
Man Kam To Control Point* (Year 2001)	1	Dual Technologies of Transmission X-ray cum Backscatter X-ray
Sha Tau Kok Control Point* (Year 2001)	1	Dual Technologies of Transmission X-ray cum Backscatter X-ray
Kwai Tsing Container Terminals# (Year 2004)	2	Transmission X-ray
Shenzhen Bay Control Point* (Year 2007)	2	Transmission X-ray
Fixed X-ray Vehicle Inspection System		
Lo Ma Chau Control Point* (Year 2003)	2	Transmission X-ray
Shenzhen Bay Control Point* (Year 2007)	2	Transmission X-ray
Total :	10	

³ *denotes the vehicular land border control points between the Mainland China and the Hong Kong Special Administrative Region.

#denotes the sea cargo terminals located at Kwai Chung and Tsing Yi in Hong Kong.

2.3.3 Safety issues

The NII scanners used by Hong Kong Customs are X-ray based and its safe operation is of paramount importance to system operators and the public. In the case of Hong Kong Customs, only trained officers are allowed to operate the equipment for the sake of safety and security. We adopt stringent safety measures as follows:

- full compliance with the statutory requirements of Hong Kong Laws as well as the World Health Organization's safety standard in governing the X-ray emission;
- radiation safety sensor is installed in the system so that the system will automatically shut down in case unusual X-ray radiation is detected;
- personal radiation dosimeters are worn by system operators during operation for measurement of radiation dosage they have been exposed to;
- regular medical check-up is arranged for system operators to track their health condition; and
- provision of regular training and operational manual to staff on safe operation of NII scanners.

2.3.4 Workflow of NII inspection

The WCO's SAFE Framework encourages the use of NII scanners as a component of risk-based processing system. However, pivotal to its success is the ability of Customs to target high-risk vehicles and containers for NII inspection. In the case of Hong Kong Customs, the adoption of NII scanners is fully integrated with the risk management system and intelligence mechanism. Customs risk analysts primarily analyze cargo manifest against established risk indicators for risk assessment. Hong Kong Customs maintains a centralized intelligence database, namely Customs and Excise Intelligence System which timely disseminates and archives the details of significant cases detected in the Department and intelligence received from local or overseas law enforcement agencies.

The intelligence is categorized into five program areas namely, (i) control and enforcement, (ii) anti-narcotics investigation, (iii) intellectual property right and consumer protection, (iv) revenue protection and collection and (v) trade controls. With the information on the latest smuggling trend and modus operandi, cargo selectors can screen high-risk cargo consignments and determine the type of examination required. The effective application of risk assessment with compliment of the intelligence system greatly assist Hong Kong Customs in conducting risk profiling to select goods and vehicles for inspection.

Customs officers in Hong Kong are vested with power under the Import and Export Ordinance, Cap. 60, Laws of Hong Kong to stop, board and search any vessel, aircraft or

vehicle and examine the cargo on board when they are entering or leaving the territory. Nevertheless, traders are not required to pay any fee regarding X-ray scanning or other forms of cargo examination.

Hong Kong Customs promotes the use of automated system in the submission of electronic advance cargo information⁴ for Customs clearance. With advance cargo information, Customs cargo selectors can have more time to conduct risk assessment before the cargoes reach the entry/exit points and decide what action to be taken. While the majority of vehicles and cargoes can enjoy seamless customs clearance, vehicles selected for X-ray scanning will be directed to a designated compound for inspection. If suspicious images are detected during a NII scanning, Customs officers will conduct intensive examination. A detailed workflow of the selection of cargoes for NII scanning at entry/exit points is at [Annex II](#).

NII scanners can significantly reduce the time taken in an inspection and save manpower. Below is a comparison on NII scanning and manual mode of examination for a fully loaded 45-foot container in Hong Kong:

Table 2.3: Inspection efficiency: comparison between NII scanning and manual mode of examination

	NII Scanning	Manual Open Examination
Processing time	Less than 30 minutes ⁵	More than 2-3 hours
Manpower requirement	3 Customs officers	3 Customs officers and 4 labour workers

2.3.5 Enforcement effectiveness

According to the enforcement experience of Hong Kong Customs, NII scanners are effective tools in detecting contraband/undeclared cargo hidden inside concealed compartments in vehicles/containers and those mingled with other general cargoes with different material density. Common illicit goods seized in Hong Kong include narcotics, dutiable cigarettes, electronic and computer parts and high-valued metal, e.g. silver and nickel.

In 2010, there were 75 smuggling cases detected with the aid of the Mobile X-ray Vehicle Scanning System and Fixed X-ray Inspection System, in which 34 persons were arrested

⁴ Advance cargo information include air cargo information under Air Cargo Clearance System (ACCS), land cargo information under Road Cargo System (ROCARS) and sea cargo information under Electronic System for Cargo Manifests (EMAN) of which Hong Kong Customs is the systems' owner.

⁵ Processing time of NII scanning includes time required for safety check before a scan, X-ray scanning and image interpretation.

with the seized goods valued over HK\$70,000,000 (EURO €6,125,000). The seized goods included cigarettes, computer accessories, digital cameras, mobile phones and parts.

2.4 Strategic Management of Inspection Equipment

As a pilot run, the use of NII scanners in Hong Kong in 2001 was confined to two land border control points. Performance reviews on the equipment were narrowly conducted by a handful of operators in the two control points. When the use of NII scanners has been gradually extended to other control points and sea ports in Hong Kong, the aforesaid de-centralized management approach started posing more and more operational problems such as lack of central steer and monitoring on the management of the equipment, non-standardized user requirement, redundant resources on market research, long procurement process and prolonged equipment down time, etc.

To enable us to move towards a knowledge based and customer oriented model, Hong Kong Customs adopted an integrative approach to conduct strategic and holistic management on NII scanners in 2009. A Three-tier Departmental Management System was established to formulate, implement, monitor and evaluate the strategies of inspection equipment, including NII scanners for container.

2.4.1 Three-tier Departmental Management System

Tier One - Project Development Steering Group

Chaired by the Deputy Commissioner with all Assistant Commissioners as members to give policy steer on the long-term development and strategic management of inspection equipment of Hong Kong Customs.

Tier Two - Inspection Equipment Work Group

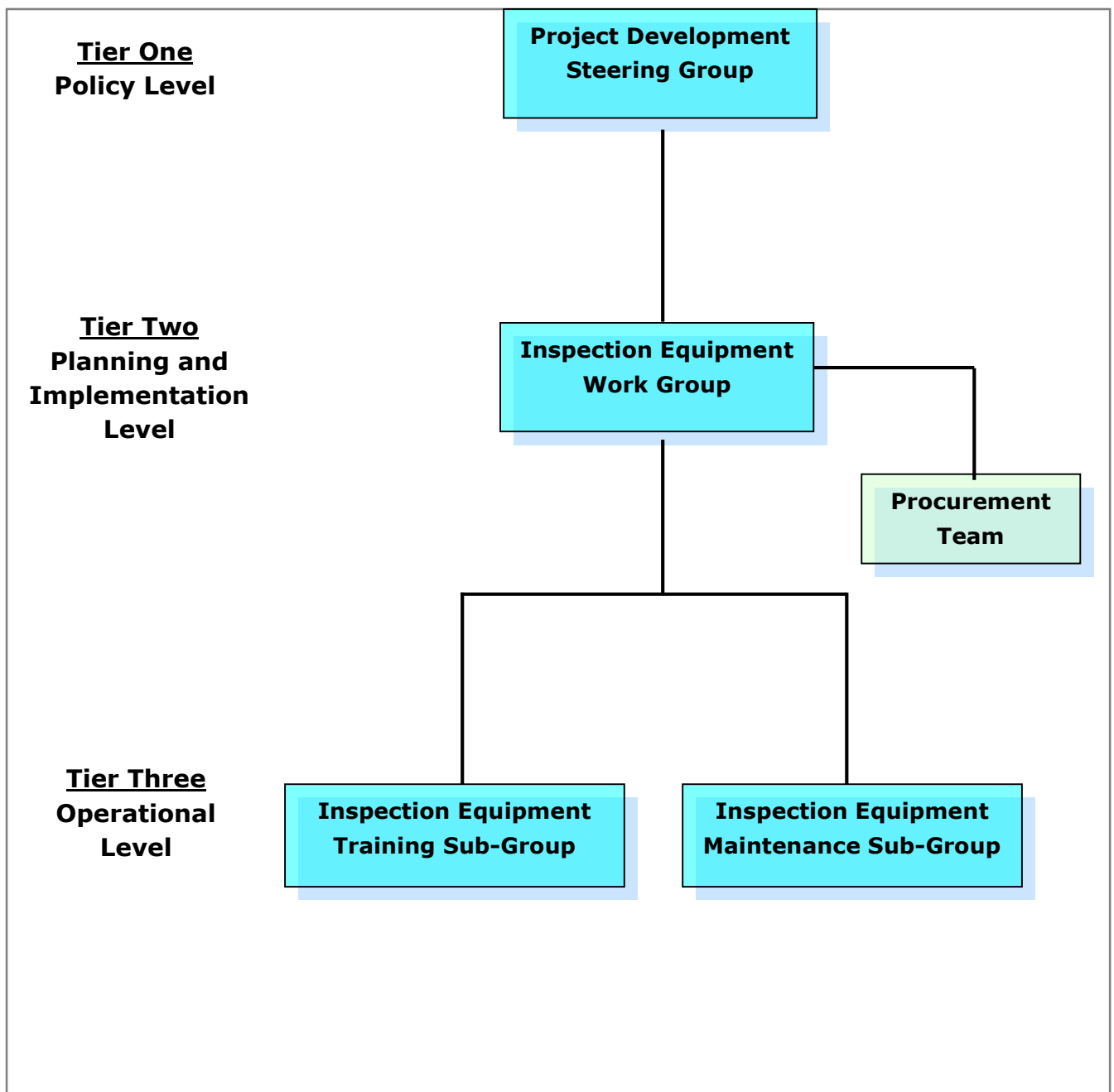
Chaired by the Head of Office of Project Planning and Development (A Senior Superintendent) with deputy heads (Superintendents) of user formations from airport, seaports, land border control points and training wing as members, the Work Group is tasked to formulate plans and implement policies on the development, procurement, training, maintenance and replacement exercise of inspection equipment.

A dedicated Procurement Team comprising 3 middle-managers (One Assistant Superintendent and two Senior Inspectors) is formed to assist the Work Group to centralize the research, procurement, management and review of inspection equipment including NII scanners.

Tier Three - Inspection Equipment Training Sub-Group and Inspection Equipment Maintenance Sub-Group

Two sub-groups are set up respectively to enhance staff expertise in equipment operation and to improve maintenance and support services for frontline users to ensure operational continuity.

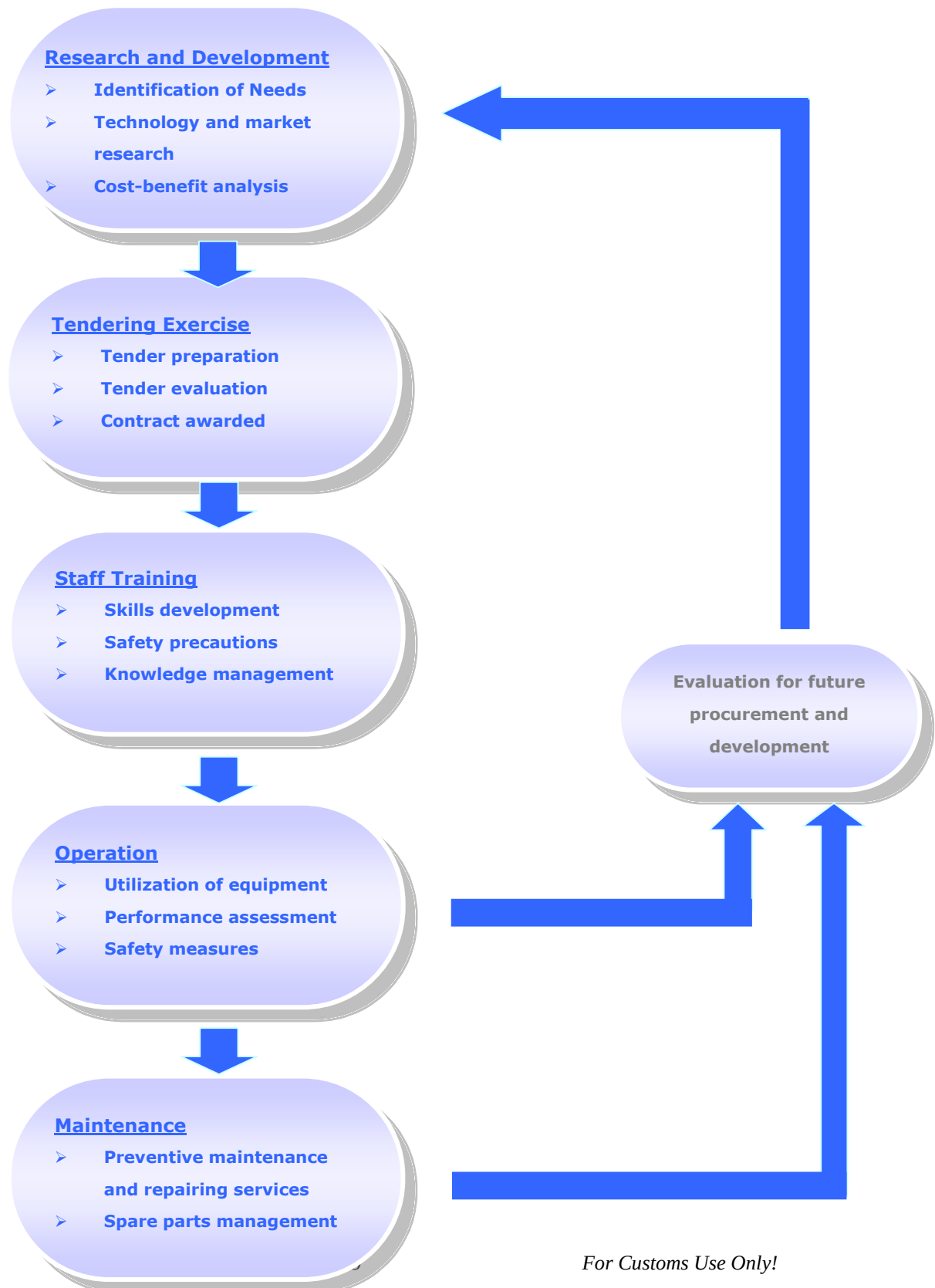
Figure 1: Three-tier Departmental Management System



2.4.2 Integrative approach on NII scanner management

Under the Three-tier Management system, Hong Kong Customs follows the process below in the procurement and management of NII scanners:

Figure 2: Integrative Approach on NII Scanner Management



2.4.3 Research and development

The Inspection Equipment Work Group meets quarterly to review and identify evolving needs of each entry/exit point. The Work Group will arrange to conduct comprehensive and in-depth technology and market research to help Hong Kong Customs identify appropriate and effective equipment to cope with the changing environment. A full cost-benefit analysis is conducted to determine whether procurement of NII scanners is justified and cost-effective.

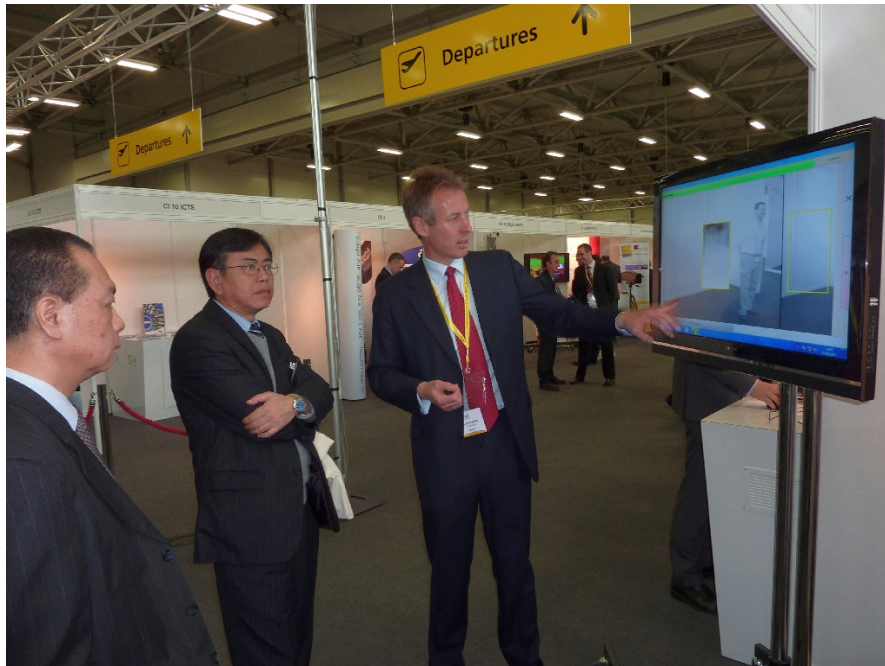
Overseen by the Inspection Equipment Work Group, the Procurement Team conducts worldwide technology and market research via the following means to keep abreast of the latest technology:

- **WCO Databank on Advanced Technology**, which provides detailed and updated technology information on advanced inspection equipment for Customs administrations;
- **Overseas Enforcement Equipment Exhibitions**, such as the WCO Technology and Innovation Forum, Global Security Asia Exhibition and Home Office Scientific Development Branch Exhibition, which demonstrate new and emerging technologies for customs inspection in order to advocate efficient use of advanced technology at border;
- **Benchmarking with Overseas Counterparts** facilitates Customs administrations to exchange best practices as well as operational difficulties in the application of advanced technology and innovations; and
- **Equipment demonstrations by suppliers** showcase the latest inspection technologies and equipment that are readily available to suit Customs needs.

As Hong Kong Customs has limited expertise on the technical specifications of the NII scanners and the detailed procurement procedures on complicated systems, external professional bodies such as the Electrical and Mechanical Services Department (EMSD) and the Government Logistics Department (GLD)⁶ are engaged in the procurement process. They will offer technical assistance and expert advice on the new technology available in the market, safety concerns including radiation hazards and occupational health risks as well as fulfillment of international procurement requirements.

⁶ The Electrical and Mechanical Services Department (EMSD) and the Government Logistics Department (GLD) are government departments of the Hong Kong Special Administrative Region (HKSAR). EMSD provides full project management and consultancy services to government departments on the design of electrical, mechanical and electronic systems, preparation of tender specifications, tender evaluation, contract management, site supervision, testing and commissioning of systems. GLD is pledged to provide cost effective and timely logistics support in the area of procurement and supplies.

Hong Kong Customs attaches great importance on devising long-term development plan on the application of inspection equipment to enhance enforcement capability while facilitating trade. We have actively engaged in overseas exhibitions/forums/meetings on the application of NII scanners, and established strategic partnership with vendors and overseas counterparts for researching advanced equipment and benchmarking the best practices. Hereunder are some episodes :



Senior officers (Assistant Commissioner Mr Yu Koon-hing (centre) and Chief Superintendent Mr Liu Cheung-shing (left)) of Hong Kong Customs visited Home Office Scientific Development Branch Exhibition in the United Kingdom in March 2011



Representative of the Emerging Technologies Team of the UK Border Agency delivered seminars on advanced technologies for Customs inspection in Hong Kong in September 2010



Facilitators and participants from 25 member administrations of WCO Regional Workshop on X-ray Scanner Image Analysis in Hong Kong in December 2009

To ensure that the procurement of high value equipment is fully justified, Hong Kong Customs conducts cost-benefit analysis with reference to the following factors:

Cost

- Non-recurrent cost - one-off cost for equipment, X-ray building and associated builder's works, delivery, installation and consultancy fee for engineering experts; and
- Recurrent cost - regular preventative and corrective maintenance cost, fuel and electricity cost, labour cost, operating cost for the X-ray building.

Benefits

- Increased operational efficiency at borders and seaports;
- Enhancement of contraband detection capability;
- Reduction of revenue loss due to smuggling of dutiable goods;
- Anticipated manpower and cost saving; and
- Improvement on supply chain security.

2.4.4 Funding for procurement of NII equipment

Under the Basic Law of the Hong Kong Special Administrative Region (HKSAR) of the People's Republic of China, Hong Kong is vested with legislative power. The Legislative Council is the legislature of HKSAR whose main functions are to enact laws, examine and approve budgets, taxation and public expenditure; and monitor the work of the Government.

The Finance Committee of the Legislative Council will scrutinize public expenditure proposals put forward by the Government before approval. Given the huge capital outlay on the procurement and maintenance of NII scanners, Hong Kong Customs has to seek funding approval from Legislative Council for procurement and replacement of any single equipment exceeding a threshold of HK\$10 million (EURO €875,000).

The Project Development Steering Group of the Department will examine the submissions from user formations for procurement/ replacement of inspection equipment (including NII scanners), as well as the analysis and recommendations made by the Inspection Equipment Work Group before endorsement. Endorsed items are then submitted for support of the concerned policy bureaux⁷ of the Hong Kong Government and funding approval by the Legislative Council if required.

2.4.5 Tendering

A fundamental principle on the procurement policy of Hong Kong Government is to obtain goods and services at the best value for money. Equal opportunities should be given to local and overseas suppliers to participate or competing in government procurement. Hong Kong is a signatory to the World Trade Organization Agreement on Government Procurement and global tendering exercise is required for purchase of goods and related services at a value over HK\$1.4 million (EURO €122,500). The whole tendering process is undergone through open, fair, competitive and transparent procedures.

For procurement of NII scanners, Hong Kong Customs employs EMSD as project consultant to provide technical and professional advice on the preparation of tender specifications, tender evaluation, testing and commissioning of the equipment. GLD, being a designated government department for procurement of stores and equipment for the Hong Kong Government, provides expert advice and oversees the whole tendering process. The Procurement Team of Hong Kong Customs will work closely with these two departments to monitor the tendering process to ensure the NII scanners are timely procured, delivered and commissioned. The progress shall be reported to the Inspection Equipment Work Group during the quarterly meeting. Detailed division of work among different government departments in the procurement of NII scanners is depicted below:

⁷ The policy bureaux overseeing the work portfolio and expenditure of Hong Kong Customs are Security Bureau, Commerce and Economic Development Bureau, and Financial Services and the Treasury Bureau.

Table 2.4: Division of work among government departments in procuring NII scanners

Government Department	Responsibilities
Hong Kong Customs	➤ Consult frontline users to identify advantages and shortcomings of scanners in use ➤ Identify geographical and physical constraints for NII scanner operation ➤ Consolidate operational requirements ➤ Provide information on staff training needs and maintenance matters ➤ Initial market research and benchmarking
Electrical & Mechanical Services Department	➤ Provide technical solutions to meet operational requirements ➤ Draw up technical specifications, such as image quality, X-ray penetration, resolution, scan speed, radiation standards, health and safety requirements, etc. ➤ Conduct technical vetting during tender evaluation ➤ Provide technical recommendations to Government Logistics Department ➤ Testing and commissioning upon delivery ➤ Monitor contractor's performance during defects liability period
Government Department Logistics	➤ Examine tender documents prepared by Electrical & Mechanical Services Department ➤ Draw up commercial terms and conditions of tender ➤ Issue tender invitation ➤ Evaluate tender submissions to select successful tenderer ➤ Award contract

2.4.6 Staff training

Skill Development

The principle of operation and application of NII scanners in cargo and vehicle inspection are included as a part of induction training for all new recruits of Hong Kong Customs. On the job training will be provided to every officer for skill development when he/she is posted to the NII Scanning Team of different work places e.g. airport, seaport or land border control points. The scope of training covers a wide spectrum, including operating knowledge, image interpretation and safety precautions. Only trained Customs officers are authorized to operate NII scanners.

Training courses for operators, maintenance team and trainers to be provided by the system supplier are included in the terms of tendering document as mandatory requirement. The Inspection Equipment Training Sub-Group is established to gather inputs from the training specialists on inspection equipment, including NII scanners and oversee the training strategy. The Training Sub-Group is tasked to monitor the training progress and review the training requirements regularly. The development of training for frontline officers is closely monitored by the Inspection Equipment Training Sub-Group to ensure the training packages/programmes meet the needs of frontline operation.

Knowledge Management

To enhance the detection capability of image interpreters of NII scanners, Hong Kong Customs established an X-ray Image Databank for Borders and Ports in 2010. The databank consolidates and categorizes X-ray images of significant cases effected at all entry/exit points of Hong Kong for easy retrieval and reference by frontline X-ray interpreters. Case photos with new modus operandi shared by overseas counterparts are also attached as reference to heighten the awareness of frontline staff. The X-ray image databank does not only establish a platform for frontline officers to share their experience and detection efficacy on NII scanning, but also provides useful training materials for beginners in using NII scanning. Some sample images in the databank are at [Annex III](#) for easy reference.

On the hardware side, Hong Kong Customs maintains an Enforcement Equipment Databank to consolidate the inspection equipment that is applicable to frontline operation. The central database provides comprehensive and updated information to frontline officers for identification of appropriate equipment for future procurement.

2.4.7 Operation

Performance Assessment

NII scanners can help facilitate Customs inspection if they are properly deployed and

utilized. In order to ascertain whether the NII scanners are utilized efficiently and effectively, users are required to submit a Quarterly Return comprising the following information of NII scanners to the Inspection Equipment Work Group for assessment:

- utilization rate;
- enforcement effectiveness, in terms of the number of smuggling cases detected, types, quantity and value of seizures;
- breakdown record;
- repair time needed; and
- rating on overall performance of the equipment.

The performance assessment provides standardized, reliable and objective information for the Work Group to identify areas of improvement. For instance, frequent breakdown records may indicate underperformance of certain models of NII scanners. Such information will help Hong Kong Customs evaluate the operational efficiency of the existing scanners and serve as reference material in the prospective procurement exercises. With the timely assessment, the Project Development Steering Group will be able to identify areas for improvement and direct the Inspection Equipment Work Group, as well as two Sub-Groups to take follow-up actions.

2.4.8 Maintenance

Regular preventative maintenance and corrective repair services are crucial to the uninterrupted operations of NII scanners. Being the government agent and consultant in mechanical and electrical services, EMSD possesses sound technical knowledge and expertise on maintenance works of the NII scanners. Hong Kong Customs has been employing the department as the maintenance agent of NII scanners by entering a Service Level Agreement (SLA). The SLA clearly defines the level of services and performance pledges, such as the service availability, response time to fault call and fault rectification time. EMSD is obliged to achieve the specified performance target in the SLA.

To standardize and enhance the maintenance/support services of inspection equipment, the Inspection Equipment Maintenance Sub-Group will examine the Quarterly Return submitted by users to identify scanners with maintenance problems, e.g. prolonged down time for case study. The Sub-Group will report the findings to the Inspection Equipment Work Group and make recommendations for improvement.

As the delivery of most spare parts of NII scanners from overseas suppliers will usually take more than two months, the maintenance agent shall keep sufficient stock of spare

parts, such as X-ray generation tubes, X-ray detector modules and hydraulic system parts, etc. to ensure timely replacement. This requirement has to be clearly stated on the tender document during procurement stage.

2.4.9 Evaluation and monitoring mechanism

The three-tier Departmental Management System establishes a holistic approach for Hong Kong Customs in the use of NII scanners. The Quarterly Return from users provides valuable information regarding utilization and performance of NII scanners and builds up feedback learning loops that allow the Inspection Equipment Work Group and the respective Sub-Groups to take remedial actions to improve the performance of equipment in every aspect. The Project Development Steering Group will examine the recommendations made by the Work Group members and give policy steer on the departmental strategy for procurement, replacement and management of NII scanners.

2.5 Benefits in Using NII Scanners

The use of NII scanners has rendered huge benefits from the perspectives of supply chain security, Customs enforcement and trade facilitation. These benefits are well received by Customs administrations, traders and the society.

2.5.1 Benefits for Customs Administration

- **Improve inspection efficiency**

Using NII scanners for container scanning significantly shortens inspection time, from two to three hours to less than 30 minutes. Enhanced operational efficiency enables Customs administrations to select more high-risk containers for X-ray scanning while ensuring a rapid movement of goods at entry/exit points. Physical inspection involving long process and additional manpower is only required if anomalies are detected.

- **Enhance enforcement capability**

NII scanners are proven to be effective in detecting contraband, in particular those hidden inside concealed compartments of vehicles/containers and mixed with other general cargo with different densities. Clear X-ray images with highlight of organic substances (such as illicit drugs, explosives and plastic weapons) in eye-catching colour help frontline officers identify concealed contraband or unmanifested cargo easily, therefore enhancing detection capability.

➤ Save manpower

Physical inspection of a full-loaded 45-foot container normally takes two to three hours with the engagement of three Customs officers and four labour workers. For NII scanners, only three Customs officers are required and the inspection can be completed within 30 minutes.

➤ Reduce revenue loss

NII scanner is an effective tool to detect smuggling of dutiable commodities⁸ in bulk quantity, which help safeguard revenue of the Hong Kong Government.

2.5.2 Benefits for traders

➤ Reduce operating cost

The use of NII scanners significantly shortens the Customs inspection time at entry/exit points and hence benefits the traders, especially those in logistics industry by reducing their operating cost and enhancing their competitive edge on providing speedy delivery service to their customers.

➤ Enhance cargo security

Not only Customs administrations but also traders and their overseas trading partners have grave concern on supply chain security. The use of NII scanners can help safeguard cargo security without impeding the free movement of bona fide cargoes.

2.5.3 Benefits for society

➤ Reduce risk of terrorism

NII scanners can help detect weapons of mass destruction and explosives, and hence protect the society from terrorism and maintain the integrity of internal security.

➤ Assure social order

NII scanners can detect organic substances such as narcotics and precursor chemicals. Obviation of drug trafficking will help safeguard the local community by suppressing the drug supply and associated crimes.

⁸ Hong Kong is a free port and there are only four types of dutiable commodities which are liquor, tobacco, hydrocarbon oil and methyl alcohol.

2.6 Challenges

NII scanners for container/vehicle inspection are made-to-order equipment and the procurement exercise includes market research, tendering, production, assembly, inspection and delivery. The whole process may take more than two years in the case of Hong Kong. In order to ensure timely procurement and replacement, Customs administrations are recommended to form dedicated office to centralize the management of inspection equipment for establishing and retaining of knowledge and expertise.

The technology of NII scanner is ever-changing and manufacturers will keep on refining and modifying their products to meet the customer's needs. The long procurement process will inevitably hinder Customs administrations to acquire the latest technology from the market. In this regard, regular and comprehensive technology research, in particular on emerging technology is indispensable for effective procurement.

Application of NII scanner involves huge capital investment on equipment and maintenance which imposes significant financial burden to Customs administrations, in particular those countries with scattered entry/exit points. Support from the policy and financial bureaus of the government is essential for sustainable development in procurement and subsequent replacement of the equipment.

NII scanner is proved to be an efficient and effective equipment in container/vehicle inspection but Customs administrations should be fully aware of its inherent and operational constraints, including limitation on penetration power and incapability to detect counterfeit goods. Customs administrations still have to resort to other means of inspection, such as open examination and sniffing by Customs detector dog, etc. to supplement the inadequacy. Site constraint is also another concern that needs to be well considered and meticulously planned before procurement.

Unlike radiation detectors and e-seal security devices, NII scanner is not featured with automatic alert system. That said, its efficacy is closely tied to the competency of image interpretation of NII scanner operators. While NII scanners are capable of generating high quality X-ray images, the operators should possess ample knowledge in identifying irregularities on the images so as to detect the contraband. In this regard, continuous training plan and knowledge management such as image databank have to be drawn up for the successful implementation of the equipment.

2.7 Way Forward

Entering the 21st Century, Customs administrations are facing with immense challenges derived from the fast changing landscape in global trade. Clearance service aside, Customs today is obliged to strengthen our value proposition to support the global

logistics development, facilitate international trade and enhance safety and security at the border. The use of NII scanners will improve Customs ability to detect high-risk consignments and enhance the overall efficiencies in the administration of goods.

In 2008, WCO introduced ten building blocks under the New Strategic Direction for Customs in the 21st Century. WCO encourages the Customs administrations to take advantage of new and emerging technologies to enhance, amongst others, intelligence processing, risk management, and non-intrusive detection. Extensive application of NII scanners in Customs inspection is an indispensable trend for Customs administrations. In the case of Hong Kong Customs, we have not only applied NII scanners in the existing work areas, but also categorized them as standard operational equipment in the resource planning for new infrastructural projects such as the expansion of Hong Kong International Airport and construction of new land border control points.

Although NII scanners have been used in daily operation for a decade, Hong Kong Customs remains committed to explore and take forward measures to further enhance its capability and application. Advanced training programmes, in particular on image interpretation and knowledge management, are being implemented to enhance frontline officers' capabilities to discern anomaly in vehicle/container scanning. On the other hand, Hong Kong Customs will strive to strengthen the risk assessment and intelligence system to facilitate risk analysts to accurately target high-risk vehicles/containers for NII Scanning.

Hong Kong Customs fully supports the theme of International Customs Day 2011 - "Knowledge, a catalyst for Customs excellence" and is honoured to have the opportunity to share our experience on the application of NII scanner via WCO's platform. As a steadfast commitment to the international Customs community and trade stakeholders, Hong Kong Customs will continue to strengthen the existing practices and collaborate with WCO and member administrations to sustain the momentum of pursuing global supply chain security while promoting the seamless movement of legitimate goods.

Annexes to Hong Kong Report (see separate attachments):

- I. Container and Vehicular Throughput in Hong Kong
- II. Workflow of Selection and NII Scanning of Cargoes in Hong Kong
- III. Sample Images in X-ray Image Databank of Hong Kong Customs

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