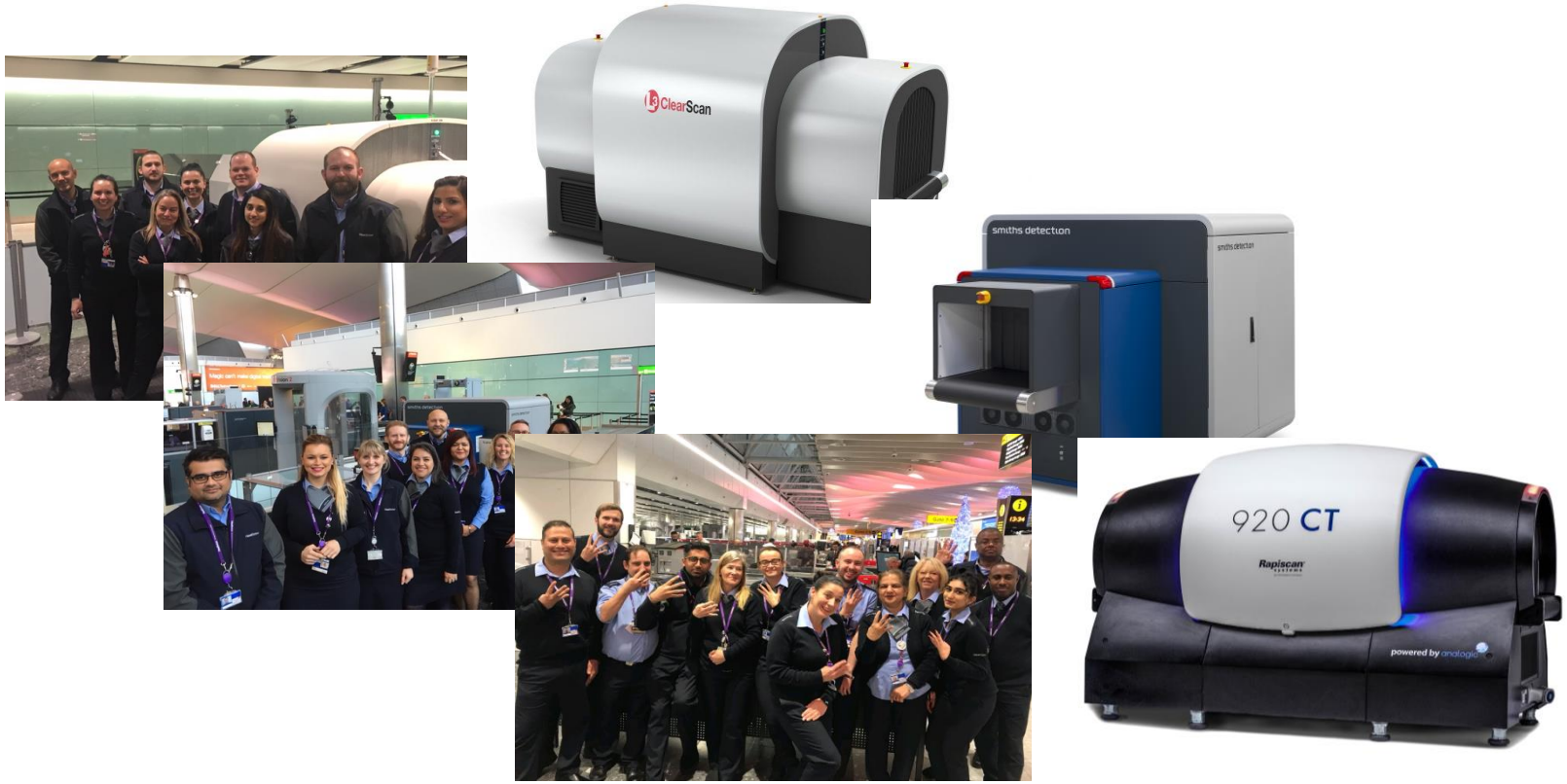
Department for Transport

UK Experience on CT Checkpoint deployment



Department for Transport

The Problem

- Cabin Baggage screening has always been done with 2D x-ray systems
- No EDS just operator viewing all images

- EDS capability brings step change in detection capability
  - Allows for passenger facilitation
  - Electronics/Liquids in bags
- With new technology brings new challenges
  - Training of staff
  - Approval of equipment
  - Integration of systems
  - Changes to CON-OPS
    - Everything back in the bag
  - Monitoring of changes

Department for Transport

Take Home

EDS-CB has challenges to think through to be successful

BUT

- Trials have shown that deployment is viable
- Security Improves
- Passenger experience improves
- Throughput is increased
- IPP is decreased

EDS-CB is a platform and process to improve security, current algorithm are not the end game

- Automatic prohibited items detection
- Increase threat range
- Image only on alarm
- Other technologies for resolution process

Department for Transport

To get to success – Trial and background work

Setting Requirements to allow a trial

- Image Quality
- TIP
- Training
- Moving at the right pace

- Monitoring of Performance
  - Regular TIP reports
  - Overt Testing
  - Cover Testing
  - Regular updates from airports

- As regulators looking to the long term need to think about
  - Image Quality Requirements
  - How TIP will look with multiple CON-OPS and different Technologies
  - Do the integrated systems function as we think
  - Trays – what are the effects of new things going through the approved scanner

Department for Transport

Training & Moving at the right pace

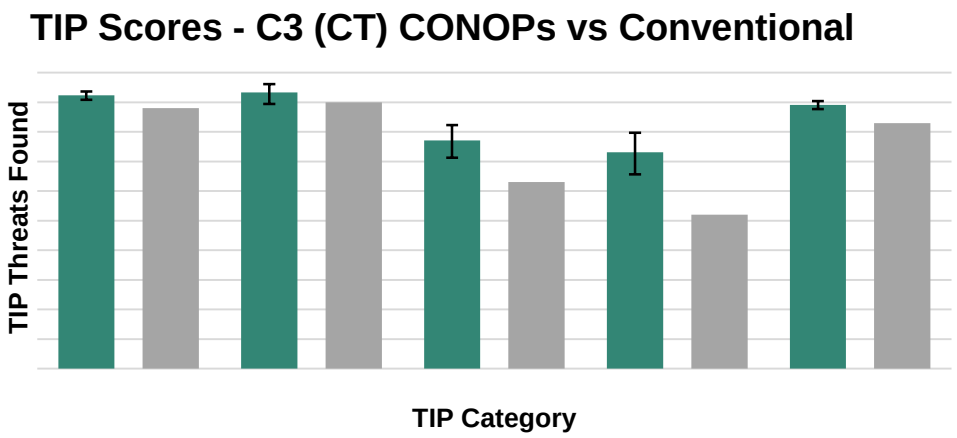
- Use of 3D emulator before moving to the real 3D system machine, which made it much smoother and easier for officers to go from 2D to 3D
  - 3D perceived as easier than 2D for screeners
  - Screening time higher to start with but quickly reduces
  - Screener reluctant to go back to 2D

All Trials began with the current CON-OPS (electronics and liquids out of Bags)

- At 300 TIP events if scores where at least equivalent to current systems CON-OPS was moved on to allow electronics in bags (C" CON-OPS)
- At 300 TIP event in that CON-OPS if no deterioration of performance move to liquids and electronics in bags (C3)

Department for Transport

Monitoring a Trial – Both security & process



Average Time	Conventional	CT C3
Divest	52s	43s
Redress	51s	42s
Bag Search	2m 10s	1m 25s
Overall	3:49	2:36

Running Overt and covert test

Overt; where an image is presented to an operator and they are told a threat is present and asked to identify it

Covert: Where baggage with threats present are passed through the scanner by someone posing as a travelling member of the public

Department for Transport

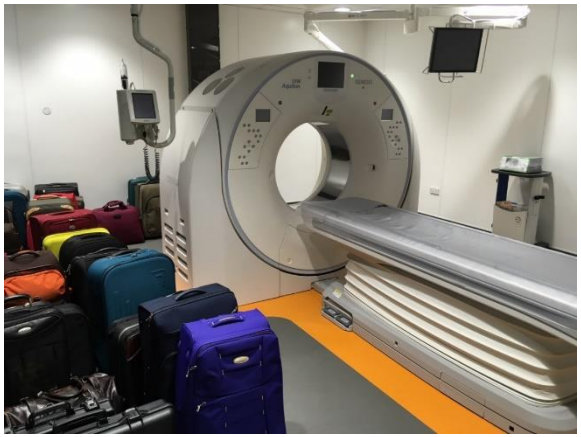
3D Image Quality

The Problem

- No IQ standard exists for 3D systems
- All 2D systems must meet an IQ standard

The Solution

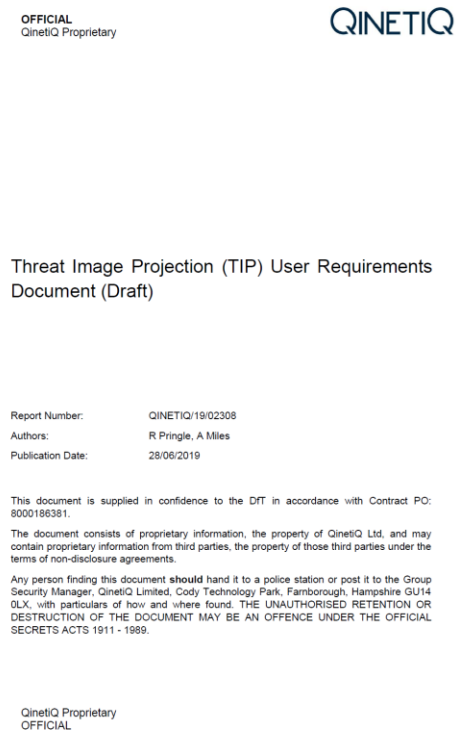
- To produce evidence to inform development of an Image Quality (IQ) standard for Computed Tomography (CT) scanners used in aviation security
- Design and conduct an experiment to look for relationship between CT IQ and screener threat detection



Department for Transport

Threat Image Projection (TIP)

- TIP software and imagery
- TIP libraries
- Performance data and recording
- User interface and feedback messages
- Access and security
- TIP reporting database
- TIP requirements and acceptance testing for automatic screening lanes and X-ray systems
- TIP Roles and Responsibilities



OFFICIAL
QinetiQ Proprietary

QINETIQ

Threat Image Projection (TIP) User Requirements Document (Draft)

Report Number: QINETIQ/19/02308
Authors: R Pringle, A Miles
Publication Date: 28/06/2019

This document is supplied in confidence to the DfT in accordance with Contract PO: 8000186381.

The document consists of proprietary information, the property of QinetiQ Ltd, and may contain proprietary information from third parties, the property of those third parties under the terms of non-disclosure agreements.

Any person finding this document **should** hand it to a police station or post it to the Group Security Manager, QinetiQ Limited, Cody Technology Park, Farnborough, Hampshire GU14 0LX, with particulars of how and where found. THE UNAUTHORISED RETENTION OR DESTRUCTION OF THE DOCUMENT MAY BE AN OFFENCE UNDER THE OFFICIAL SECRETS ACTS 1911 - 1989.

QinetiQ Proprietary
OFFICIAL

Department for Transport

Third Party Integration (3PI) User Requirement Document

- Document is for both Airports & Manufactures
- URD layouts what compliance looks like
  - Incorporates TIP URD
  - Incorporates Cyber URD
  - Incorporates approvals process
- How compliance is achieved
  - How compliance is maintained i.e configuration control
  - How airports will routinely demonstrate compliance
- Draft sent to Manufactures and airports for comment
  - Received comments back

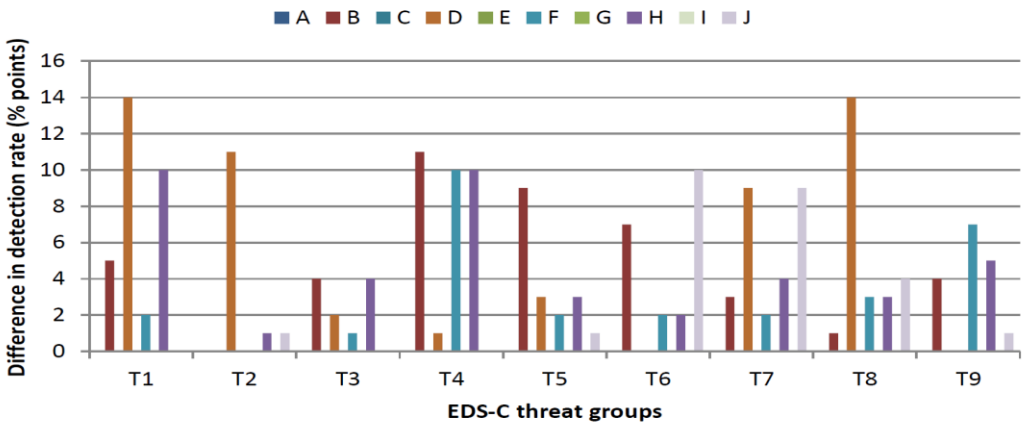
Department for Transport

Trays (The law of unintended Consequences)

The Problem

- There are many different trays for tray return systems
- Do these trays affect the algorithm performance?

- The Solution
- Conduct test to verify if trays have an effect
- If do consider responses

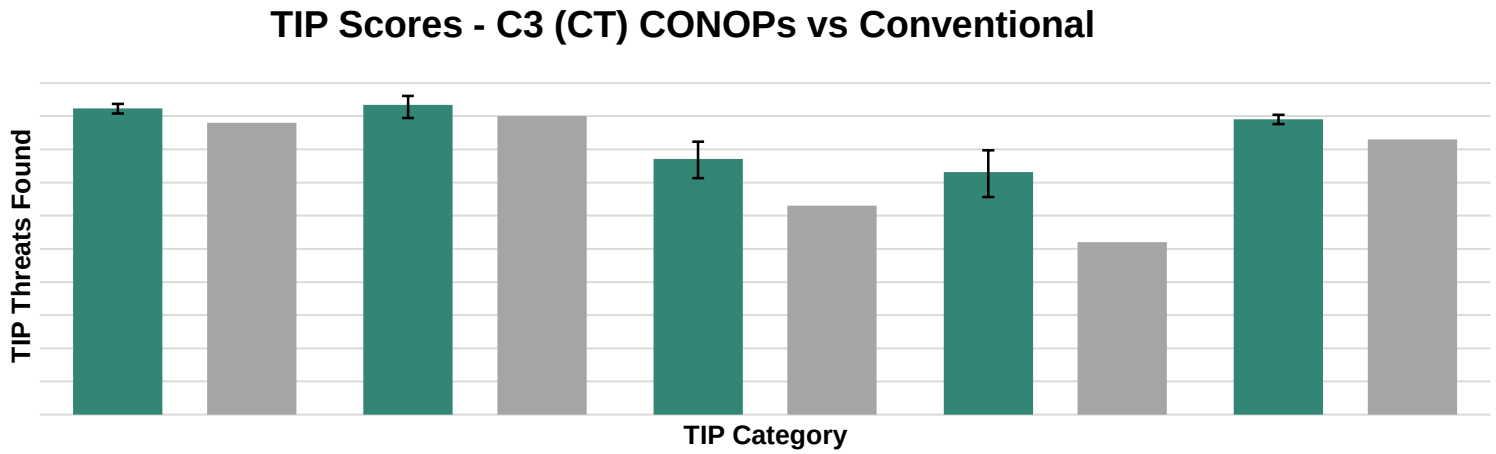


Department for Transport

Back Up Slides

Department for Transport

Results when Trial Planned well



CT system running C3 CON-OPS

Conventional 2D system (liquids and electronics out of bag

Department for Transport

Not Just for Security

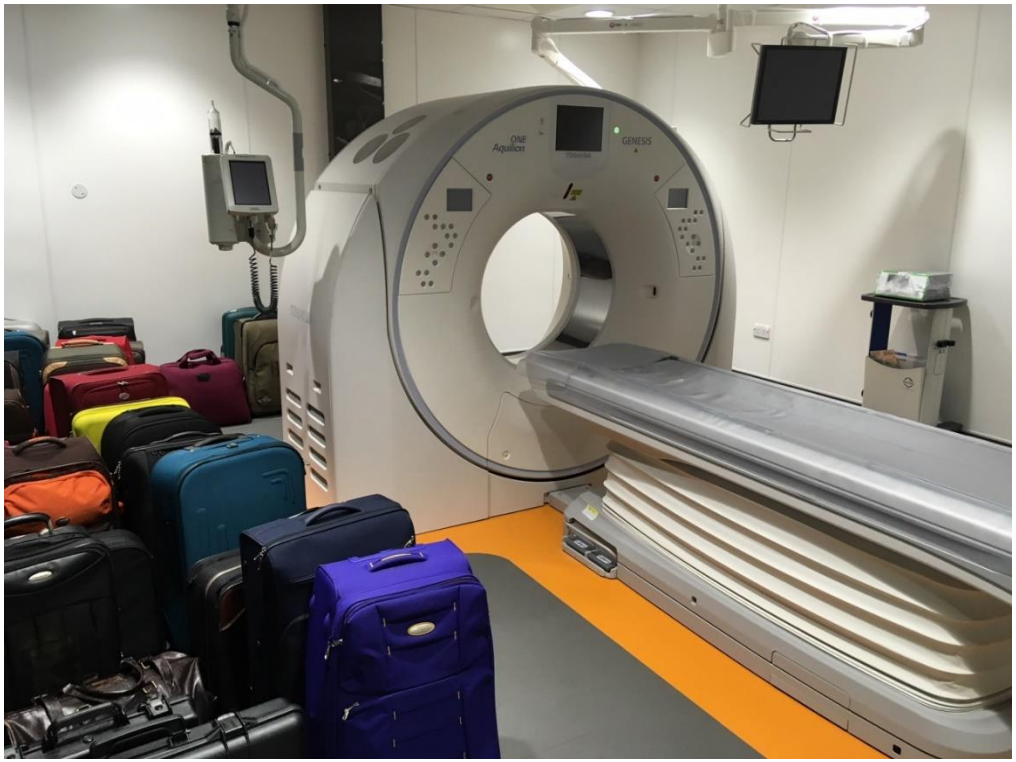
Average Time	Conventional	CT C3
Divest	52s	43s
Redress	51s	42s
Bag Search	2m 10s	1m 25s
Overall	3:49	2:36

In this example the CT lane reduces the passenger security journey time, from the point of collecting a tray to finishing redressing, by 30% on average

Department for Transport

Experimental Design

- Measure detection on a data set for a range of different image qualities
- Do this by collecting high quality X-ray images and degrading to lower quality
- Focus initially on spatial resolution, with potential to extend to other parameters later



Department for Transport

Data set design – Two Parts

- Part A designed to address the question of alarm resolution
- Akin to HBS screening

- Part B Can you find an unknown threat in a bag?
- Only used IED
- Akin to Cabin Baggage screening

Department for Transport

Slice vs 3D view

- How important is the slice view?
- Therefore trial will be conducted with and without it

Department for Transport

Threat Image Projection (TIP)

The Problem

- TIP in 2D
  - 1000 Threat images
  - Easy to project into 2D bag
- TIP in 3D
  - 6000 images
  - Some use FTI which is difficult
  - Some use CTI, time consuming to create
- Both libraries require 10% update each year

Department for Transport

TIP User Requirements Document

- DfT reviewed all existing TIP regulation and guidance:
  - Existing national guidance.
  - ECAC Document 30.
- Discovered a number of areas that were out of date or conflicting.
- From this a single document was created containing:
  - Updated versions of existing guidance
  - New guidance for EDS-CB

Department for Transport

User Requirements

- The TIP URD is set out as a formal requirements document, with each line assigned a URD Number for ease of reference, for example:

- URD001 The TIP management system (TMS) **shall not** interfere with the normal functioning and operation of the X-ray or EDS-CB machine. Fundamentally, the computer **should** have adequate processing power to run TIP without adversely affecting the quality of the X-ray image, the TIP image or the effectiveness of the normal functions.

- The words **shall** (and **shall not**) denote a requirement.
- The words **should** (and **should not**) denote a point of guidance.

Department for Transport

Third Party Integration (3PI)

The Problem

- For EDS-CB to work x-ray systems need to be integrated with tray return systems and sometimes third party software
- None of these are regulated and the effects on integration unknown

The Solution

- Develop means to test integrated systems
- Develop guidance document and approval process

Department for Transport

Issues where Found

- Images not always appearing
- Bags appearing at reject station for unknown reason
- Cues being given that a TIP was being presented
- TIP not being presented in correct ratios
- TIP related data was lost
- TIP recorded in incorrect categories
- Performance data not being recorded accurately
- TIP library images being cropped
- TPIS distribution methods leading to unfavourable TIP projection ratios
- Multiple trays appearing on splash screen

Department for Transport

Approval Process – What is being tested

Full configurations must demonstrate TIP compliance

- the Threat Image Projection (TIP) to bag ratio
- bag range
- random ratio
- feedback message and timings
- inclusion and exclusion of library images
- user database

In addition to testing TIP functionality, the effectiveness of the following will also be tested:

- Tracking of X-ray images from initial creation through the system to ensure that all images are viewed by an operator and, where rejected, all images are correctly displayed at the search station.
- Assurance that decisions taken by the X-ray operator are actioned correctly by the Tray Return System (TRS), e.g. when an image is rejected, the correct bag is physically rejected.
- Validation of automated data used to demonstrate regulatory compliance, ensuring that the data produced matches reality.
- Examining and understanding discrepancies that arise between totals of bag counts coming from the X-ray machine and that generated by TPIS.

Department for Transport

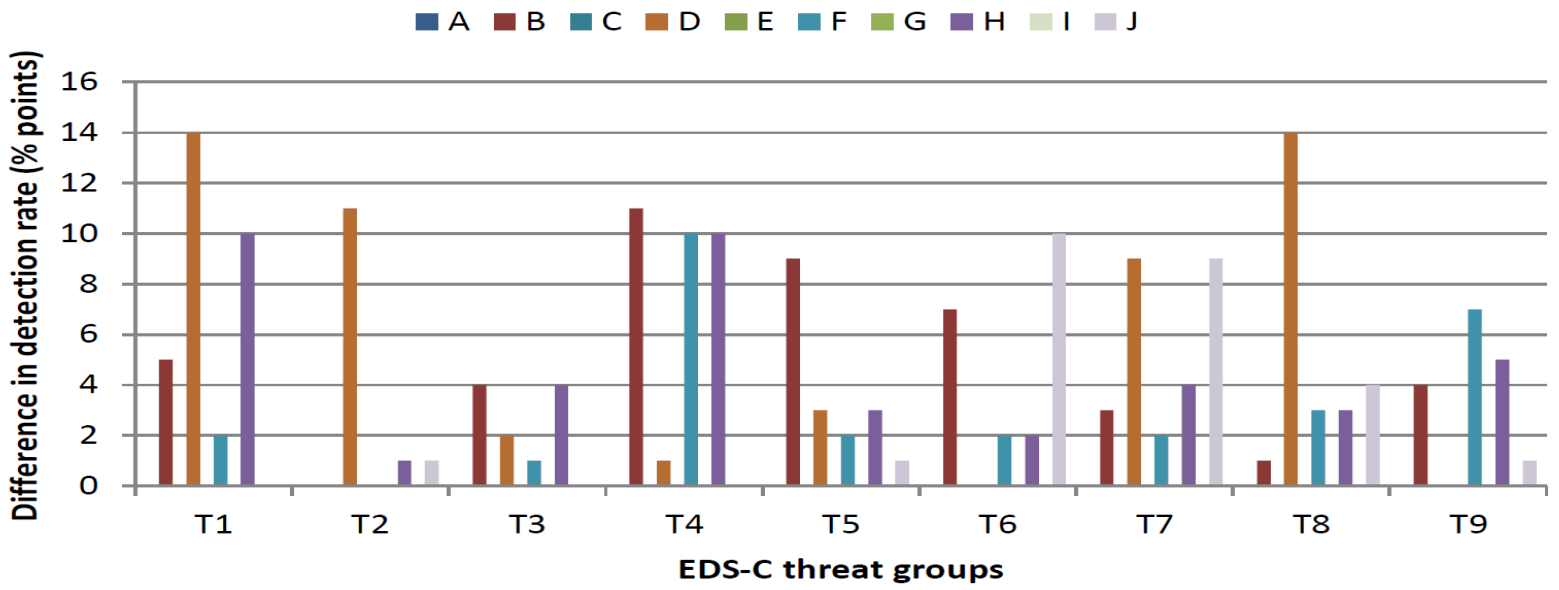
Configuration Control

- A System is approved with one set of Hardware and software
- Any change to the approved set-up would require requalification
- Any changes requiring re-approval would have to happen at TMS supplier
  - This would require re-doing full test?
  - This would be independently verified

- Configuration control will be a RAG status
  - Red – Full re-test
  - Amber – manufacture can supply evidence that no re-test is needed
  - Green – no retest is needed

Department for Transport

The problem Graphically (Trays have an affect)



Department for Transport

A range of solutions considered

- Standardise or ban trays
- Full ECAC test on each tray
- Reduced ECAC Test
- Make Trays a variable in test
- Develop a set of vulnerability tests
- Use of simulants to measure Pd outside of test centre
- Develop and use a test piece
- Allow OEMs to submit data
- Approve based on physical properties
- Don’t worry about trays just allow their use with out certification

Department for Transport

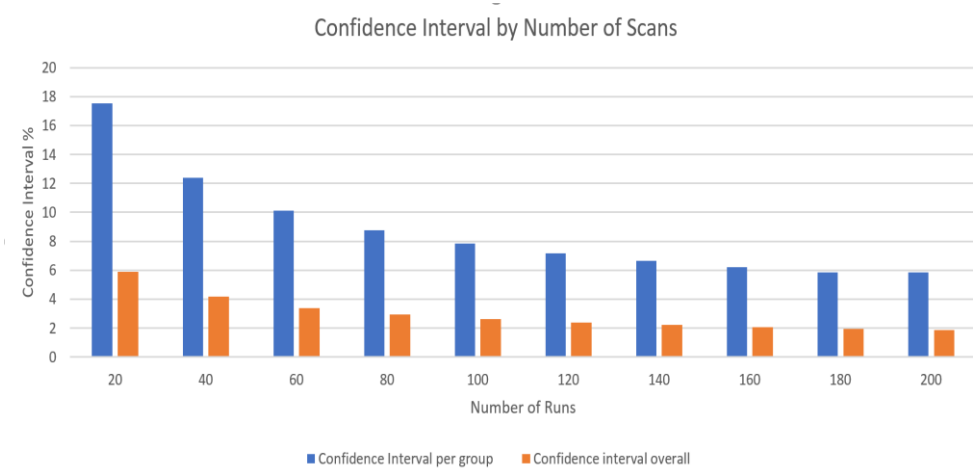
Concept of Reduced Test

Determine most important aspects of test to demonstrate tray compliance

- From data this is always for lowest mass test
- Test should look at just lowest mass
- Would still involve the full run for lowest mass

Additionally

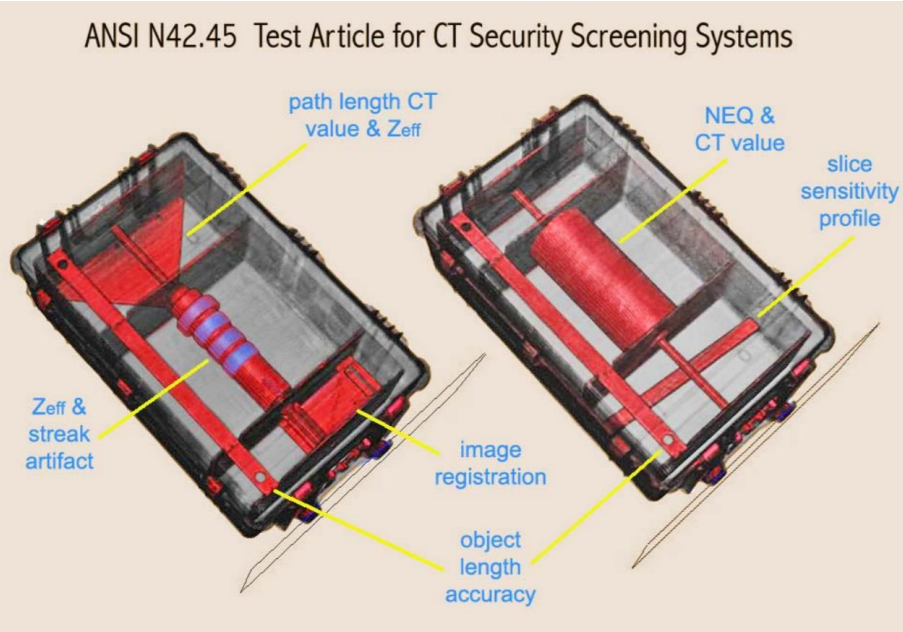
- Develop specific tests to investigate areas of weakness
- Add these excursion tests to the current certification process



Department for Transport

Develop a Test Piece

- ANSI standard has demonstrated for TSA compliance on configuration control
- DfT to research test piece for both 3D & 2D systems
- Will link IQ metrics to known detection results



Department for Transport