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Smart Security – A View of Innovation in Security Screening at International Airports
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Airports Council International – the global trade representative of the world's airports – is pleased to submit this testimony on global advancements in airport security screening practices, in particular the "Smart Security" Program.

Smart Security Vision and Objectives

Recognizing the challenges of growing passenger numbers, continuously evolving threats and limited resources, ACI and our airline partners at the International Air Transport Association joined forces in 2013 to define a future for passenger and cabin baggage screening where passengers proceed through security with minimal inconvenience, where security resources are allocated based on risk, and where airport facilities are optimized.

Today, this vision has been widely recognized throughout the world by airports, airlines and regulators. An increasing number of airports around the world are implementing measures and processes recommended by the Smart Security program.

The objectives of the program are threefold. Firstly, to deliver strengthened security through a focus on risk, increased unpredictability, better use of existing technologies, and the introduction of advanced detection capabilities.

Secondly to increase operational efficiency including faster throughput, better use of equipment, reduced cost per passenger, and best use of space and staff.

And finally, to improve passenger and staff experience through reduction in queues and waiting times, reduced manual handling and better use of technology for less intrusive and less time-consuming security screening.

Although focused on the screening checkpoint, Smart Security also benefits the security at an airport as a whole, particularly through the reduction of large crowds in public areas.

The Smart Security program is structured through trials, tests and information sharing. Airports, regulators and airlines have worked together to test different technologies and processes and have shared their findings with the project team, in order to produce a set of best practices or guidance material. This, in turn, is shared with the wider community so that all can benefit from the experience of participants in the project.

There is no one solution for all airports. Instead, the project has identified a number of "components" that can be implemented, depending on the regulatory requirement, and the needs, facilities and risk profile of the airport. For this reason there is not one "Smart Checkpoint" that can be used as an exact model, rather a menu of options that can be combined to meet requirements.

Smart Security has demonstrated significant improvements in operational efficiency, passenger satisfaction and security value.

Components deployed include Centralized image processing – or remote screening – to enable x-ray machines to be networked, and images viewed away from the checkpoint location or across lanes. Trials have demonstrated significant efficiency improvements, especially when combined with other concepts. Most notably, airports have seen increases in image throughput and as well as reductions in total passenger processing times by an average of 30 seconds per passenger at some airports.

Checkpoint environment and management enhancements include greater automation (e.g. tray handling systems), resource optimization (such as parallel divesting) and automated checkpoint performance monitoring solutions. Some airports have reported a flow increase of up to 20%.

Some airports have implemented a completely new look and feel at checkpoints, such as Amsterdam Schiphol, which is designed to provide a calmer, more passenger friendly environment for travelers to divest and reunite with their possessions. This reimagined checkpoint benefits the passenger experience and aids the detection of suspicious behavior.

Using full body scanners as a primary or secondary measure for passenger screening also has been demonstrated to provide effective security while improving passenger experience and reducing the need for full manual searches. Smart Security pilots have demonstrated that an airport using a WTMD and a security scanner as a secondary screening device can facilitate over 400 passengers per hour per lane.

Airports that have taken part in trials and research include Amsterdam Schiphol, Dublin, Doha, Melbourne, London-Heathrow, Gatwick and Manchester. Many others have implemented components; for example the Canadian Air Transport Security Authority has installed new automated lanes at Montreal and Calgary, and automated lanes are beginning to be deployed here in the United States, using many of the same principles recommended by Smart Security such as lane automation, parallel divesting stations and tray return systems.

Turning to governance, the project is steered by a group of international partners made up from regulators, airports and airlines. This means that all interests are taken into account and there is a high degree of cooperation between all parties that need to buy-in to a trial or implementation. Both TSA and CATSA are members of the steering group, along with the UK and Dutch governments. The key to success has been collaboration and openness, with a view to improving the whole aviation security system.

Results

Quantifying results has been achieved through proof-of-concept implementations in close collaboration with early adopters, and uses a set of very specific performance measures to evaluate the impact.

Security Effectiveness

> The **threat detection capability** and the **robustness** of a security system can be measured through observation, covert testing, security officer performance data and the evolution in the number and type of items detected/confiscated, etc. Screening equipment is tested and certified against specific threat detection **standards**. Other key performance indicators, such as the **deterrence** factor, the level of **adaptability**, and the application of an **outcome focused risk-based** framework requires qualitative appraisal by State agencies.

The key role of measuring security effectiveness is reserved for the government regulators and agencies represented on the Smart Security Management Group (SSMG), which currently include the Canadian Air Transport Security Authority (CATSA), the US Transportation Security Administration (TSA), the New Zealand Aviation Security Service, the UK Department for Transport (DfT), and the Dutch National Coordinator for Security and Counterterrorism (NCTV). While the project team focuses on the operational performance and passenger experience implications of Smart Security solutions in the various tests, trials and proof-of-concept implementations, regulators and government agencies need to ascertain that these solutions are in line with their expected security outcomes.

However, there are strong qualitative arguments to support the notion that the solutions promoted by Smart Security are a step up from the conventional security checkpoint that relies on walk-through metal detectors (WTMD) and conventional X-ray equipment.

- Security scanners address metallic and non-metallic threats in a single process.
- Multi-view X-ray equipment, which is increasingly prevalent, provides the operator with more information by showing multiple viewing angles of the same bag or tray. Next generation X-ray systems that are currently in operational testing stage, further improve on this by displaying the image in a 3-dimensional projection that can be rotated freely to allow the operator to see around objects; this can be complemented with software capabilities like virtual separation of objects, allowing the operator for instance to virtually 'remove' a laptop from the image and to inspect the bag and the laptop separately in a 3D view.
- Explosive Trace Detection (ETD) further augments explosives detection on passengers and cabin baggage.
- Auto Clear (automatic clearance of low clutter images) and Auto Reject (automatic rejection of high clutter images) algorithms do not directly add to the threat detection capability of the system, but will allow the officer to dedicate more attention to those images where human intelligence provides added value.
- Automated threat detection systems such as Explosive Detection Systems (EDS) will further augment the officers' threat detection capability.
- There is general consensus among security experts that the unpredictable approaches that Smart Security promotes would contribute to the deterrence factor.

Operational Efficiency

This arguably is the area where most progress has been made to date. Very significant improvements in operational efficiency have been achieved through a combination of the following components:

Centralized Image Processing (CIP) or remote screening is by far the biggest game-changer we have seen in recent years. It allows for networking of cabin baggage screening equipment so that the images can be reviewed and analyzed by an officer without the need to be physically located next to the equipment. This also opens the door for further optimization, for instance by assessing images from passenger, crew and staff checkpoints in a single control room, or by centralizing across terminals or even across airports in a long distance scenario.

While CIP has the ability to dramatically increase X-ray image processing capacity, the benefits will be even more substantial when it is combined with optimized lane configuration and automation, starting with innovative divest solutions to maximize the in-feed and reduce X-ray starvation, such as a parallel loading system, which has the added benefit of allowing passengers to overtake one another in the process, reducing the stress factor as passengers can take their time to unpack without holding up the queue.
An optimized CIP lane will also require further automation, such as the use of tray handling systems and an automated diverter to ensure that bags/trays that are selected for secondary search are duly separated in the process without the need for human intervention. Furthermore, these lanes will have to be equipped with secondary screening workstations, allowing the secondary search officer to precisely identify what caused the bag to be rejected by the remote X-ray operator.

It has also been demonstrated that, in most scenarios, security scanners can be deployed as primary screening device while keeping pace with the optimized CIP lanes; where higher throughput is required or where other factors come into play, they can be deployed as a secondary screening method.

The most common way of expressing operational efficiency is by measuring **sustainable throughput** (i.e. with a continuous in-feed, the throughput rate that can be sustained for an extended period of time). This is typically measured in terms of passengers per hour per lane (i.e per X-ray).

A conventional security lane (typically about 10 to 12 meters long, with walk-through metal detector and conventional x-ray equipment), will typically reach sustainable throughput of 150 passengers per hour – and often much less. A state-of-the-art Smart Security lane (typically about 20 meters long, with security scanner, lane automation, parallel processing of passengers, and centralized image processing) has been demonstrated to achieve sustainable throughput of well above 200 passengers per hour where the security scanner is used as primary screening measure (e.g. Schiphol), and even in excess of 400 passengers per hour where the security scanner is used as secondary screening measure (e.g. Gatwick). While these lanes come at a higher cost (mainly due to equipment cost and staffing requirements), the cost per passenger actually remains stable or may even come down, while at the same time delivering passenger experience and security effectiveness benefits.

A key element of realizing full operational benefit is for any given airport to test different configuration of equipment and staffing to find the optimal solution for their environment. For example, by varying the time-out value on an x-ray, efficiencies may be gained in processing time. Likewise, providing different numbers of divest stations may be suitable for different passenger demographics.

Passenger Experience

It has been demonstrated that Smart Security solutions have a beneficial impact on passenger experience. Amsterdam Schiphol Airport, implemented all Smart Security wave 1 solutions with special attention to the customer service aspect, and was also the first Smart Security global showcase. After they went live with their first re-imagined security checkpoint in June 2014, passenger satisfaction scores for security increased from 61% to 83% [1].

> **Queues and waiting times** have consistently been identified by passengers as the most frustrating element of the security experience (source: IATA Global Passenger Survey). This is where passenger experience is closely linked with operational efficiency: as Smart Security solutions have been demonstrated to have the potential to significantly increase throughput (see below), they provide screening authorities at least theoretically with the capacity to process more passengers during peak times and thus reduce queues and waiting times – as demonstrated at Schiphol and other airports.
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> Where security screening is privatized (as in many European countries) and airports thus have more control over and are directly responsible for funding the screening processes and technologies used, airports have increasingly reported a link between reduced waiting times in security and increased customer spending on airside, further strengthening the case for investment in security processes. Where security screening is in the hands of a central screening authority (as is for instance the case in North America), we see that there is significant political pressure to balance cost efficiency with passenger experience and reasonable waiting times. In some States (UK for instance), waiting times at security checkpoints are regulated and there are steep penalties associated with not meeting mandated service levels.
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> **Intrusiveness of security measures** is another key driver of passenger dissatisfaction at security checkpoints. This is associated with security measures that are inherently uncomfortable, such as full body pat-downs. Security scanners and Explosive Trace Detection (ETD), which are key components of the first wave of Smart Security solutions, offer the possibility to screen passenger effectively for threats while minimizing the number of full body pat-downs. Experience at early adopter airports has shown that passengers generally respond very well to the current technology – especially now that security scanners better respect the privacy of passengers thanks to the anonymized format of images and automatic target recognition.
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> **The need to disrobe** (outerwear, shoes, belt) **and divest** (liquids, electronics) is a further element that influences the passenger experience. The second wave of Smart Security solutions, currently being trialled, including next generation X-ray equipment and computed tomography systems that will effectively enable more items such as laptops and liquids to be left in passengers' bags during the screening process, and other technology innovations such as a new generation of shoe scanners and improved security scanner algorithms that will reduce the need to disrobe.

[1] Based on ASQ scores for security. ASQ is ACI's Airport Service Quality, the leading and globally established benchmarking program measuring passengers' satisfaction whilst they are travelling through an airport.

The checkpoint environment also has an important impact, including considerations such as noise, light, space and other design elements. **A customer service approach** to security screening from staff also benefits passenger experience.

A subjective feeling of safety and security, especially in the current environment of increased concerns about terrorist activity – particularly in public areas – is an equally important element of the passenger experience. While security measures should be efficient and as non-intrusive as possible, they should also be visible and make sense to passengers, who will be more comfortable with a robust security screening system rather than a lax one.

Consistency of process, i.e. the overall passenger's perception of the process being predictable despite the fact that the screening itself may be unpredictable in order to improve security outcomes, will help to reduce the level of passenger frustration. This is closely related to the preparation process and the need to disrobe and divest – why does one need to remove shoes and belts in one State or airport but not in another, for instance? While this is mainly illustrative of the need for the development of commensurate international security standards, Smart Security plays a role in demonstrating that effective and efficient technology solutions are available that will simplify the preparation process by reducing the need to disrobe and divest.

Business Case and Funding

The cost of implementing Smart Security components varies widely depending on the combination of features implemented, the cost of equipment and staff in a particular country, the competitive market for such certified equipment and the configuration required. Although there is clearly a capital outlay, the benefits can be significant.

Increase in throughput will usually come at a cost – i.e. the lane may require additional staff, more expensive equipment and/or more space in order to reach these higher throughput rates. Optimal use of staffing resources, optimal asset utilization, and optimal use and availability of space are factored into the cost case. Cost per passenger is therefore the most useful measure; the increase in throughput needs to be higher than or equal to the increase in cost that is required to achieve it.

Funding for checkpoints varies widely across the globe, depending on whether an airport or a federal agency is responsible for the delivery of security. Generally, passenger security charges or fees are used to invest in security improvements including checkpoint upgrade.

The provision of well-trained, highly motivated staff is also critical to success, and throughput results will not be achieved without sufficient staffing. Smart Security enables security professionals to focus on detection, and takes away many of the manual processes such as physically moving trays back and forth at the checkpoint. This frees up resources to enable more officers to work on examining x-ray images and facilitating secondary search and passenger screening. Models for the provision of security staff vary around the world; for example in Europe, the majority of screening services are delivered by airport staff or contractors, with strong oversight by the regulator. This enables greater freedom for an airport to implement new technologies and innovative practices, provided that security outcomes are maintained.

Uptake

It is not possible to quantify how many airports have implemented “Smart Security”, as there is no one solution that can be categorized as such. However, taking an individual component, we estimate that in excess of 100 of the world’s major airports have implemented some form of automated lane so far.

The project has also delivered close to 30 individual assessments at airports, to help airports identify the best smart security components for their needs, with an estimated uptake of 45% so far. The project will continue to deliver regional workshops in 2017 to encourage the implementation of this first phase of innovation.

Future Plans

Looking forward, the focus for the coming year will be on technologies such as computed tomography, advances in stand-off trace detection, queue management, passenger tracking, identity management and differentiated screening according to risk. The project is always seeking innovative solutions and plans an innovation event to identify new ideas.

For each of the Smart Security components, additional work and research continue to be carried out or have been identified to be completed in the following areas.

Passenger screening

The core performance of full body scanners is improving, and technology is rapidly evolving towards to models that have no moving parts and are therefore virtually walk-through. Further research in passenger screening will continue to focus on finding and developing solutions and technologies that will increase throughput and reduce the need for divesting.

In addition, future research should focus on integration with other components. For example, the use of biometrics for identity management and verification can enable risk-based differentiated screening to be applied on a per passenger basis. This means that passengers identified as high risk might either be directed to a separate screening lane for more rigorous measures, or might be coupled with variable algorithms on a security scanner to apply different levels of screening within the same equipment.

Another potential area for integration is the inclusion of explosive trace detection or other detection methods into security scanners to enhance detection capability, improve security effectiveness and reduce passenger touchpoints.

Cabin baggage screening

Future research will focus on improving the functionality of the screening equipment (especially in its capacity to automatically detect threats) while keeping the false alarm rate as low as possible. By efficiently assisting the X-ray operator’s decision in all aspects of cabin baggage screening, advanced equipment will allow a further increase in security while improving the passenger experience with reduced divestment and fewer bags sent to secondary search. Further work will also need to be carried out in hardware and software decoupling to allow for independent upgrades and easier certification, as well as checkpoint solutions tailored to an airport’s needs.

In addition, while Computed Tomography systems are still maturing (toward improved belt speed, lower false alarm rate and better image quality), there is a great deal of work to be done in understanding and optimizing the way that screening officers will use the equipment.

Alternative detection methods

With ETD already used in some States as a primary screening measure for crew, future work is needed to determine whether the same principle could be applied to passengers as part of a risk-based screening approach. As explosive detection advances to the extent that stand off screening and dynamic adjustment may be possible, further research will be required to evaluate how this technology interacts with other checkpoint elements for optimal checkpoint design. Operational unpredictability will also be assessed.

Covert unpredictability combined with dynamic lanes will make the checkpoint more robust.

Unpredictability, new screening equipment, and alternative detection methods offer the opportunity to move the current prescriptive regulations to a more flexible, outcomes-based approach. Rather than checkpoint methodology, security outcomes should be the focus.

Checkpoint environment

Future research in this area will focus on evaluating the optimum working environment, which will allow security officers to focus on their core screening duties and reduce the need for extensive manual handling.

Improvements in the checkpoint environment will always be a work in progress as designs adapt to new threats and the associated detection technologies.

These changes in screening technology and the introduction of additional elements, such as biometrics and video analytics into the passenger journey, will further facilitate the development of enhanced automated solutions.

Future trials may even move away from the conventional screening approach, exploring innovative checkpoint configurations. This could include physically separating passenger and cabin baggage screening processes and reuniting passengers with their belongings at the end of the process.

In addition, research on predictive modeling and optimal staff allocation must be conducted to assess any possible benefits relating to checkpoint reactivity and adaptability.

Centralized image processing

Future studies will contribute to understanding the feasibility and benefits of more extensive networking, both on an airport and country-wide level, including networking operations centrally across several airports.

Taking the networking concept even further, some stakeholders are now considering whether image assessment for cabin and hold baggage can be combined. Further work is needed in this area to develop the concept.

Checkpoint management

Screening equipment is increasingly becoming networked, and automated lanes are now being equipped with RFID readers, associating the passenger with their tray(s) and removing the need to manually identify trays selected for additional scrutiny. A wealth of data is therefore becoming available that, through the use of advanced data analytics, may give rise to a whole new generation of checkpoint management systems that will allow for real-time and even predictive decision making and thus achieve even greater operational efficiencies.

Risk-based differentiation

Risk-based passenger differentiation exists today, most notably with TSA's Pre-Check program. To facilitate wider adoption, States will likely seek further collaboration and agreement on issues, such as mutual recognition and equivalence, standards for risk assessment, interaction with existing security arrangements, and flexibility to counter emerging threats.

The ability to measure the effectiveness of risk based procedures, the potential impact of false positives on the traveling public, and data protection and privacy are also key elements to be considered.

Further work will take place on identity management and the ability to track and trace passengers and their belongings through the checkpoint, providing States with a full end-to-end risk-based passenger differentiation model.

Working with TSA

Smart Security has a long-standing relationship with TSA, including TSA's participation in the Smart Security Management Group. We have been working with TSA towards sharing of information from the implementation of automated screening lanes at Hartsfield Jackson Atlanta International Airport, which employ many of the features of Smart Security, and have also had some very constructive discussions with the TSA's Innovation Task Force. We believe that there is a great deal of opportunity in the United States to benefit from the lessons learned by Smart Security and vice-versa, and we look forward to working further with TSA and more US airports.