

Transitioning towards CT screening

An operator training- and monitoring perspective

A knowledge article by Point FWD in cooperation
with various key industry players



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About this article

With this paper we focus on the human aspect of CT implementation. Taking the security operator as the centre of attention; in our opinion the enabler for the quickest and most constructive way to success in state-of-the-art technology implementations. We invite you to gain more insight on how to manage the modern human-machine interaction whereas we focus on training, coaching on the job and continuous monitoring. Seeking to answer the 'why' questions to 3D image analysis difficulties, providing for solid grounds when approaching your implementation project in a broader sense. Security checkpoint stakeholders should perceive this integrated solution approach as keeping a marriage happy. This will only work if there is enough collaboration, communication and understanding.

Various industry perspectives

The insights shared in this knowledge article have the purpose of including the experiences of a rather broad group of industry stakeholders to the CT transition in the security checkpoint. While many insights originate from Point FWD guidance during implementation projects, the bigger picture is being supplied by representatives from key industry players in the Aviation Security working field. We would like to sincerely thank all our contributing partners on their efforts to compose this series of papers.

Authors

This paper is written by Point FWD's Femke Lettinga and Robin van Gemert. Femke is the former quality coordinator for training and development at security company G4S. In her prior role responsible for guiding operators through CT implementation at several national airports. Robin bringing his integrated view on CT implementation projects and the focus Point FWD has in providing data-driven guidance to airports and other security checkpoint stakeholders.

Femke Lettinga



Robin van Gemert



About Point FWD

Point FWD is a Schiphol based consultancy company with a mission to bring security checkpoint environments to the next optimal state of performance. Our future is a world in where aviation security checkpoint stakeholders have 100% insight in their security operations, being able to adequately, promptly and coherently react to regulatory changes, strategy redirections and deployment expansions. In this paper we share our experience on CT equipment implementations, operator performance monitoring and guidance on operator CT training programmes. Point FWD exists as an innovation partner for our clients through conceptualization and (re)definition of the security process, always with a data-driven, yet human-sensible mindset.

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Aviation Security Consultancy

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hello@pointfwd.com

www.pointfwd.com

www.eds-cb.com

Supporting experts

In this paper, input from various industry experts is integrated to assess the 360° stakeholder perspective on CT implementation and 3D image analysis. Collaborating companies and their experts for this paper series include Airports, Security Companies and OEM of screening software as well as Training Software. Cooperating companies and their representatives are included on this page.

Security Operators



Securitas Transport Aviation Services

Jan Cuypers, Aviation Business Transformation Manager; Marcia Awouters, Aviation Technology Development Manager.

Securitas is a global knowledge leader in security. From a broad range of specialized services, technology solutions and consulting, Securitas Aviation customizes offerings that are suited to the individual customer's needs, in order to deliver the most effective security solutions.

CTSN

Cheryl ten Brink, Service Delivery Manager

The security operator is the Dutch subsidiary of ICTS, having expertise in the deployment of CT and EDS in checkpoint situations in the early phases of the CT transition. CTSN has a collaboration with InnerEye - a revolutionary EEG (electroencephalogram) interface designed to facilitate real time threat analysis of visual data.

I-SEC Netherlands

Aza Amin, Quality & Training Business Partner

I-SEC is specialised in delivering advanced aviation security. I-SEC provides services for airlines and airports worldwide. These include handling services, safety training, advisory services and security technology. I-SEC Netherlands has developed a complete portfolio of innovative services and technological solutions that create a safe environment for organizations.

Airport Companies



Eindhoven Airport

Mariëlle Sijm, Airport Operations Manager.

After a successful pilot, EIN started deploying a total of 8 ATRS security lanes by the end of 2019 to meet the airport's capacity requirements, while making optimal use of the limited available footprint. Eindhoven became one of the first airports in the world to screen 100% of its passengers' carry-on luggage with CT screening technology.

Rotterdam the Hague Airport.

Alexander Dilweg, Aviation Security Policy Advisor.

Aligned with terminal expansions, RTM's central security checkpoint was upgraded with new equipment and is in operation since the start of 2020. After a short testing phase by the end of 2019, the airport implemented CT equipment, 5 ATRS security lanes and security scanners and therewith Rotterdam also belongs to those few airports operating on CT technology for 100% of their security screening.

OEM's and Resellers



Stage Gate II

Michiel Poppink, Chief Commercial Officer

Stage Gate 11 is a company focusing on improving the effectiveness and efficiency of airport security departments. They build bridges between technology and this market. They develop own technology and next to that bring third party computer based training software for CT equipment to the market.

Vanderlande PAX Solutions

Darren Durham, Product Manager

As part of Vanderlande's next generation of scalable solutions Vanderlande offers PAX CHECKPOINT. This combines state-of-the-art automated screening lanes with a configurable multiplex screening software to create a fully integrated checkpoint solution. Scalable and flexible, it offers increased throughput and an improved passenger experience while allowing for easy expansion.

Introduction

Explosive Detection Systems for Cabin Baggage (EDS CB) are becoming the new standard in screening cabin baggage on commercial airports across the world. Enhanced equipment enables automated screening of cabin baggage on explosives and is being implemented in various standards. For most of the bigger airports the transition towards EDS CB implicates the implementation of Computed Tomography (CT) x-ray equipment, therewith enabling the operational concept where liquids and electronics can remain inside the luggage during the security check. Replacing common x-ray equipment – mostly single and dual view systems – with CT equipment has various potential benefits.

Gunther van Adrichem (Managing Director, Point FWD) sees this transition as “the long awaited solution to make a step change in security checkpoints worldwide, providing for a better screening experience for both passenger and security operator.” He adds: “and this is just a beginning, introduction of these new technologies will allow for even bigger leaps in future detection and operational insights through available data.”

Better inspection capabilities

Eliminating the need to take out liquids and electronics can mean less trays used per passenger, increased security throughputs, a more positive passenger experience and eventually a more cost-efficient security operation. One of the enablers for these benefits is the capability of 3D imaging. 3D image analysis can be used particularly to better analyse the more complex images, for example those with electronics inside of baggage. A 2D image provides difficulties for visual analysis since laptops could be bloc-

king the sight on other items, with the consequence to manually inspect a bag which in most cases means additional screening of belongings.

The overall experience operators have regarding 3D image analysis seems positive; operators experience increased visual analysis capabilities thanks to additional manipulation and analysis functionalities. This results in less manual searches, which eventually tend to become more targeted of aim. The introduction of 3D imaging however implicates a different way of screening as compared to 2D images. It provides for novel features – such as rotation and separation – operators have not worked with before, which take time and training to be successfully adopted into their standard image analysis capability.

To achieve CT implementation success it is crucial to have a quick and consistent operator adaption to new 3D screening capabilities. After all, the best equipment is of limited value if the people who operate it are not trained appropriately.

The human factor to CT systems

With this article we focus on the human aspect of CT implementation. Taking the security operator as the centre of attention; to our opinion the enabler for the quickest and most constructive way to success. We invite you to get more insight on how to manage the modern human-machine interaction whereas we focus on training, coaching on the job and continuous monitoring. We seek to answer the ‘why’ question to 3D image analysis challenges, providing for solid grounds when approaching your implementation project in a broader sense. Security checkpoint stakeholders should perceive this integrated solution approach as keeping a marriage happy. This will only work if there is collaboration, communication and understanding.

Read all three parts of this paper

The content of this paper is built around three main pillars deep diving into the operator training perspective when transitioning towards CT. At first, the organization around training programs is looked at, setting the context and requirements for a CT training program. Then, focus is on the content of training and the actual transition of moving from 2D to 3D image analysis. At last, a perspective on the continuous monitoring and enhancement of operator performance is discussed.



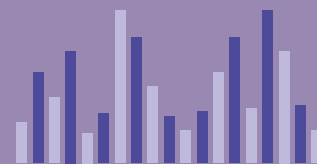
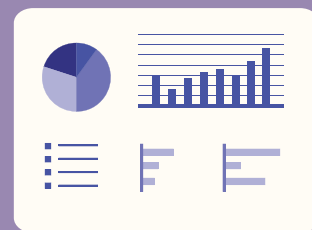
3. Coaching and progression monitoring

2. Training content and components

1. Training approach and organization

Part 3

Operator coaching and progression monitoring



Included in this part

- The operator learning curve
- Centralised Image Processing
- Progression monitoring and Operator coaching
- Group dynamics and learning environment
- Data collection, reporting and analysis.

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Operator Coaching and Monitoring

During the first periods of a CT trial project, or partial deployment, usually a limited group of operators is trained on the new system. Following the classroom and CBT training components, the last step to get operators fully trained on the new system is most often introduced as training or coaching on-the-job. Providing on-the-job training is the step in where operator capabilities should be put in practice, as effectively as this could be done, eventually to achieve performance level goals. Reaching this level of skill and operator performance is however not done by a single session of coaching. Moreover this depends on the total time spent - and the number of CT images seen in operation. It is rather an ongoing phase of familiarization, learning and enhancing performance. The progress of screening performance can be described by the operator learning curve.

Darren Durham (Vanderlande) explains: “the performance of checkpoint equipment such as automated screening lanes, CT scanners, body scanners, is often closely monitored, but the efficiency of these devices is highly impacted by the human factor. Security agents and passengers alike have a major influence on checkpoint operations, and monitoring data related to their activities can prove highly beneficial.”

In this part we look at the ongoing period of support, coaching and monitoring to achieve quickest grip on operational anomalies in day-to-day screening. Next, we bring focus on the composition of a learning curve and the impact various factors might have to alter this curve, all related to the process of CT implementation and 3D analysis. This to explore how to reach your implementation goals quicker, achieving success faster than held possible beforehand.

“Speed is often confused with insight. When I start running earlier than the others, I appear faster.”

-Johan Cruyff



Operator learning curve

When studying the progression of operator performance levels, in the basis it is advised to keep track of those who are trained on the system, and in what period training took place. Then, tracking the operator in operational instances by continuously monitoring CT screening analysis times, operator reject rates, TIP scores and recheck inspection times is required to see how the performance and throughput of these elements evolve over the first couple of months. Integrated products, such as Vanderlande’s Multiplex solution, could “provide security managers access to near real-time performance statistics of active screening agents. By closely monitoring those mentioned data points above on a individual agent level, managers can detect unusual behaviour and therefore improve resource management.” (**Darren Durham**). He adds, “such performance statistics can also be particularly useful in the context of a transition to CT screening as they provide a clear overview of each agent’s strengths and weaknesses, making continuous training more effective.”

Jan Cuypers (Securitas) explains about CT screening: “one of the big advantages of this new technology is that we are now, as a security service provider, also better capable of gathering relevant data on our operator performance”. “Whereas for us with the 2D technology gathering data was still a very manual and time-consuming process, this has now been completely altered with the implementation of CT. It now provides the possibility to capture each and every detail of the screening process”.

By understanding the learning curve of operators on specifically the above mentioned performance indicators, a better estimation can be made on when newly trained operators and new hired operators are fully trained on the system. **Marcia Awouters** (Securitas) adds: “This data is used to further improve our performance and has enabled us to better pinpoint certain areas of improvement on an individual level.

There again, this contributes highly to an almost individually customized level of training that we can now provide to our operators both in a simulated as in a real-life environment.” There are however several different choices to be made and pitfalls to avoid when extracting insights from learning curves.

Different representations of learning curves

Important here is that the various KPIs can be plotted on two essentially different axes. For example, the number of images seen by an operator can represent a specific performance indicator, independently from the period in time. This curve can be of best value when closely studying the KPI at hand, really basing this on the screener and its capability to learn through its personal experience, for example to track progression as compared to its peer group. Control variables like generation, years of experience or for example difference in checkpoint setup can be taken into account.

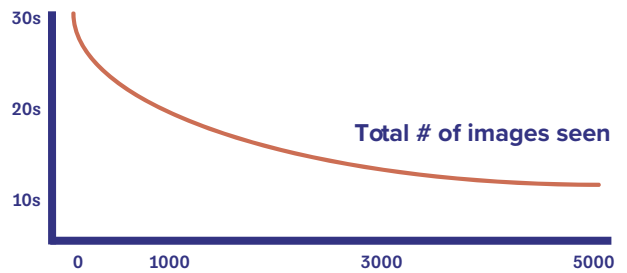
Furthermore, the progress of a KPI can be projected over time, as an overall KPI of the complete checkpoint, and thus related to potential peaks, holiday seasons or other important operational alternations. An essential note to this way of including results is that the performance of all operators regardless of their independent times / images spend in operation is being reported collectively. Therefore, airport security managers are always advised to take good care of clear representation and thus the usability of graphs for concluding statements. In this latter example it would be good to separate between time spent in live operation, the number of images seen, or the moment of final training. Data can give us the essential insights, but it should be made sure that it is accurate, consistent and relevant data that is represented and that right conclusions from the chosen representation are drawn. In this section some examples are included of learning curves over the different important KPIs related to CT screening and analysis.

Screener analysis time vs # of images

The KPI that is most central in the subject of CT screening is the average screener analysis time, also referred to as the decision time. Generally taken, this KPI represents the time period between the moment the operator is provided a new CT image, until the

time the operator gave a decision; accept or reject. The learning curve in this example includes some benchmarking data from EU airports and tells us that the average CT analysis time drops from 31 seconds at start, with a decrease of nearly 65%, to 11 seconds on average after having seen approximately 5000 CT images. However, a radical decrease in screening should be monitored to guard screening quality, for example by having this same graph, but focused on TIP scores.

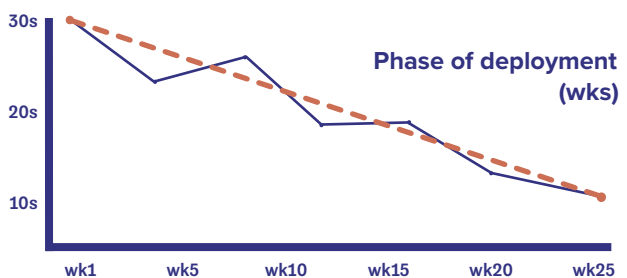
Avg. decision time (s)



Screener analysis time vs period of deployment

The second example curve gives a good impression of the full first phase of CT deployment, including overall screener analysis figures that are projected on the duration of deployment. One of the core values of KPI plotting over time is the ability to identify the impact of operational situations like peak times, holiday seasons or seasonal changes. As said, in such a curve, it is important to understand that this is setup as a collective graph of all operator groups and variances in their performance. Meaning, it might be the case that new screeners join live operation in week 6 from start, neutralizing the expected increase in performance from screeners that have spent already several weeks in operation with a greater number of images reviewed. Assigning weighing factors to the number of images viewed per operator can potentially restore balance in this type of representation.

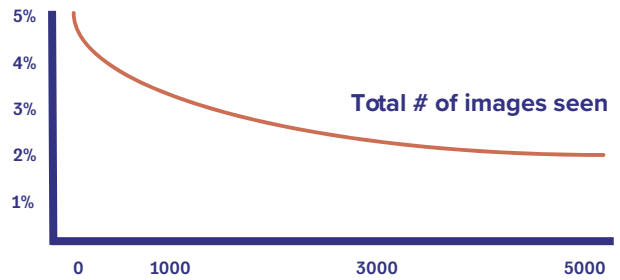
Avg. decision time (s)



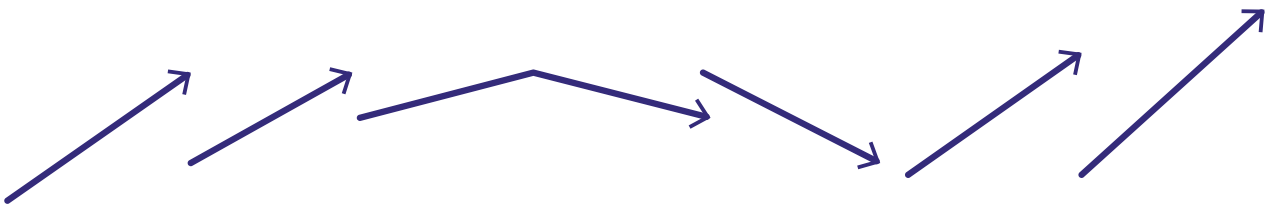
Average image rejection vs # of images

This third example KPI is aimed at the rate of operator rejects in CT deployments. The importance of this KPI directly relates to the abilities of security personnel to decisively inspect content visually, avoiding unwanted rejects of baggage that could have been correctly cleared (false alarms). 3D images provide for a multi perspective representation of contents. Therefore, training operators to effectively utilize the various functionalities of image representation proves to significantly decrease operator rechecks from 5% at start of operation to a stable 2-3 percent after approximately 4000 images seen. This might seem a small decrease in rejects, but the impact at recheck can be great and can mean substantially less or more baggage to be manually unpacked, having a direct relation to a potential greater number of diebacks in peak time.

Operator reject rate (%)



Eindhoven Airport is interested in reject percentages, but even more interested in the reasons for rejected baggage says **Mariëlle Sijm**. She adds: “what EDS alarms have been generated and on what content types? What do operators give as important reasons for rejecting trays and how can we learn from these instances in order to provide them with valuable feedback in training?”



Enhanced Centralised Image Processing

One of the main technological enablers for reaching optimal CT efficiency is the implementation of Centralised Image Processing (CIP), **Darren Durham** explains. However, “when the image analysis task is performed in a remote area or in a multiplex configuration at the checkpoint, screening agents lose the direct contact they are used to have with the recheck operators. This means that they also lose access to constant feedback on the accuracy of their decisions.” With this happening, processes get hampered easily and lane performance could drop significantly due to unnecessary rechecks, or increased timing on additional communication.

To solve this issue, Vanderlande has added a feedback functionality to its Multiplex screening soft-

“for example, an item identified as a potential knife by the screening agent could be identified as a toothbrush by the recheck operator.”

Darren Durham
Vanderlande PAX Solutions

ware. When recheck operators inspect the content of a tray, they can then associate a result to the scene to confirm or deny the presence of a threat item. In the event of a false alarm, the recheck agent can also add a comment to specify the type of item found. **Darren** explains: “for example, an item identified as a potential knife by the screening agent could be identified as a toothbrush by the recheck operator. The feedback data is then collected and made available to the screeners and their managers, therefore reducing the impact of the physical distance between agents and allowing for continuous improvement.”

Coaching to enhance learning curves

As the operator learning curve on the various KPIs is merely a registration of the process at hand, it can only be changed by actively enhancing the way operators analyse CT images. Aside from spending a decent number of hours on screening, providing coaching and training on the job can help enhance overall screening results. Based on the experience of various experts, the quality of coaching and training determines the eventual positive impact on the screener learning curve.

Marcia Awouters from Securitas adds: “here again, this contributes highly to an almost individually customized level of training that we can now provide to our operators both in a simulated as in a real-life environment.”

In the following paragraphs, we include some findings from operational instances that have shown helpful in performing training and coaching on the job, having notable positive impacts on the progression of overall screener performance. These findings are separated into three categories, including CT specific coaching, human based findings and organizational influence factors.

1 CT specific coaching

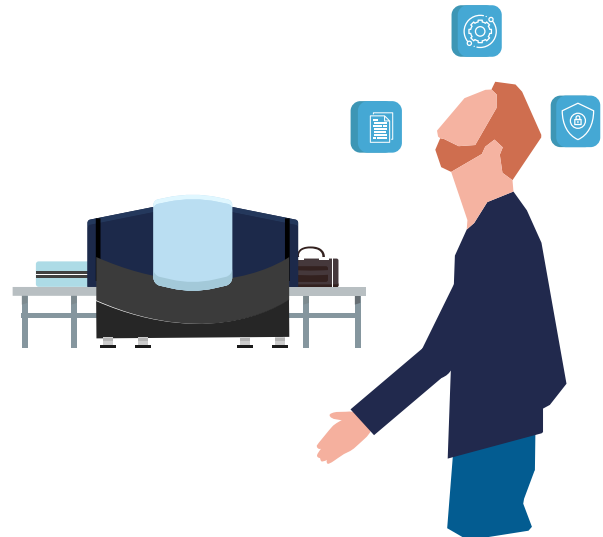
Aza Amin from I-SEC Nederland BV has experience in the transition to EDS CB for over more than 1000 operators at Schiphol Airport. Regarding coaching he explains: “It is essential that agreements between all stakeholders are made very clear about coaching on the job; agreements in terms of who will perform the coaching, when and how”

The CONOP of image analysis changes significantly in the transition from 2D to 3D image analysis. The impact for the image analysis operator might be the biggest. Yet, the effect of the transition to CT is not limited to the image analysis but has consequences for the entire security process.

Standardized operation

Airports, security companies, manufacturers and integrators should all be involved in the development of standard operating procedures, working instructions and quick reference cards and seek for an optimal balance in operator decision time and operator

performance in quality. The CONOPS for operators is dependent on many factors, such as the type of checkpoint (departure checkpoint or transfer checkpoint), regulation for alarm resolution and available equipment for secondary screening.



CT Coach capabilities

The coach, who can either be a trainer or highly experienced operator, will monitor and coach the trained operators and has a key role in the transitioning process. The coach is part of the security team and coaches the operator on all positions, focusing on the specific needs of each operator, with the intention of running a high performing, customer friendly and smooth operation. Besides the requirement of great experience with CT equipment, a good CT coach obtains the following characteristics.

- The coach is able to communicate effectively with: (novice) 3D image analysts, supervisors, external parties.
- Is effective in giving and receiving feedback.
- Is able to identify bottlenecks in the process and respond proactively.
- Is able to assess the image analysis performance of operators in an objective manner.
- Has good coaching and didactic skills.
- Is highly motivated and flexible.

The CT Coach furthermore has an important role in hosting the operators by coaching and assisting them in many ways, based on the needs of the individual. Hosting in relation to the passenger to achieve

ve the optimal passenger experience at the security checkpoint is also a goal to achieve for the CT Coach. The passenger journey changes with the deployment of CT with ATRS and offers a great opportunity to influence the journey in a positive way. As a CT coach, you make sure that hospitality is implemented in every step in the security process. It is important that you perform as a leader and mentor for your colleagues.

Focus on operator performance

The coach observes the quality of the operator performance of the inexperienced operators. Operator decision time is also part of the operator performance. Usually when operators are inexperienced, they are more insecure on their analysis. By gaining more experience, operator decision time starts decreasing. The release reporting is a checklist that can be used as a guideline to identify and register operators as experienced operators. The coach observes the operators' skills regarding:

- Analysis of 2D images and functionalities: understand the purpose of the functionalities and know to use them.
- Analysis of 3D images and functionalities: understand the purpose of the functionalities and know how to use them.
- Knowledge of EDS C3 procedure at divest, image analysis, secondary screening and passenger screening and understand the coherence between the processes

Off-line individual enhancement

Off-line training, such as emulators or simulators often determine the starting level and initial CT expertise of an operator. To help operators get ready for operation with 3D images many images should be available for CBT. The libraries must be regularly updated to keep operators up to date with new developments in threats, but also to keep them focused on the content and not to solely rely on their memory.

Furthermore, in order to keep operators on the right level of performance, CBT could be an instrument for off-line training, using operator specific feedback. Sessions could be organized in a specific order, always increasing the level of difficulty. This element also provides some "fun" for the operator as they can

actually see and experience their progress. Furthermore, sessions should contain a certain number of images that insures the focus of the operator. It can be, for example, better to have more sessions with 25 images than lesser sessions with 50 images.

2

Human and group dynamics

Work experience

Operators with more experience tend to learn faster than operators with less or no experience. They are more familiar with the basics of image representation and have thorough analysis skills. **Alexander Dilweg** (RTH Airport) shares their plan for coaching on the job: "we plan to assign lead agents that operate on one lane only, instead of having a supervisor for the complete operation. With this way of organising we believe coaching can be made possible easily, effectively and promptly. Not only issues will be solved timely, also feedback is provided directly back to personnel at hand, when the actual issue or question evolved."

"We plan to assign lead agents that operate on a single lane only, instead of having a supervisor for the complete operation."

Alexander Dilweg
Rotterdam the Hague Airport

Generation differences

These can be presence in the operator learning curve, looking at 3D analysis. For example, where generation Y (millennials) grew up with rapidly evolving digital technology innovations, research also shows they tend to learn faster on how to operate digital devices. Millennials tend to be more familiar with a high variety of different technologies as compared to older generations.

Motivation

Operators tend to learn faster when they are motivated. Their level of concentration will be better when having a positive attitude. It is important to involve participants in the organization of the implemented systems and give them a chance to contribute their insights on how their specific job is to be performed. The main concept behind socio-technical systems is that (new) systems can only work in a satisfactory way if the social and technical are both considered equally and as interdependent aspects of a work system. An important aspect is that machines must be treated as open systems - with evaluation in follow up after implementation. **Aza Amin** (I-sec Netherlands) explains: “to improve the quality of training and coaching it is most important to evaluate the feedback of the operators. For example, operators can indicate that they prefer more coaching on an emulator for Computer Based Training, compared to theoretical coaching, and that the coaching program must be adjusted accordingly”.

Peer pressure

When an operator analyses images during operation, there is often peer pressure. This peer pressure results in assessing fewer images as a threat. By identifying an image as a threat, he provides more work for his colleague to search the baggage. This has a negative effect on the operator learning curve. This problem is reduced when multi-plex is applied at the checkpoint where operators receive images from all lanes on a random basis



3

Organizational impact factors

Screening environment

Airport security checkpoints are often noisy and stressful environments, making it more difficult for an operator to stay focused. Therefore, implementing remote screening via Centralized Image Processing (CIP) is also seen as a mean to avoid this type of nuisance. With CIP, coaching becomes more efficient as well because operators are centralized in one room. Also, the operators' ergonomics can be taken into account considerably with CIP.

Airport engagement

Engaging with security staff to identify problems that they see in the process and work together on addressing these issues. This can create a security process that is more tailored to those whom work with it and ensures that the final solution is better supported by the security staff. This can be done by collecting valuable operator experiences in weekly sessions and keeping them involved in changes to be implemented in the trial phase. Airport Operations Manager at Eindhoven Airport **Mariëlle Sijm** explains: “in order to learn from operational issues and notable situations, we are in close contact with security company G4S. On a technical level, failures are being notified, logged and distributed very promptly and to the right stakeholders. This shows what is possible at a mid-size airport, when having a good and direct relationship with the security operator”.

“operators can indicate that they prefer more coaching on an emulator for Computer Based Training, compared to theoretical coaching”

Aza Amin

I-SEC Netherlands

Continuously monitoring is key

People, technology and procedures will keep on changing over time. For this reason, checkpoint environments will continue to evolve with a rather dynamic character. The only way how to keep up with these changes, and to keep pursuing the most optimal state of performance (e.g efficiency, throughput, passenger experience) of a security checkpoint, is to continuously monitor the various sub-processes and their integrated components and staff. This should start with defining main goals for operation, after which goals for reporting and analysis can be defined. Key in this is to cooperate between vendor, airport and operator.

The means for data collection in checkpoints are rapidly growing, in all direction of direct user groups within the checkpoint. That is, passenger flow through the security process can nowadays be followed easily with help of sensor equipment, and specific details could be captured with help of hand-held

measurement systems. As seen in this very part, progression of the security operator can be assessed with help of advanced software integration, whereas within a security lane advanced machine log data can provide service technicians great knowledge on lane failures, as well as performance over time. But also the other way around, observations from security operators can give context to the collected data. Security operators have the know-how on practical solutions for expected challenges, keeping the ergonomics for both operators and passengers always top of mind.

An improvement culture is one of the best ways how to keep focusing on enhancement. One of the main enablers for achieving this is by having a collaborative approach between all primary stakeholders in the security checkpoint (airport, vendor, operator). When every stakeholder provides their capability at its finest and with the greatest ambition, success is here to stay.

>> **Read all other parts of this CT knowledge article series.**

[Read all parts](#)

3. Coaching and progression monitoring

2. Training content and components

1. Training approach and organization

Got triggered by the content of this article?

Point FWD specializes in the guidance on CT implementation into global security checkpoints. On the CT implementation perspective, guidance goes in specific direction of CT implementation approaches, specific equipment training programmes and helpful tools for accurate data collection and progression monitoring.

Please get in contact for exploring how Point FWD can be of help achieving success in your CT implementation project.

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hello@pointfwd.com
www.pointfwd.com

Stationsplein ZW 985 Tristar 2 4th floor
1117 CE Schiphol, The Netherlands