



# SCIENCE & SECURITY Issue 29

CASRA NEWSLETTER

It is time to publish our newsletter!

Since 2012, we have been publishing newsletters in which we present results from our research, address trends, and provide information for security practitioners.

The current EU Regulation limits the continuous reviewing of X-ray images to 20 minutes. Thereafter, security officers (screeners) must take a break of 10 minutes or rotate positions to perform a different task. In this issue, we present results from a four-month field study about time on task and task load in X-ray screening. Our study suggests longer screening durations up to 30-40 minutes are possible without a security risk, at least in remote screening.

The second article presents an interview with one of the largest security companies operating at German airports: FraSec. We talk about their X-ray screening operations as well as the usage of CASRA's innovative X-Ray Tutor 4 (XRT4) and FraSec's experiences with it.

We hope you enjoy reading these new articles and as always, we are looking forward to receiving any feedback you might have as well as your input on topics you would like us to address in upcoming newsletters.

With best wishes,



Dr. Diana Hardmeier  
Director



Prof. Dr. Adrian Schwaninger  
Chairman

## TOPICS IN THIS ISSUE:

### RESEARCH PUT ACROSS

#### SHOULD SECURITY OFFICERS BE LIMITED TO 20 MINUTES OF X-RAY IMAGE SCREENING?

European regulation currently restricts the inspection of X-ray or CT images of cabin baggage to 20 minutes of continuous screening. To evaluate whether this duration could be increased, a group of security officers working in remote cabin baggage screening was inspecting images for up to one hour. Results suggest that 30-40 minutes of image inspection seem feasible if security officers can stop early when their concentration wanes.

### SECURITY IN PRACTICE

#### A LOOK BEHIND THE SCENES AT FRASEC: SECURITY AT FRANKFURT AIRPORT

Within this interview, Sven Blumenschein, FraSec's quality officer, gives us in depth insight into their daily operations in X-ray screening and their deployment of CASRA's innovative X-Ray Tutor 4 (XRT4) to ensure high standards in aviation and airport security. FraSec, one of the largest security companies at German airports oversees over 4,000 employees in different locations such as Frankfurt, Stuttgart, Berlin, and Hamburg as well.

## SHOULD SECURITY OFFICERS BE LIMITED TO 20 MINUTES OF X-RAY IMAGE SCREENING?

Text: Yanik Sterchi

The European regulation currently restricts the inspection of X-ray or CT images of cabin baggage to 20 minutes of continuous screening. Whereas the basis for this restriction is unclear, it seems plausible that it is based on research investigating how performance changes in vigilance tasks. These tasks require continuous attention to look for infrequent targets or events (e.g., observing a CCTV footage for intruders or monitoring a machine for a malfunction) research typically found the number of detected targets to drop over the first 20 to 35 minutes of the observation [7]. However, it is unclear whether a similar drop in performance should also be expected for security officers, who search X-ray images for prohibited items. These so-called screeners likely require more active visual search and decision making (Koller et al., 2009) whereas typical vigilance tasks require the detection of simple, single signals from background noise [3].

With the introduction of remote cabin baggage screening, the question whether security officers should be limited to 20 minutes of continuous X-ray image screening has become more prominent. On one hand, remote screening means that X-ray images of cabin baggage are screened in a separate room away from the checkpoint, which makes rotating every 20 minutes becomes more complicated compared to when the images are screened right at the security lane. On the other hand, remote screening offers a quieter environment that might allow screeners to maintain their attention for a longer period of time.

To get a first indication on whether screeners can inspect X-ray images for longer than 20 minutes, CASRA first

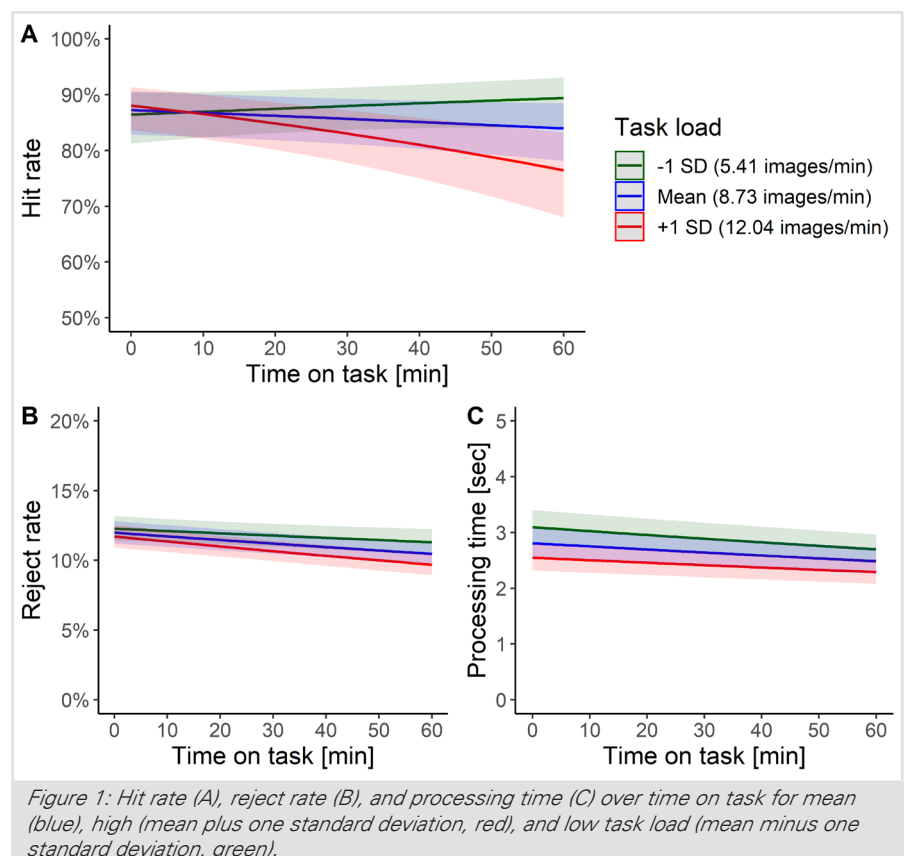
conducted a laboratory study, in which some screeners analyzed X-ray images for three times 20 minutes with a break of 10 minutes in-between whereas other screeners analyzed the images for one hour at a time. This study showed that screeners could maintain performance over one hour of continuous screening. However, they reported a small, but statistically significant increase in distress compared to screeners who only performed three times 20 minutes of screening with 10-minute breaks in-between. More detailed results of the study can be found in [issue 19 of our newsletter](#) or the journal publication by [Buser et al. \(2020\)](#).

Proving that screeners can maintain performance for one hour in a lab set-

ting does not necessarily indicate that screeners should screen for up to one hour several times a day for several months or years. We therefore conducted a field study at an international airport over four months to investigate how longer screening durations affect performance in an operational environment [2].

### SETUP OF THE FIELD STUDY

For the study, one of multiple checkpoints at the airport was selected, which used remote cabin baggage screening (while other checkpoints at the airport still used conventional local screening). About 50 screeners worked regularly at this checkpoint and were randomly divided into two groups. One group continued working as before and ro-



tated after about 20 minutes of screening if not sent to a break or otherwise disrupted. The other group was encouraged to screen for up to one hour but was instructed to stop if they felt that they could no longer concentrate. During the study, the Threat Image Projection (TIP) performance of the screeners was regularly monitored to make sure that the study did not cause a relevant drop in security. To monitor whether longer screening time causes more stress, participants were asked to report their stress level every three weeks by filling out a short questionnaire [8] right after completing a screening session. They were further asked to report why they stopped screening in case they did so before reaching their maximum screening duration. After four months, 41 screeners had completed the required minimum of eight screening sessions, having completed a total of 2'376 screening sessions and analyzed a total of 436'512 X-ray images.

#### HOW DID PERFORMANCE CHANGE OVER TIME?

The centralized image processing system used at the airport recorded the screeners' decision for each analyzed TIP and regular bag image along with when and for how long the image was analyzed by the screener. To investigate how performance changed over time, we estimated a series of linear and generalized mixed models for the hit rate (percentage of detected TIP images), reject rate (percentage of rejected regular bag images) and processing time (time from the display of an image to the screeners' decision for regular bag images).

Figure 1 shows how the hit rate, reject rate, and processing time changed over the duration of continuous screening (time on task). Interestingly, whether the hit rate declined and by how much depended on the screeners' task load (number of images analyzed per min-

ute). Whereas there was no significant decline for the average task load of 8.7 images per minute (blue line in the figure), there was a decline when the task load was one standard deviation above the average (12.0 images per minute). For the reject rate and processing time, there was a small decrease over time, which did not strongly depend on the task load.

#### WHAT DID THE SCREENERS THINK ABOUT THE LONGER SCREENING?

At the end of the study, we surveyed the participants what they thought about screening longer. The 15 screeners who completed the survey reported that it became difficult to continue with screening at around 30–40 min ( $M = 39.29$ ,  $SD = 9.17$ ) and that a screening duration of around 30 min ( $M = 31.79$ ,  $SD = 9.92$ ) was optimal. The stress questionnaire showed no indication that longer screening caused more stress.

#### PRACTICAL IMPLICATIONS

The results of our study suggest that screeners can be allowed to screen for 30-40 minutes with no or only a small decrease in detection of prohibited items and without much negative impact on their detection performance or stress. Whereas we found a decrease in detection performance when the task load was high, one should keep in mind that for the majority of images the task load was average or low. The effect of time on task and task load on hit rate that we found can also be put into perspective by comparing it to other effects: time on task and task load explained less than a fifth of the differences (variance) in hit rate compared to performance differences between security officers.

It should be noted that the results of our study are limited to one airport and that the screeners were encouraged to stop screening if they felt unconcentrated. Considering that screening staff

and their work environment differs between airport, it is not clear whether prolonged screening durations at other airports would cause as little impact on performance as we observed. It is also not clear whether performance can be maintained as well when screening is done at the checkpoint rather than remote. We therefore recommend to carefully monitor screening performance if the duration of screening is increased. But from what we can say based on our study, extending the screening duration to 30-40 minutes should definitively be considered.

#### THREAT IMAGE PROJECTION

During X-ray baggage screening at airports, the frequency of real threat articles (target prevalence) is very low, and a low frequency of targets reduces their detection. Airports counteract this by projecting prerecorded images of threat items (fictional threat items, FTIs) onto randomly selected X-ray images of passenger baggage using a technology called threat image projection [4]. Therefore, screeners are exposed to more threats. Because it is recorded whether a TIP was detected by the screener or not, TIP data can be used to calculate the screeners' hit rates as an indicator of their detection performance.

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## A LOOK BEHIND THE SCENES AT FRASEC: SECURITY AT FRANKFURT AIRPORT

Text: Franziska Meier



Figure 1: Screener analyzing cabin baggage X-ray image;

Source: FraSec

FraSec is one of the largest security companies operating at German airports with locations in Frankfurt, Stuttgart, Berlin, and Hamburg. FraSec sets high standards in aviation and airport security and services with over 4,200 employees and many years of experience.

Today we talk to Sven Blumenschein, Quality Officer at the FraSec Academy, who gives us some interesting insights.

**SVEN, THANK YOU FOR YOUR TIME TODAY. FRASEC EMPLOYS AROUND 3,000 SECURITY SCREENERS WHO WORK AT THE CHECKPOINTS IN THE TERMINALS. WHAT ARE THE REQUIREMENTS TO BE HIRED AS A SCREENER AT FRASEC?**

The requirements for prospective screeners depend on the regulatory requirements of the German Aviation Security Act and they distinguish between passenger screening and staff screening. The minimum age is 18; there is no upper age limit. In my own basic training,

there was even someone who was 62 years old and then worked as a screener until retirement. There is a medical test to determine whether an applicant is physically fit, which is necessary for the manual passenger screening. Color blindness is an exclusion criterion, as the evaluation of color X-ray images on the monitor is mandatory.

**WHAT IS THE RECRUITMENT PROCESS AND TRAINING LIKE AT FRASEC?**

Candidates apply at the central recruiting office in Frankfurt. The training for passenger and staff screening is similar, as the requirements are practically identical. An X-Ray ORT (X-Ray Object Recognition Test), dictation and a basic English test are performed. This is followed by a personal interview to discuss the motivations for employment.

Before candidates are sent to the appropriate courses, a thorough background check is conducted by the police. Only after this comes back successfully, an airport identification card is issued,

and allows participation in the training.

The basic training for passenger screening lasts eight weeks. The first part comprises theoretical training. Various legal texts, procedures and also past terrorist attacks are covered. This is followed by an intermediate theoretical examination by the authorities. After passing, the applicant moves on to the second, practical part, which includes training in personnel screening, baggage screening, CT testing, and initial experience with the XRT4 Tutor. The basic training for staff screeners is quite similar but is certified by a different branch of authority.

**WHAT CHALLENGES DOES FRASEC FACE EVERY DAY WHEN SCREENING BAGGAGE AT CHECKPOINTS?**

Frankfurt Airport is one of the biggest airports worldwide with more than 70 million passengers in 2019. That performance requires high qualification of staff and well working processes every single day. Additionally, Frankfurt Airport often serves as a test airport for new technolo-

gies and procedures, which require constant staff training. Another challenge is that passengers do not always adhere to the airlines' specifications. Due to the variety of travellers, e.g. business traveller or vacational traveller, there is a wide spread of time for security checks. This can lead to delays at the checkpoints if liquids are not removed, for example. Fortunately, in Frankfurt we have virtually only CT machines at Terminal 1, where nothing has to be removed. This speeds up the process enormously and makes it more pleasant for passengers.

#### HOW OFTEN DO BAGS NEED TO BE SCREENED FOR A SECOND TIME AND HOW OFTEN IS IT AN ACTUAL THREAT?

Thanks to advancing technology, the number of multiple screenings of suitcases has generally been reduced. Dual-view technology allows suitcases to be viewed on two screens from different perspectives. The introduction of 3D CT equipment for carry-on luggage has further reduced secondary screening, as suspicious items can often be eliminated by changing perspectives.

The most common items found are often mundane items such as too-large liquid containers or Zippo gasoline lighters.

Transfer flights often result in finds because regulations vary in different countries and are disregarded by passengers. What is allowed in one country may be considered prohibited in Germany.

#### WHAT HAS CHANGED THE MOST IN THE SECURITY BUSINESS OVER THE LAST 10 YEARS?

The biggest change is undoubtedly technology. 11 years ago, when I started, we didn't have liquid scanners, but worked with an old handheld probe, a gate probe and baggage screening equipment. The screening process changed a lot, while the passengers remained essentially unchanged.

The changes were gradual. The transition from single-view to dual-view ma-

chines took a while for screeners to get used to the second screen. However, the update worked very well and reduced alarms and re-checks.

The switch from 2D to 3D is still underway in Frankfurt. Not all screeners have been trained yet, so they are currently working on the respective machines for which they are certified. The change requires a rethinking of image evaluation and also entails changes in the hardware.



#### LET'S TALK ABOUT THE TRAINING SOFTWARE. HOW IS XRT4 USED AT FRASEC?

Since January 2023, all of our screeners have been using XRT4. They regularly train the image analysis on the simulator. There are internal quarterly tests for people and staff screenings that run through the software. For this purpose, image pools are compiled that contain dangerous objects. According to EU regulations, a high detection performance must be achieved.

In addition, all employees complete e-learnings of approximately 30-45 minutes in length on the XRT4, which are created via the Theoretical Block feature. These cover general topics such as data protection and compliance. Although the software was originally developed for image interpretation, it now also offers the possibility for theoretical learning content with various courses that can be assigned to users individually.

#### HOW MANY EMPLOYEES TRAIN WITH XRT4 AND WHAT ARE THE TRAINING CONDITIONS LIKE?

Practically all FraSec employees train with XRT4. In Germany, it is mandatory that screeners train in image analysis for 20 minutes every week and e-learning is also completed by employees who work

as admin or service staff.

For the weekly training, rooms are available near the check points where several screeners can train at the same time.

#### HOW MANY SCREENERS ARE CERTIFIED AND RECERTIFIED EACH YEAR?

Last year, a total of 2,500 people were certified and recertified. Official recertification is done every three years by the authorities.

#### HOW ARE THE EXPECTATIONS OF THE XRT4 TRAINING SOFTWARE FOR FRASEC BEING MET?

We are very pleased with the XRT4 training, which provides advanced dual-view and 3D CT training. The simulator in the XRT4, which was specially developed for the Smiths Heimann machine and has a customized keyboard, provides ideal conditions for training.

E-learning is now also used very intensively. The flexibility to assign courses individually is practical and can be easily checked with the help of various reports.

#### HOW DOES FRASEC SEE SECURITY SCREENING DEVELOPING IN THE FUTURE?

We assume that in the future more and more will be scanned in 3D. Although devices already exist and are increasingly being used, there are still major developments ahead.

In some cases, we are already working with remote screeners who no longer sit at the control station but in a separate room. This new concept requires a redesign of the entire checkpoint, as the people at the monitors no longer rotate. The experience so far has been rather positive, as the screeners are able to work in a more concentrated manner in the dedicated room. However, we have found that the lack of distractions means that baggage screening is quicker, and in some cases, there can be congestion when screening passengers. This will be the next process to be optimized.

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