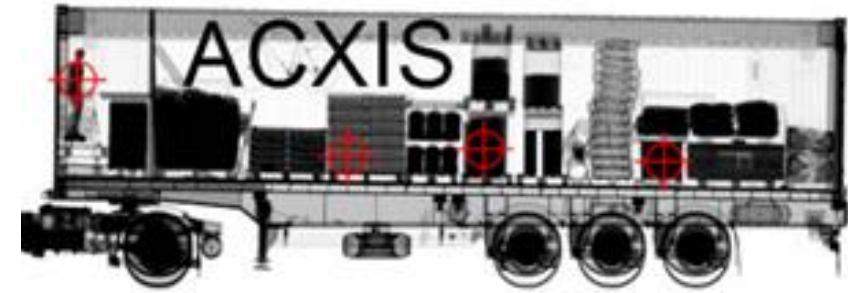


# ACXIS

## Automated Comparison of X-ray Images for cargo Scanning

WCO TI Forum, 28 October 2015, Rotterdam, The Netherlands



Wicher Visser


CASRA



smiths detection



IIS

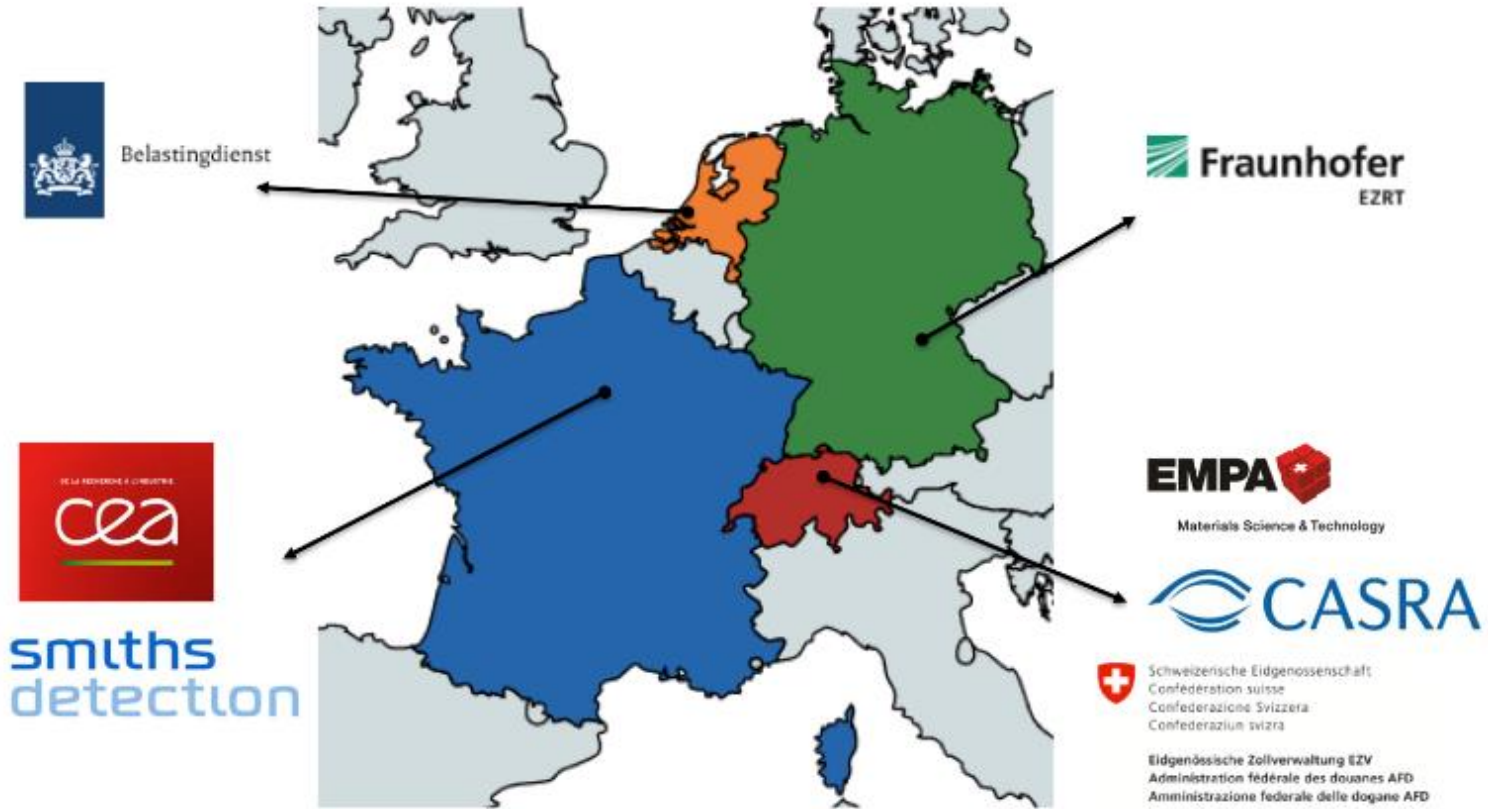
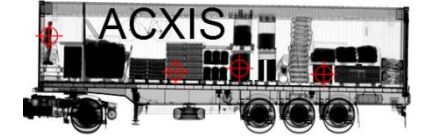
 Schweizerische Eidgenossenschaft  
Confédération suisse  
Confederazione Svizzera  
Confederaziun svizra

Eidgenössische Zollverwaltung EZV  
Administration fédérale des douanes AFD  
Amministrazione federale delle dogane AFD



Douane  
Belastingdienst

# Partners & Funding



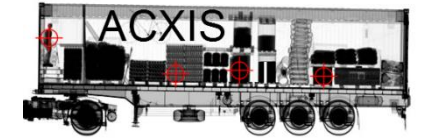
Eidgenössische Materialprüfungs- und Forschungsanstalt  
 Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung  
 Commissariat à l'énergie atomique et aux énergies alternatives  
 APSS Software & Services AG  
 Smiths Detection  
 Eidgenössische Zollverwaltung  
 Ministerie van financiën directoraat generaal - Belastingdienst

[EMPA](#)  
[EZRT](#)  
[CEA](#)  
[CASRA](#)  
[SH](#)  
[FCA](#)  
[DTCA](#)

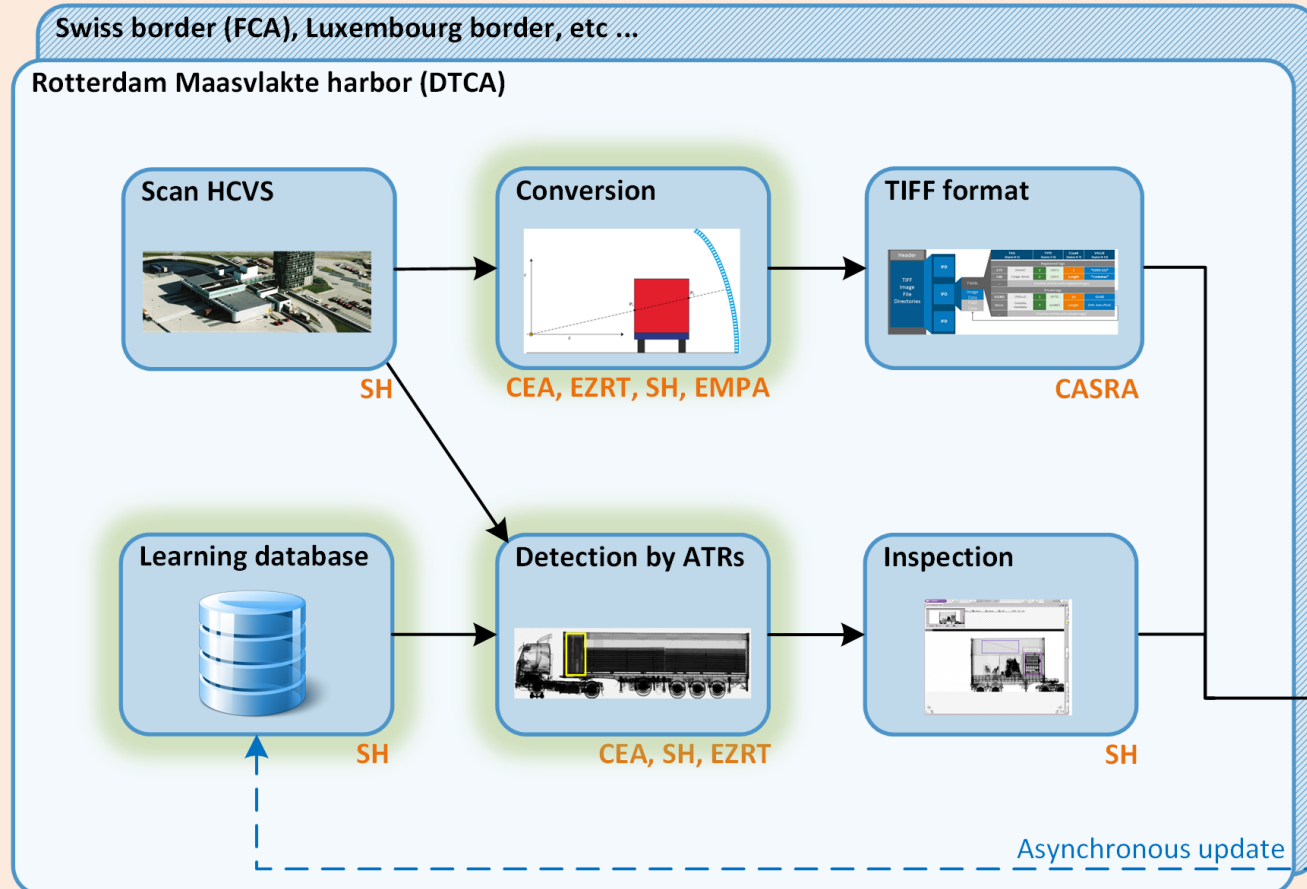
Zürich (Switzerland)  
 Fürth (Germany)  
 Saclay (France)  
 Zürich (Switzerland)  
 Vitry (France)  
 Bern (Switzerland)  
 Rotterdam (The Netherlands)



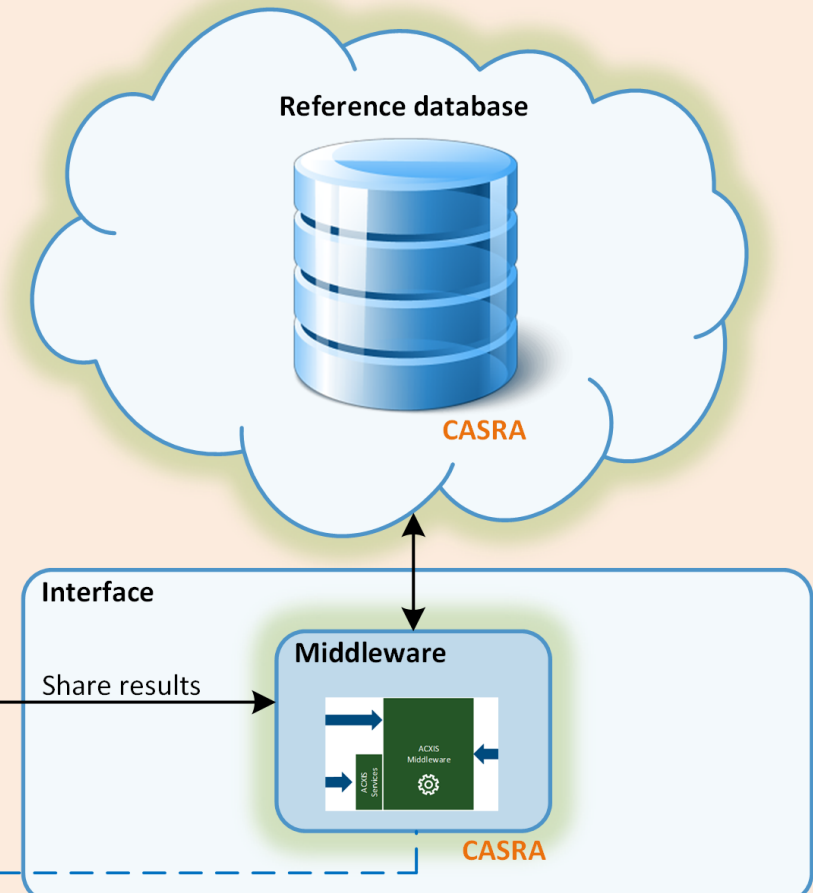
# Inspection procedure



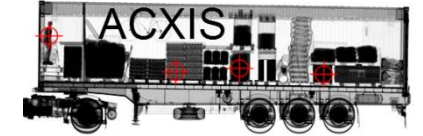
## Customs inspection



## Centralized database and network



# Acquisition of X-ray image data



X-ray images are created for

- Experiments
- Training content
- Reference database

Scans and 3D models of

- Cigarettes
- Narcotics
- Weapons

Sources:

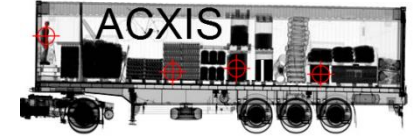
- 2 productive scanners
- 3 lab scanners



DTCA test container



# Machine Independency



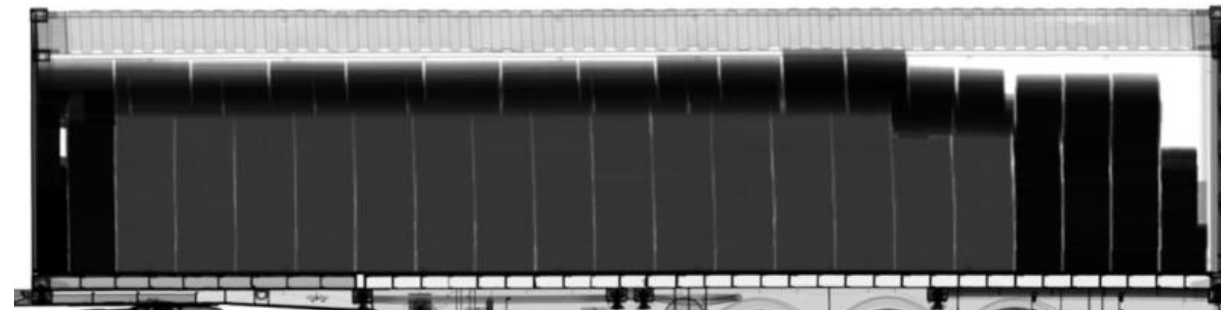
Share X-ray scans between machines (and sites and customs agencies). This requires:

- Conversion between energy spectra
- Noise and contrast modelling
- Geometry conversion
- Scatter correction

For:

- Knowledge exchange
- Detection algorithms

ORIGINAL



CONVERTED

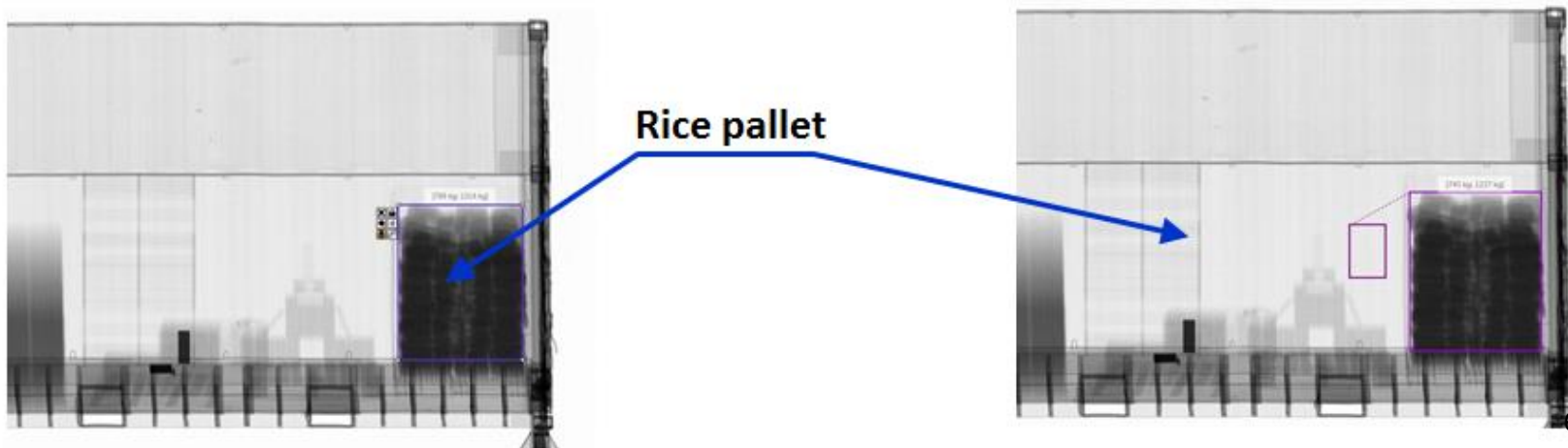
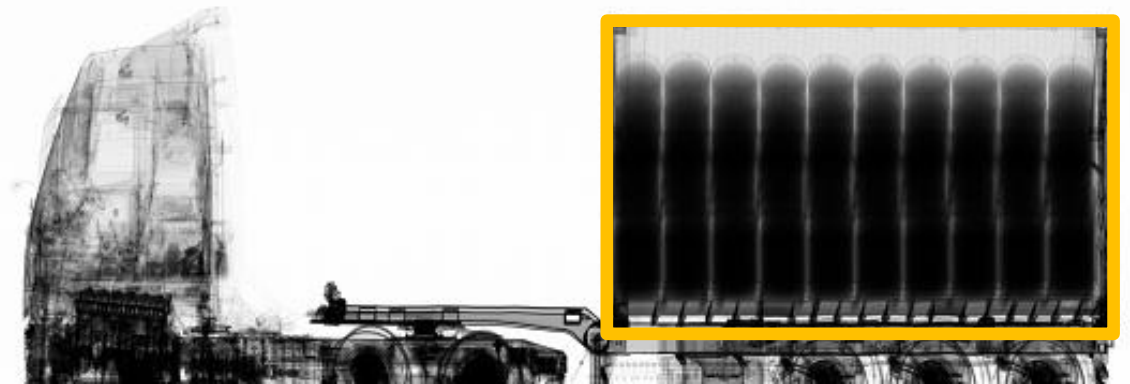


# Automated Target Recognition

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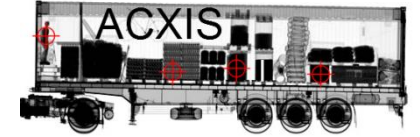
Various algorithms are developed to provide X-ray screening operators with opt-in assisted analysis

- **Weight estimation (local and global)**



# Automated Target Recognition

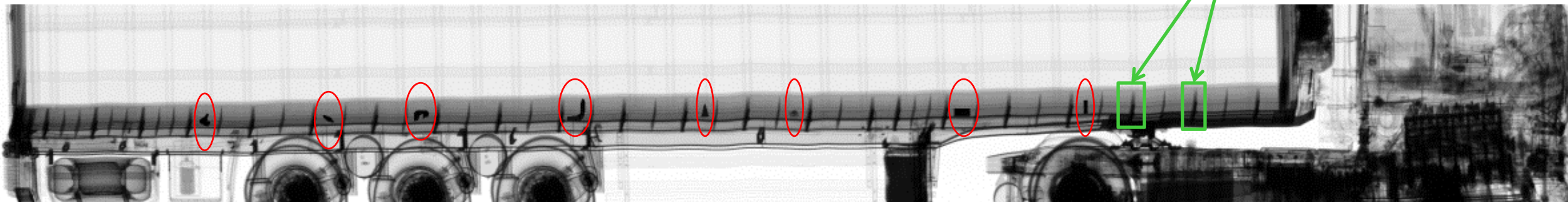
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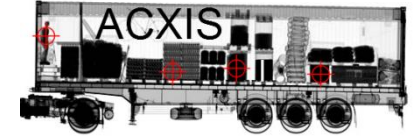
Various algorithms are developed to provide X-ray screening operators with opt-in assisted analysis

- Weight estimation (local and global)
- **Anomalies in container structure**

chassis  
structures

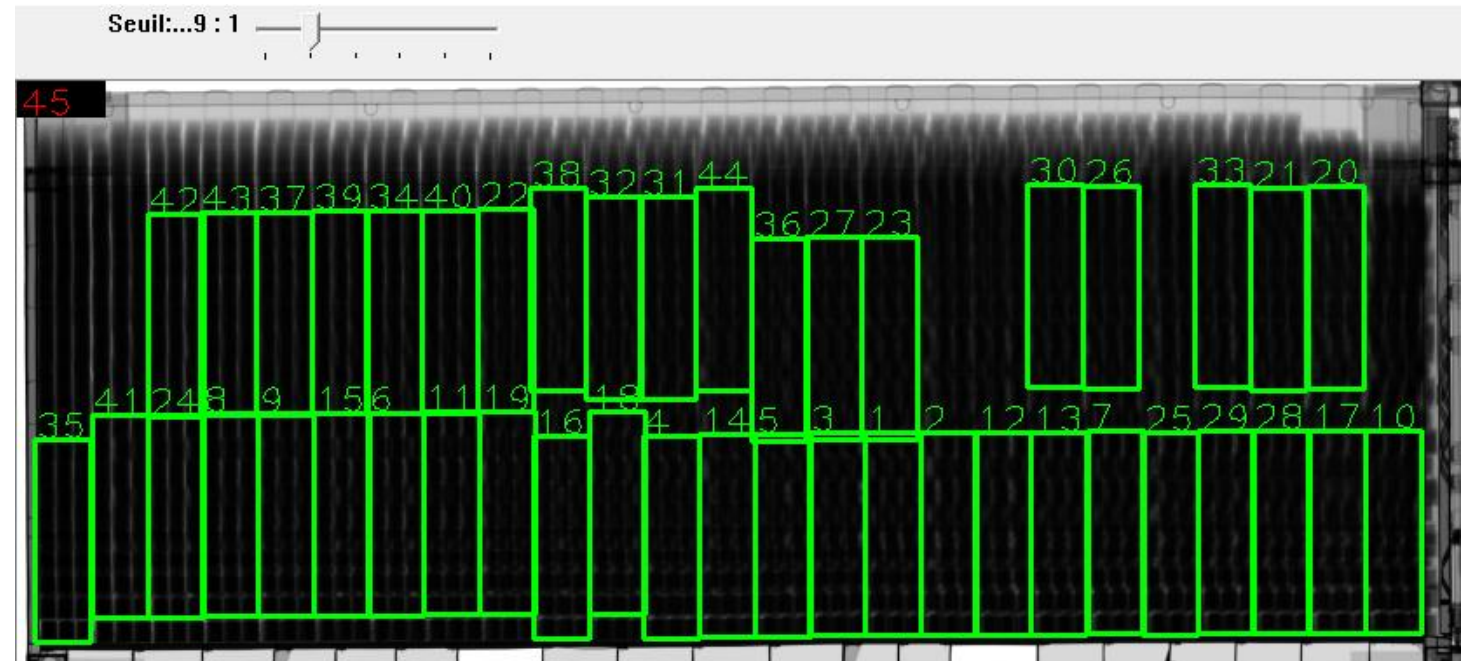


# Automated Target Recognition



Various algorithms are developed to provide X-ray screening operators with opt-in assisted analysis

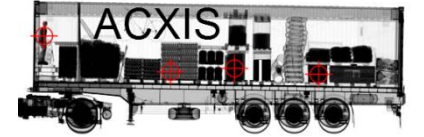
- Weight estimation (local and global)
- Anomalies in container structure
- **Counting of similar items**





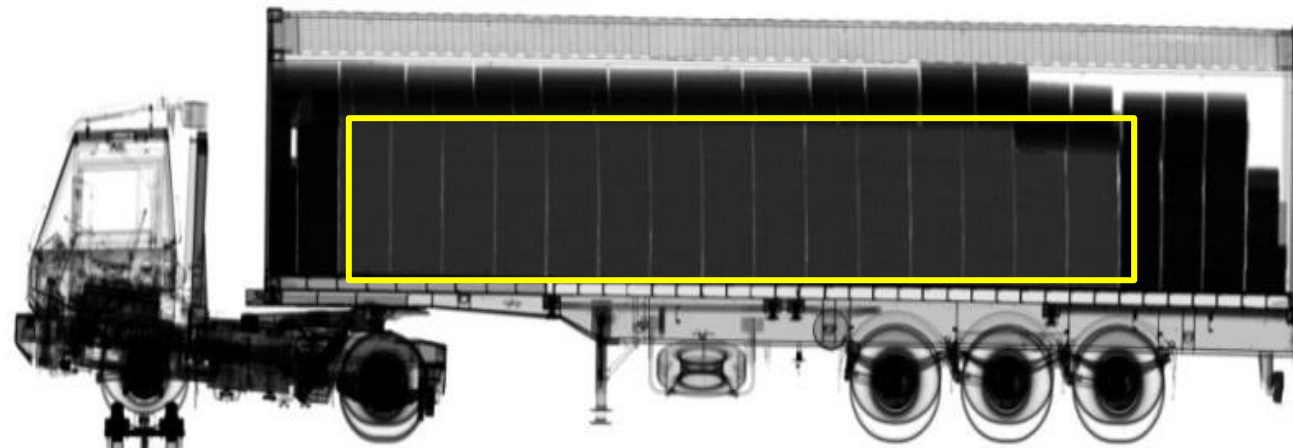
# Automated Target Recognition

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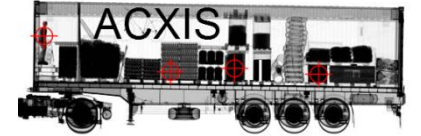
Various algorithms are developed to provide X-ray screening operators with opt-in assisted analysis

- Weight estimation (local and global)
- Anomalies in container structure
- Counting of similar items
- **Cigarettes detection (Smiths Heimann HCVS 9Mev)**



# Automated Target Recognition

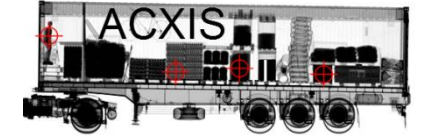
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Various algorithms are developed to provide X-ray screening operators with opt-in assisted analysis

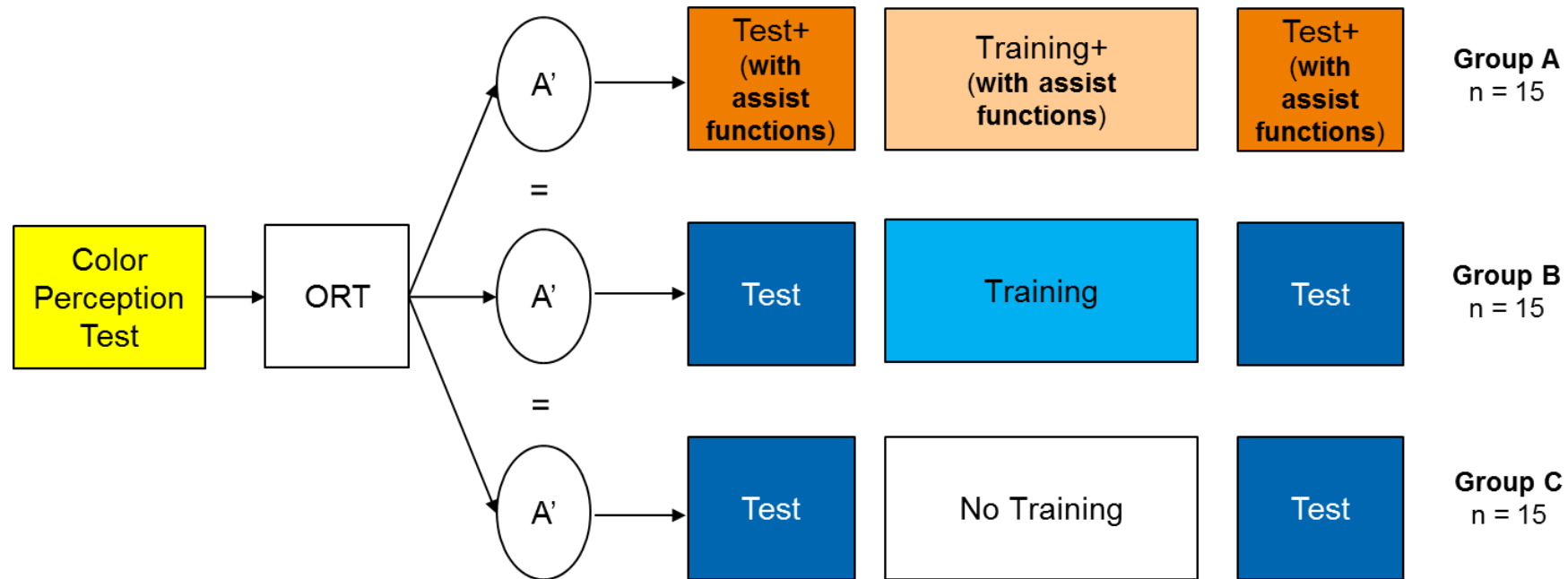
- Weight estimation (local and global)
- Anomalies in container structure
- Counting of similar items
- Cigarettes detection (Smiths Heimann HCVS 9Mev)
- **Narcotics detection**
- **Weapons detection**

# Validation



The validation study measures CBT training effect for

- Screening competency **without assist functions**
- Screening competency **with assist functions**



ORT

Test/Training

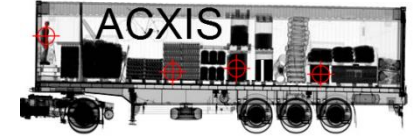
Test+/Training+

= Object recognition test

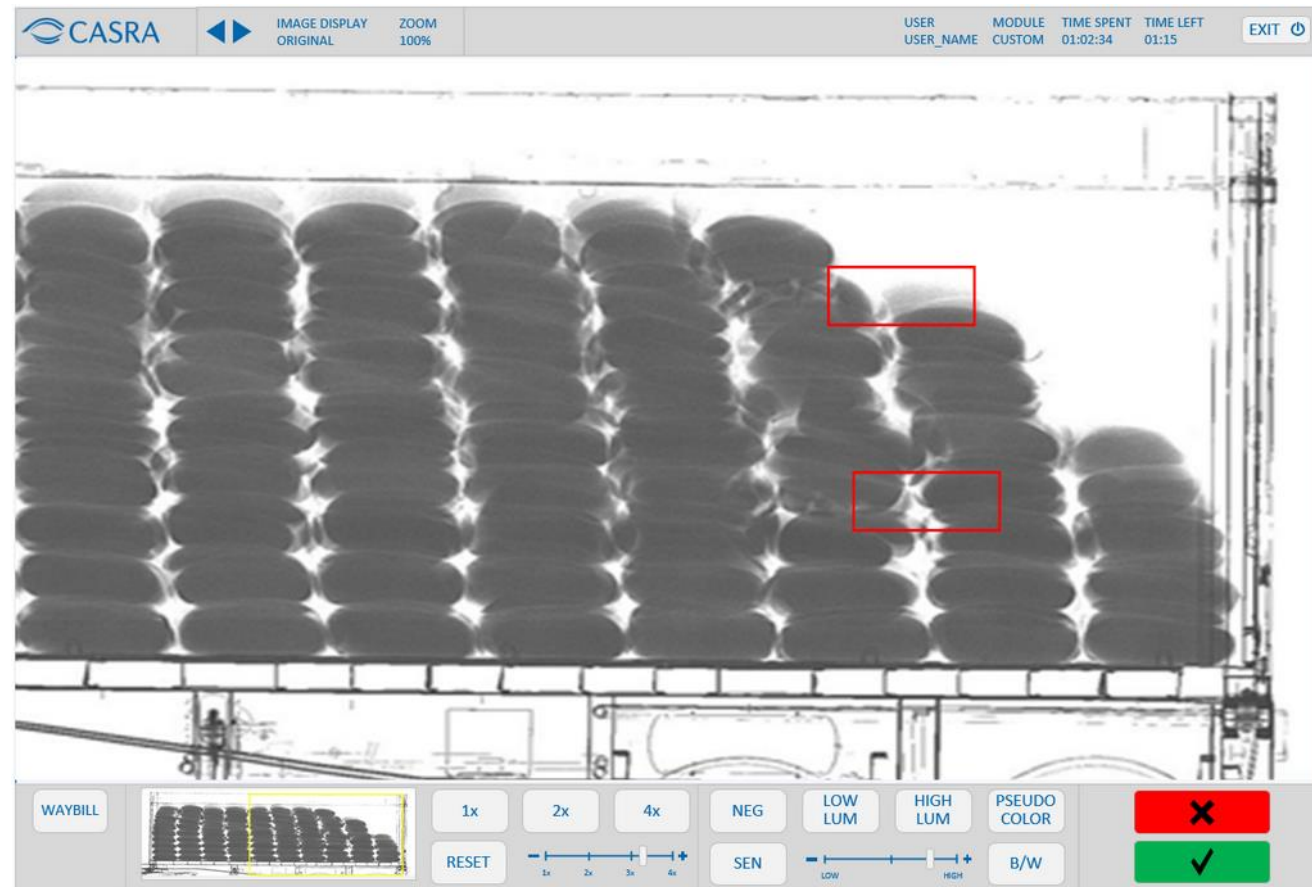
= Cargo images (CTIs)

= Cargo images (CTIs) with additional information (i.e. Frames, highlights)

# Validation



The study shall be carried out using simulation software.



Visit us at the ACXIS booth (#64) for a live demo!

# How to Train and Certify the X-Ray Image Operator Using the CASRA Solution

**Claudia Lüchinger**  
Product Manager

WCO Conference Rotterdam, October 26, 2015

# Competency Lifecycle

X-ray security screeners



**X-RAYORT**  
Object Recognition Test

**X-RAYCAT**  
Competency Assessment Test

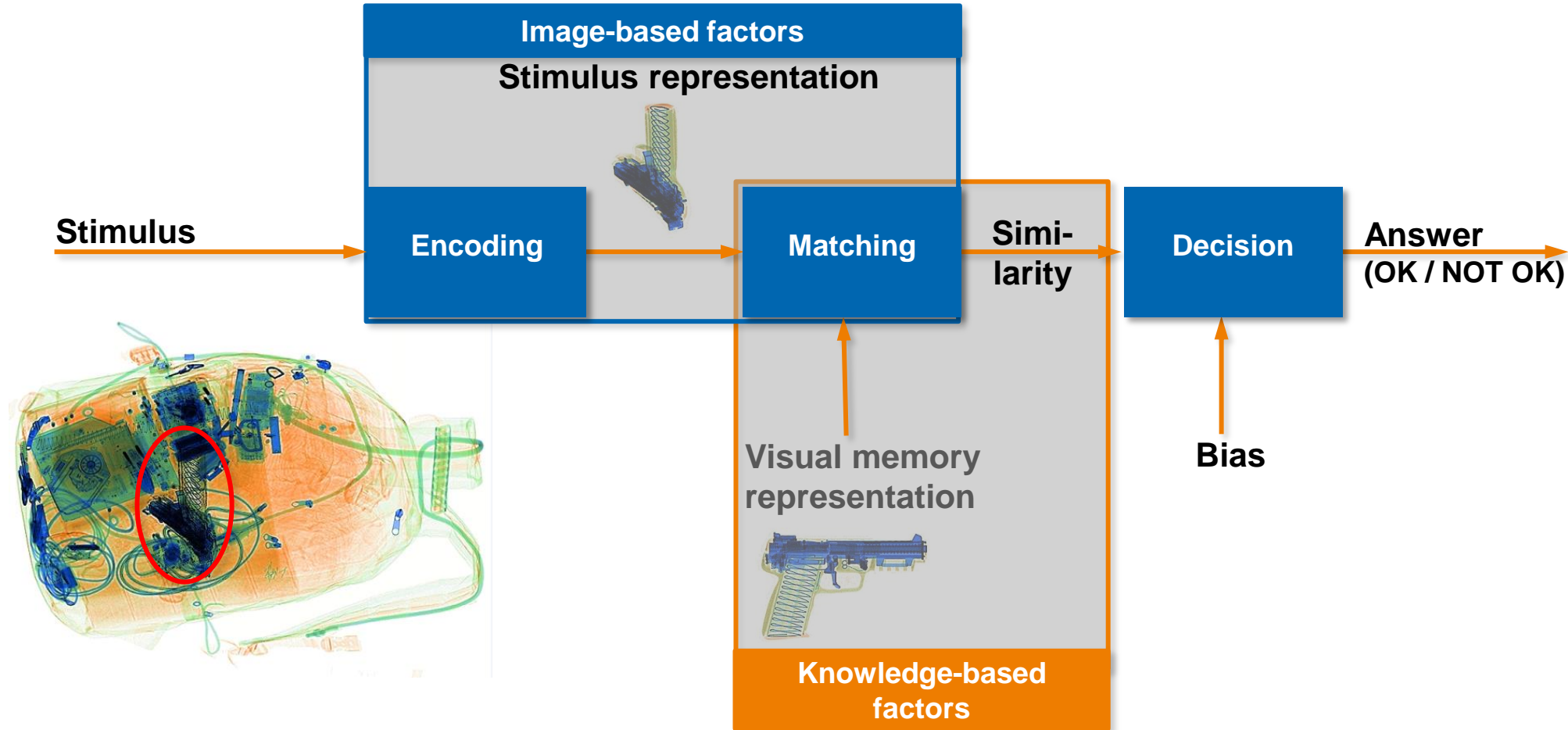
**X-RAYCAT**  
Competency Assessment Test

**XRT**  
X-RAY TUTOR 3

**XRT**  
X-RAY TUTOR 3

CASRA Solution

# Psychological Process



Source: Schwaninger, A. (2004). Object recognition and signal detection. In: B. Kersten & M.T. Groner (Eds.), *Applications of perceptual psychology*. Bern: Huber.

# Object Recognition

The detection performance depends on...

**Image-based factors**

**Bag Complexity**



**Superposition**



**Rotation**



**Knowledge-based factors**

**Unknown Objects**



**Unfamiliar Appearance**



**Unusual View**



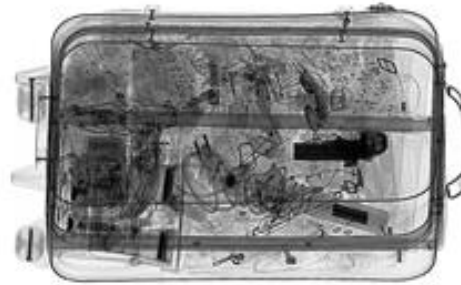


# X-Ray Object Recognition Test

**X-RAYORT**  
Object Recognition Test

measures the  
potential to become  
a good screener

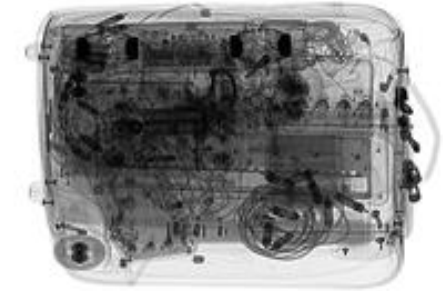
...and predicts future  
job performance



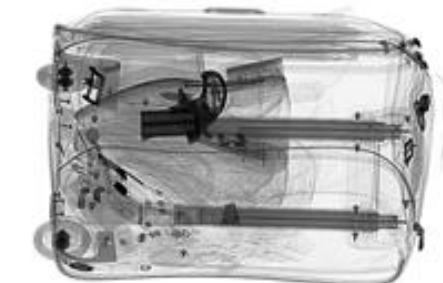
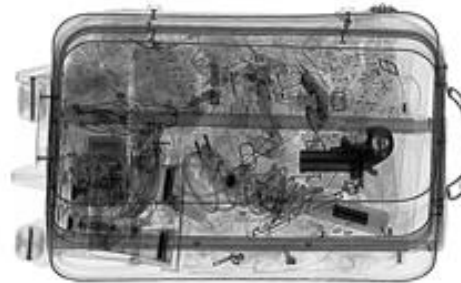
ROTATION



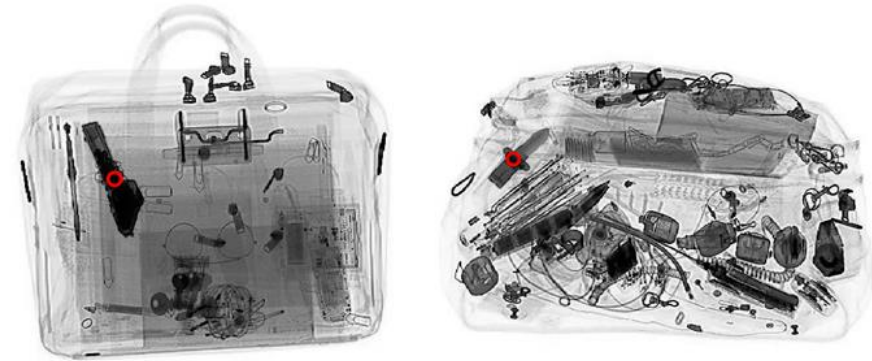
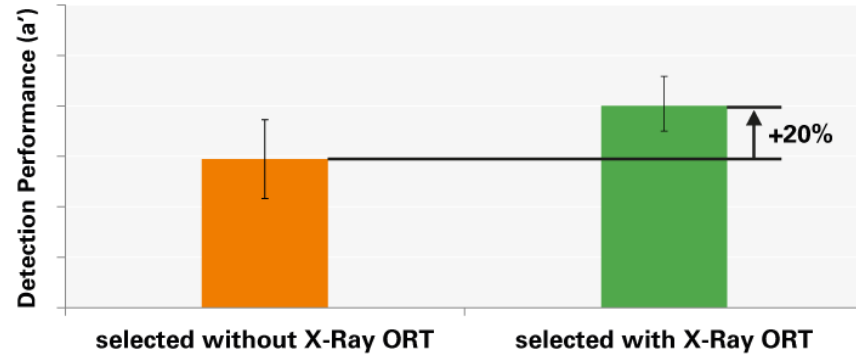
SUPERPOSITION



BAG COMPLEXITY

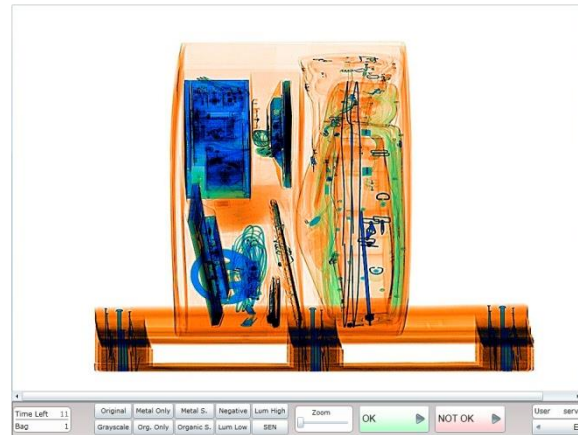


# X-Ray Object Recognition Test



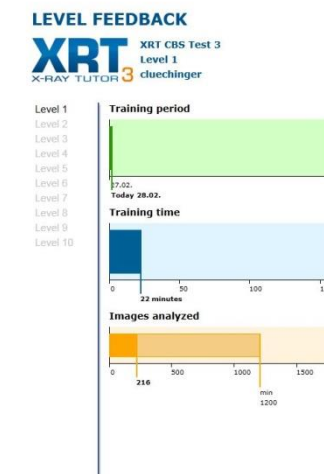
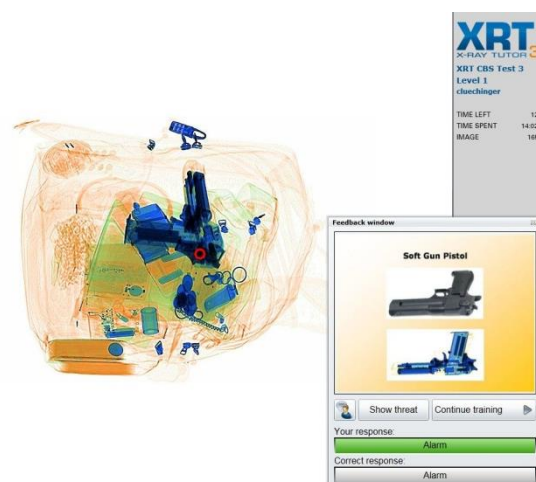
- › Not everybody can become a good screener!
- › Higher performance of screeners selected with X-Ray ORT
- › Proven scientifically and very easy to use

# X-Ray Competency Assessment Test



- › Certification is important for comparison and quality assurance
- › Highly reliable, valid and standardized test
- › Proven scientifically and applied since 2005

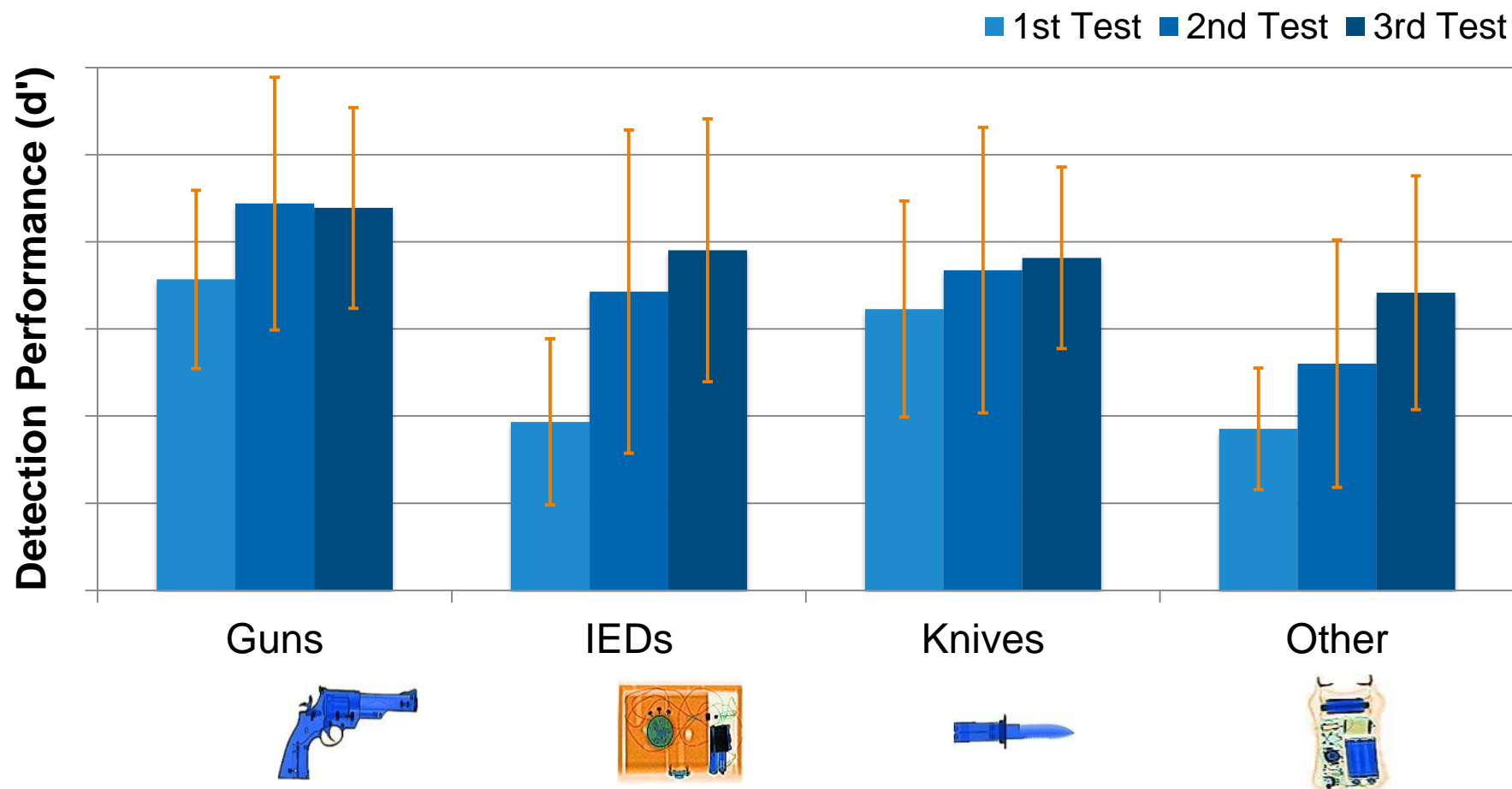
# X-Ray Tutor for Training

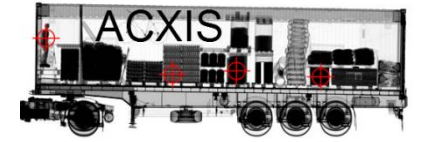


- › X-ray image recognition training is important
- › Very effective and efficient training
- › Powerful technology but still very easy to use
- › Scientifically proven

# Effectiveness of XRT3

20 minutes of training per week

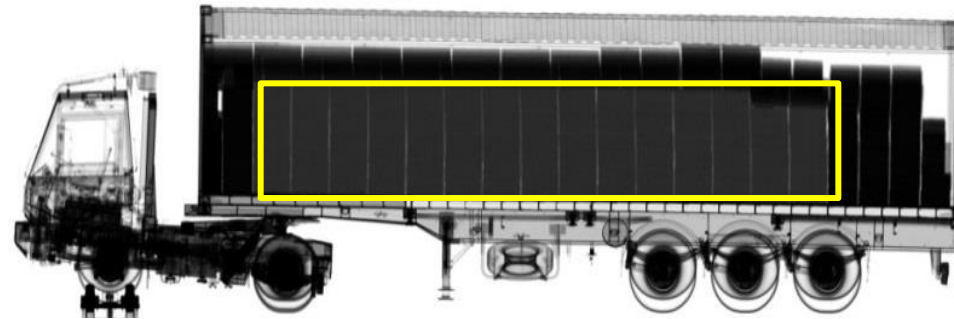


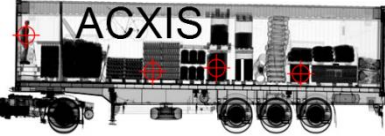


# Validation Study for ACXIS

Two main goals of the study

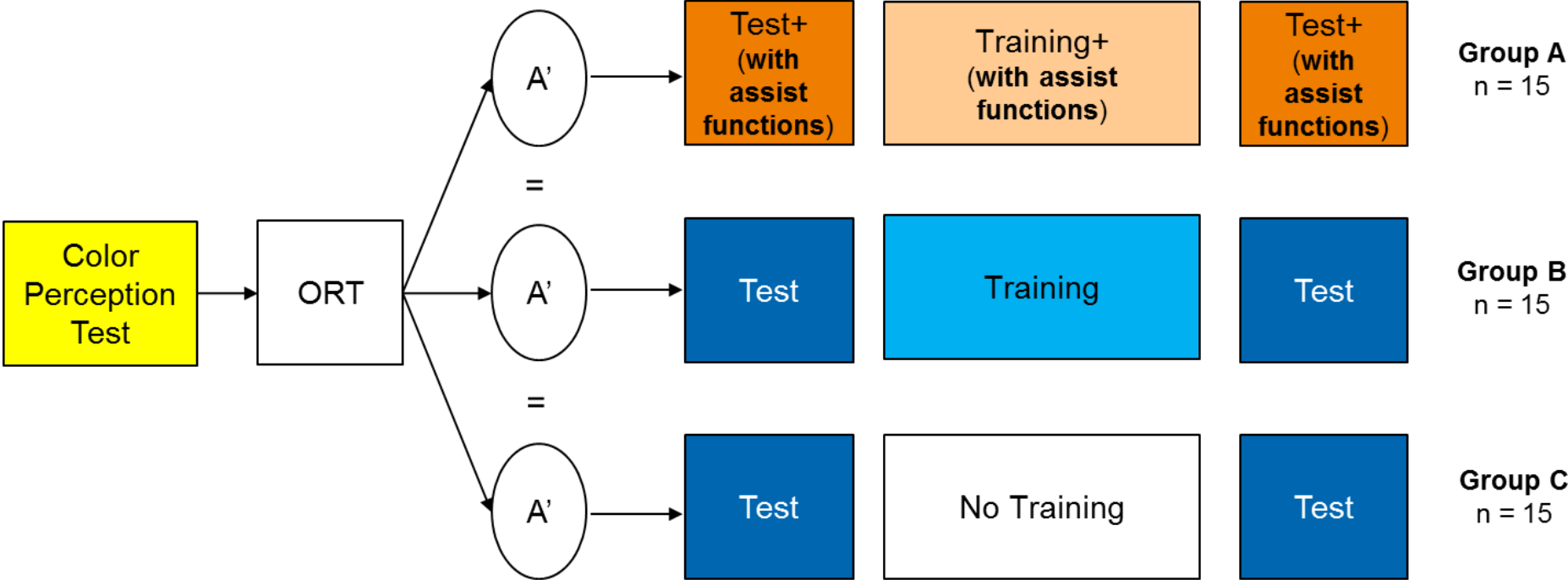
- 1) Evaluate how **automated target recognition (ATR) assist functions**, which are provided by the scanning software, can help cargo screeners to detect target objects in X-ray images of cargo containers.
- 2) Evaluate how recurrent training can **increase the X-ray image interpretation competency of cargo screeners**.





# Validation Study for ACXIS

## Study design



ORT

Test/Training

Test+/Training+

= Object recognition test

= Cargo images (CTIs)

= Cargo images (CTIs) with additional information (i.e. Frames, highlights)

Thank you for your attention