

Horizon Europe PARSEC

www.parsec-project.eu

Introduction to the PARSEC-project – Part 1 Project overview

May 2023



A project funded by the European Union's Horizon Europe research and innovation programme under the Grant Agreement No 101073963.



Consortium partners (19 in total)



1. Customs and police

- Dutch Customs (DCA)
- Belgian Customs (BCA)
- UK Border Force (UKBF)
- Hungarian Customs (NTCA)
- Dutch Police (NPN)
- Belgian Police (BFP)



2. Technologies

- Direct Conversion (DC)
- TWI Ellas (TWI)
- HALO X-ray Technologies (HALO)
- Dynaxion (DYN)
- Transcrime (UCSC)



3. Postal operators

- Post NL (PNL)
- Bpost (BPO)
- Poste Italiane (PIT)



4. Other partners

- TAPA EMEA (TAPA)
- TU Delft (TUD)
- University of Lausanne (UNIL)
- Cross-border Research Association CH (CBR)
- CBRA Services BE (CBS)

PARSEC will pursue the following four main objectives:



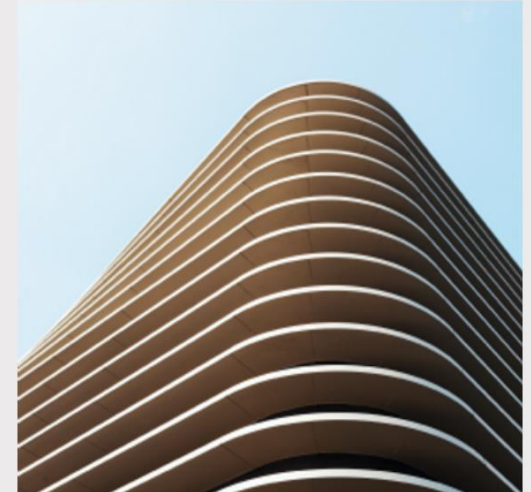
Enhance detection of threats and illicit goods in the postal and express courier flows through delivery of new data analytics techniques and novel non-intrusive technologies.



Achieve higher logistics and detection performances in the context of postal and express flows.



Strengthen the preparedness and reaction capacities in the postal and parcel service.



Ensure future uptake of project results via effective dissemination and exploitation activities.

Scope for threat materials & illicit goods types



Multi-threat risk assessment: De-risking of parcels and letters with data to reduce load on subsequent technical detection and manual inspection activities.



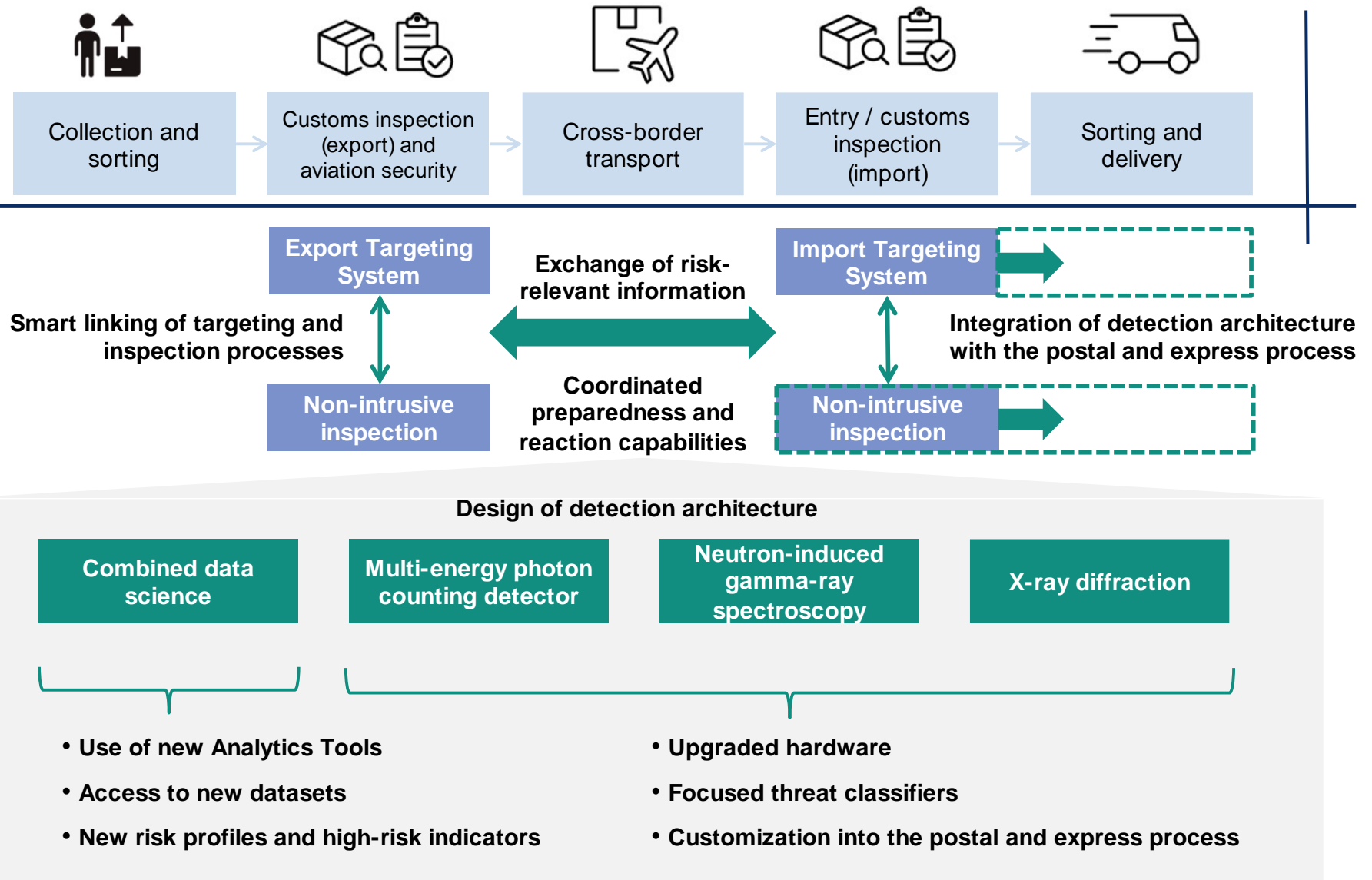
Illicit drugs detection: Delivery of capability which enables fast and predictable postal and express courier operations without burdening inspection resources with high rates of false positives.



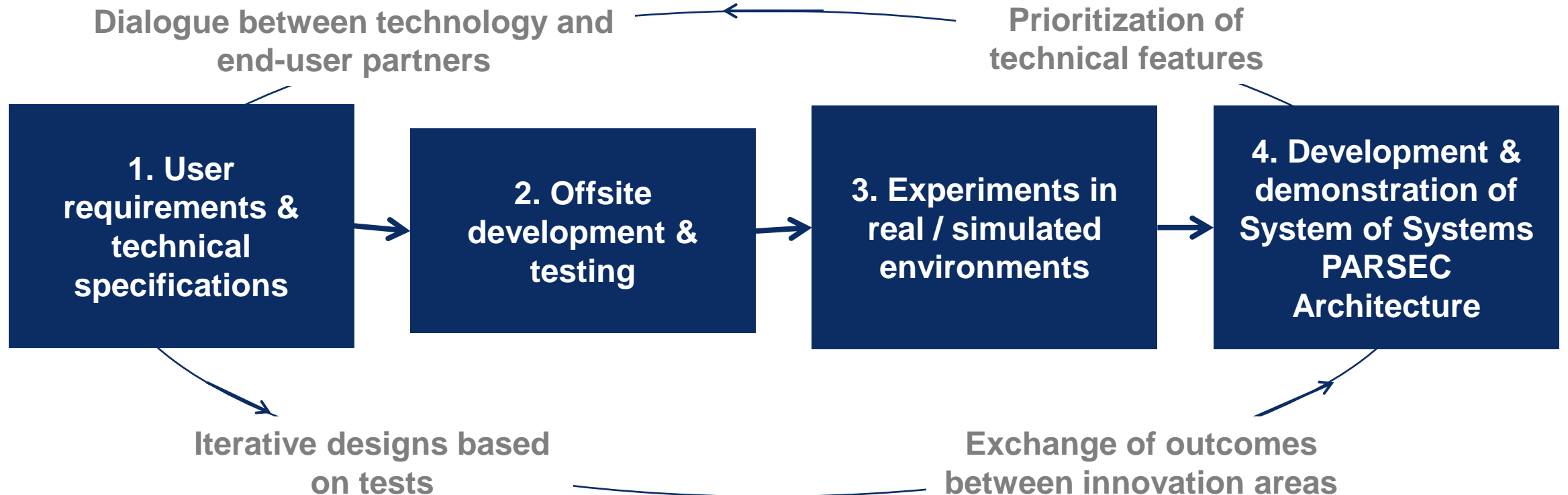
People safety to counter explosives, CBRN threats, and other hazardous materials: Contribution to such detection capabilities to deny misuse of the postal supply chain and protect postal employees, law enforcement officers and wider public from harm.

PARSEC

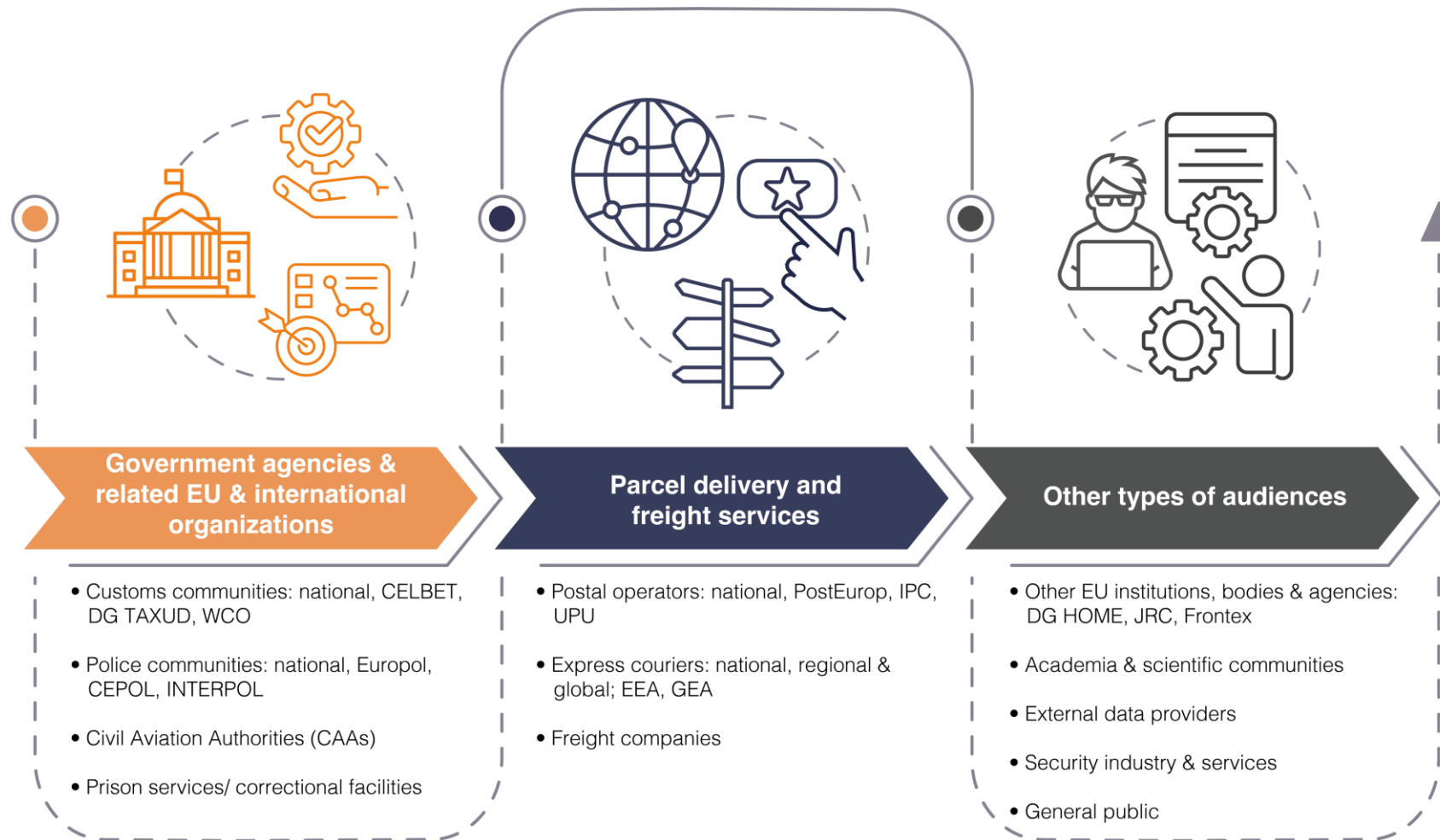
innovation concept & four innovation areas



Development cycle: activities & elements



PARSEC Communication, Dissemination & Exploitation activities - Target audiences overview



Horizon Europe PARSEC

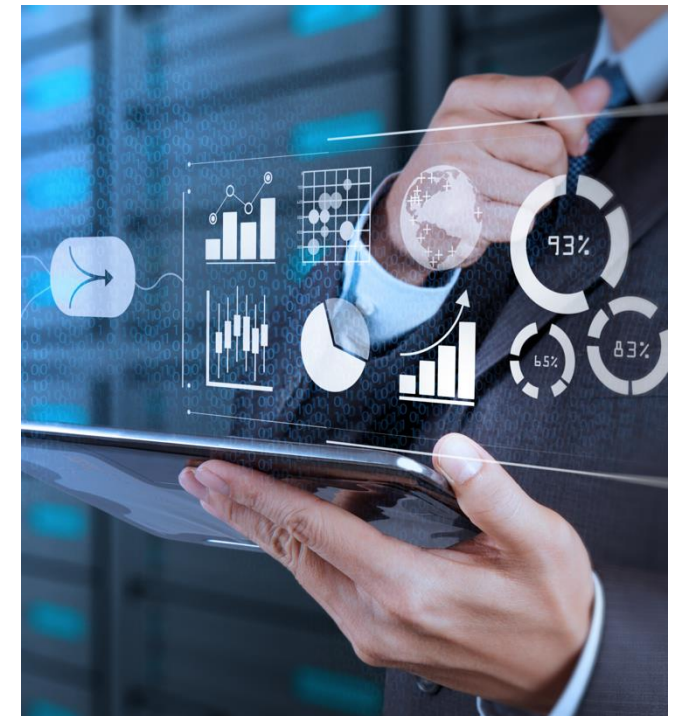
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Introduction to the PARSEC-project – Part 2
Technologies and innovations

May 2023

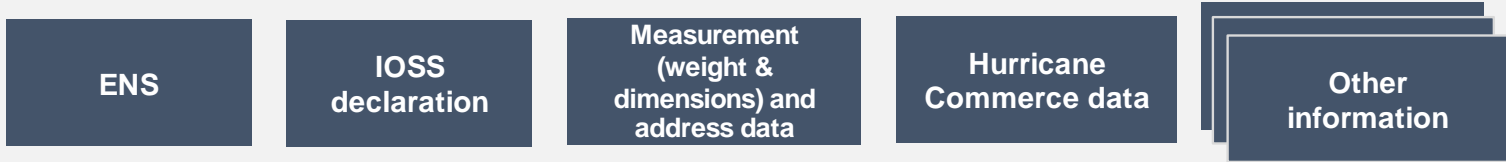


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PARSEC Architecture v1.0

I. Risk-relevant datasets



II. Risk engine

- Selection of high-risk parcels to non-intrusive inspection
- Guidance what threats to look for

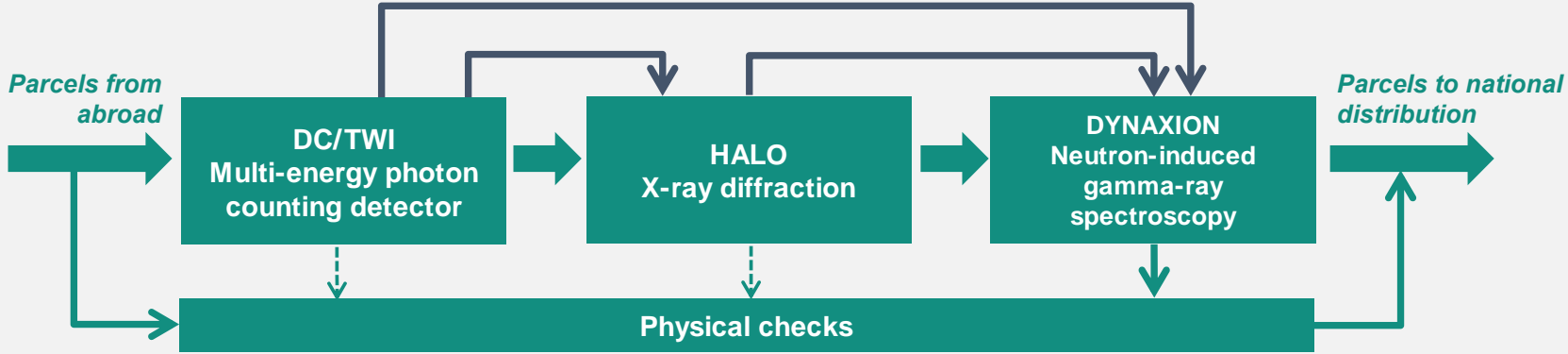


Guidance to DC/TWI 1st layer inspection

- Cross-analysis of images against datasets (e.g., does X-ray image correspond to declared description of goods?)
- Storage of all information for trend analysis and machine learning purposes
- Control feedback from physical checks (what was actually found)

III. Parcel flow and controls

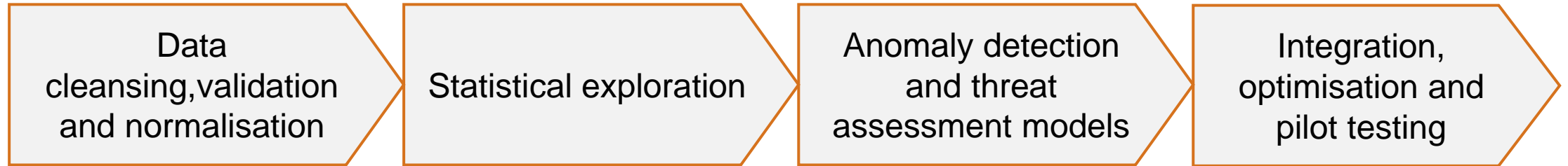
- Machine-to-machine guidance on what parcels to check, what threats to focus on, and a location where to look for threats inside a parcel



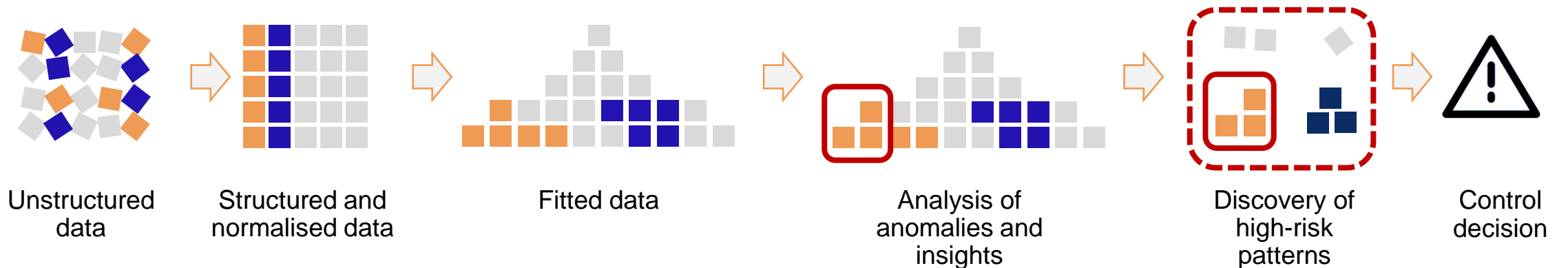
Combined data science — process

Combined data science
(led by Belgian Customs)

Task progression →



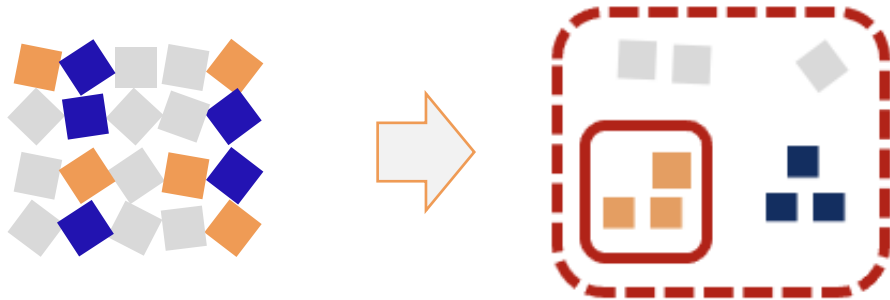
Data refinement process: from unstructured data to control decisions →



Combined data science, logic

Combined data
science
(led by Belgian
Customs)

Process from data to insights



Upgraded features

- Cross-analysis of images vs documents
- More refined control feedback loops
- Novel risk targeting algorithms

Control decision



- What parcels to control?
- What threats to look for?
- What methods to use to control the parcels?
- Where inside a parcel to look for the threats?
- What is the urgency of control?

Initial datasets in PARSEC (1/2)

Combined data
science
(led by Belgian
Customs)

- **Belgian Customs (BCA):** Customs security declaration (ENS) and Import declarations for eCommerce ('H7').
- **UK Border Force (UKBF):** reference information for 'a test kit' of parcels and packets representing the range of sizes, weights, shapes, and other characteristics of items that customs control at the border.
- **Direct Conversion (DC):** image data from the DC photon counting detector, system metadata, and associated data collection protocols.
- **HALO X-ray (HALO):** the dataset is generated by a standalone X-ray diffraction (XRD) threat resolving inspection system, which provides XRD spectra and information about likely locations of threat objects inside a parcel.

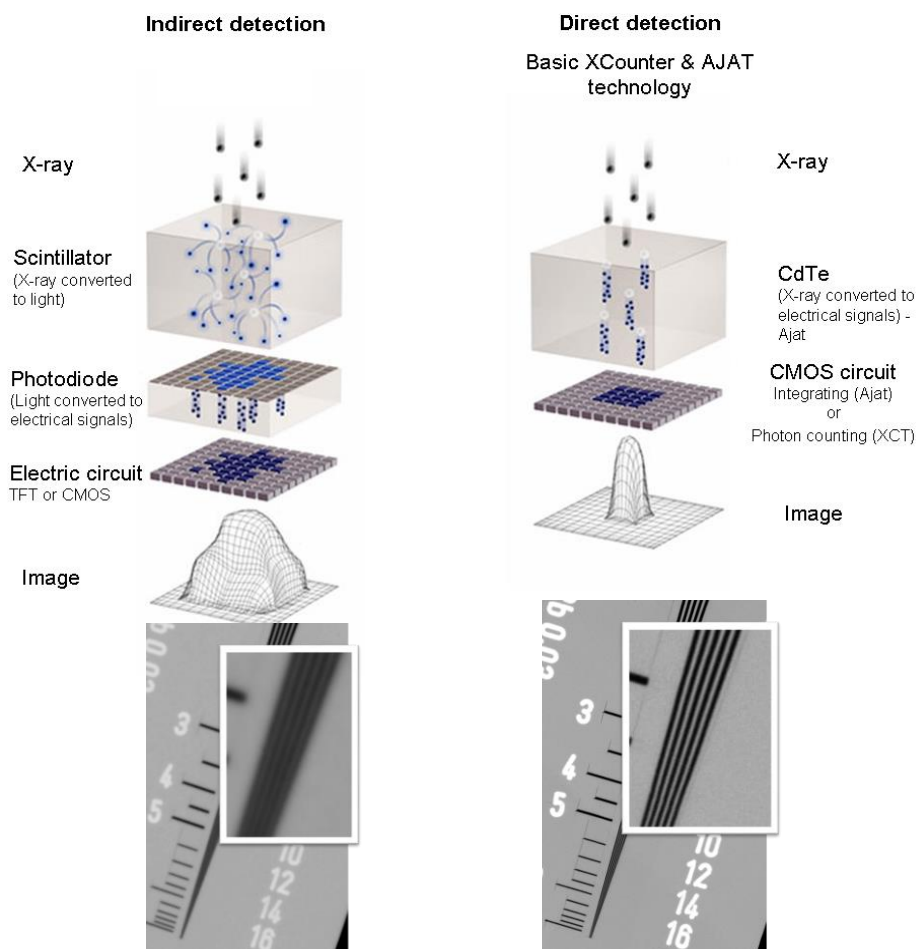
Initial datasets in PARSEC (2/2)

Combined data
science
(led by Belgian
Customs)

- **Dynaxion (DYN):** the dataset contains spectral and image information that is produced with Dynaxion's neutron-induced gamma-ray spectroscopy.
- **Transcrime (UCSC):** two main risk scoring databases for PARSEC (a) risk scores associated with origin-destination data for countries, across different types of goods & (b) risk scores associated with high-volume senders and receivers (legal persons), based on detailed analysis of corporate and compliance data.
- **Cross-border Research Association (CBR) & University of Lausanne (UNIL):** dataset concerning the PARSEC simulation tool configuration and parcel flow dynamics, including parcel characteristics (e.g., weight and shape), type of threats, input rates of parcels into the system etc.; plus, data about selected facilities (physical dimensions of facility, conveyor dimensions & speed, queue capacity, technology space requirements etc.)

Photon Counting Technology – Enabling Innovation

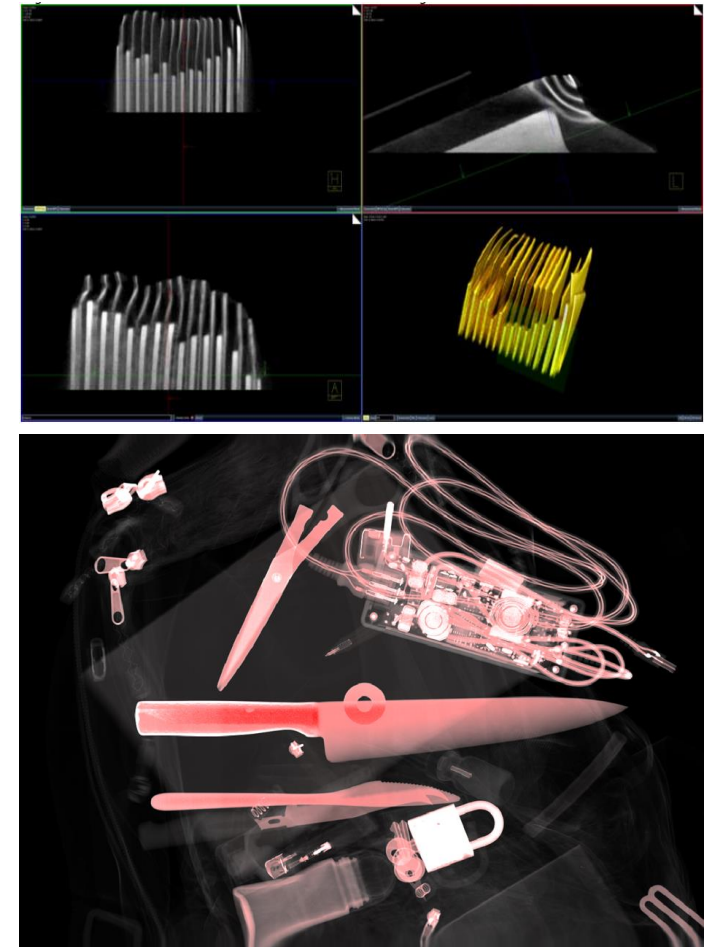
Multi-energy
photon
counting
(DC/VAREX)



- **Direct access to x-ray energy:**
 - Photon counting
 - Energy separation
- **No scintillator layer**
 - no light spread, sharper PSF
 - no lag, reduced ghosting
- **High efficiency and sensitivity**
 - 100% fill factor – efficient system designs
- **Unlimited dynamic range**
 - Screen more types of goods optimally

Screening at the speed of Global Commerce

- **Ultra high speed: 1:1 pixel readout**
 - 10,000 fps MAX enables high system belt speeds
 - Real-time images and algorithms
- **High resolution imaging**
 - Screen multiple items at one for batch processing
 - High quality images enable algorithms and user screening of threats without direct handling
- **Multi-energy detector system**
 - Selectivity for threats for accuracy
 - Optimal ranges for parcel/mail threat screening



HXT264 Solution

X-ray
diffraction
(HALO)

HALO X-ray diffraction platform

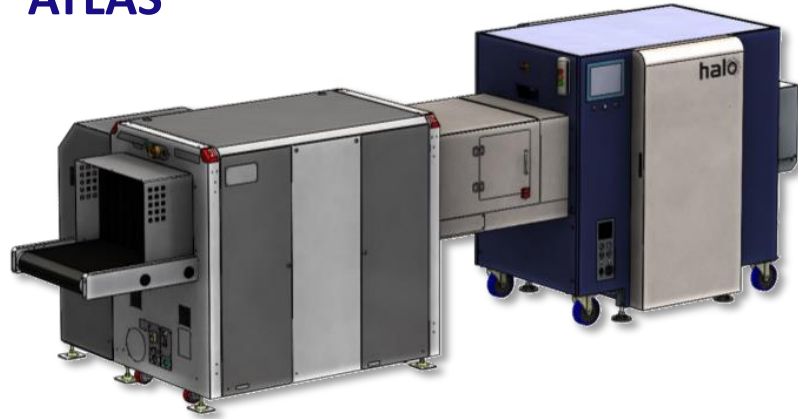


- **Augments X-ray screening equipment for increased detection and decreased false alarms**
- **X-ray diffraction-based materials discrimination in 2s**
- **Customisable threat libraries**
- **Technology readiness level 7**
- **High reliability (field tested in live airport environment)**
- **Low cost and small format**
- **US DHS & UK DfT supported**
- **Backwards compatible with all major X-ray screening vendors**

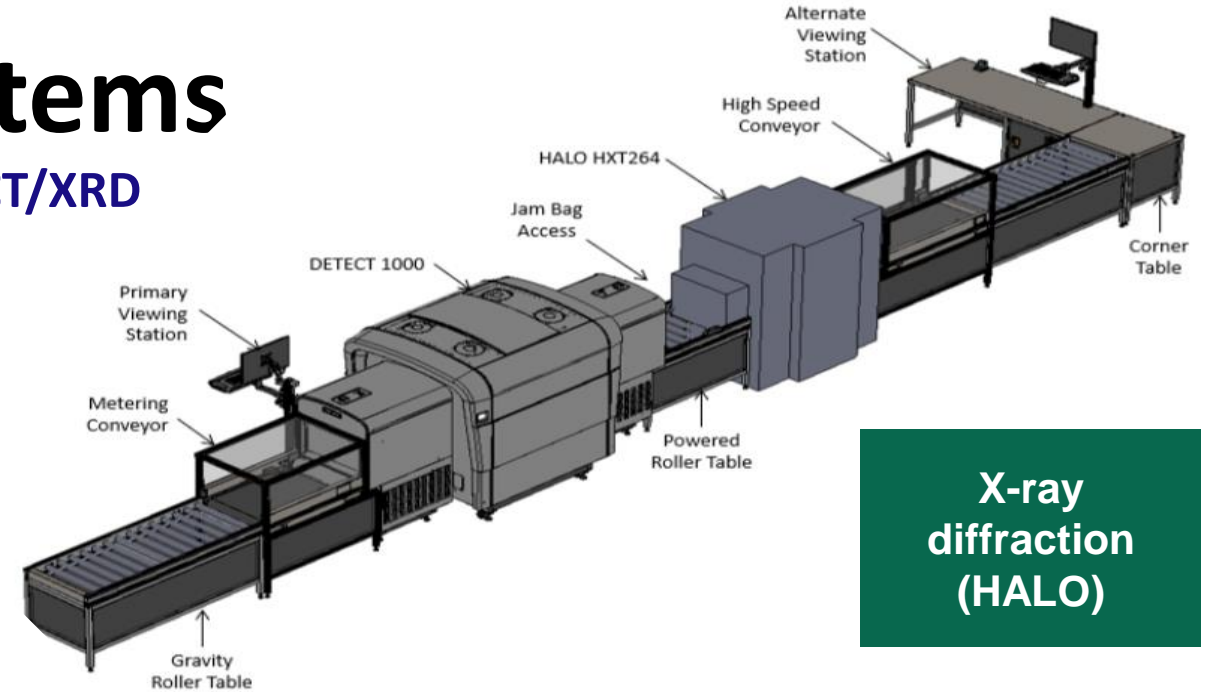
HXT264 system-of-systems

Current deployments:

ATLAS



CT/XRD



- Integration with Rapiscan 620DV
- Developed by US DHS under the ATLAS program
- Demonstrated >5 factor in reduction in false alarm rate
- ATLAS currently deployed at Coventry international sorting hub, UK

- Integration with IDSS Detect 1000
- Developed by US DHS under the CT/XRD program
- Explosive data collection at the Transport security labs (NJ, USA)
- Currently deployed at BOS logan airport for SOC data collection

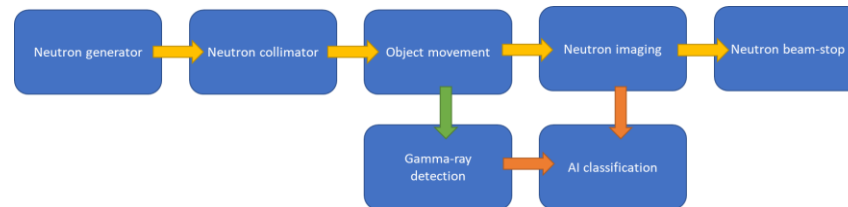
Future deployments: Varex multi-energy photon counting technology – HALO HXT264 – Dynaxion neutron induced gamma-ray spectroscopy.

Level 3 screening using neutrons

ADVANTAGES

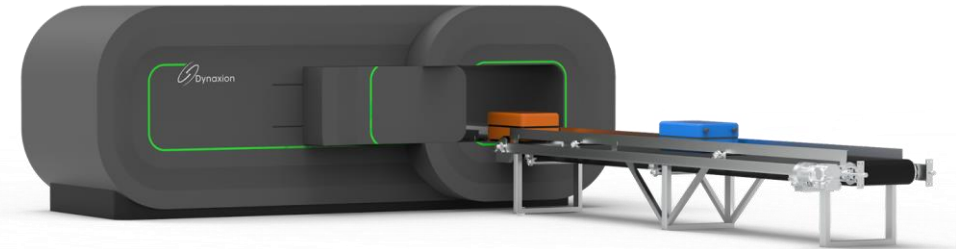
- Fully automated
- Non-invasive
- Low false alarm rate (<5%)
- High detection rate (>95%)
- Object & substance identification

PATENTED SYSTEM CONCEPT



- Unique particle accelerator-based neutron source
 - Selectable neutron energy
 - High flux (10^7 n/s/cm² at 1 meter)
 - Pulsed (microsecond pulses)
 - Low power (5x lower power)
 - Compact (5x more compact)
- Dynamical voxel scanning system to identify substances

KEY SYSTEM FEATURES AND CAPABILITIES

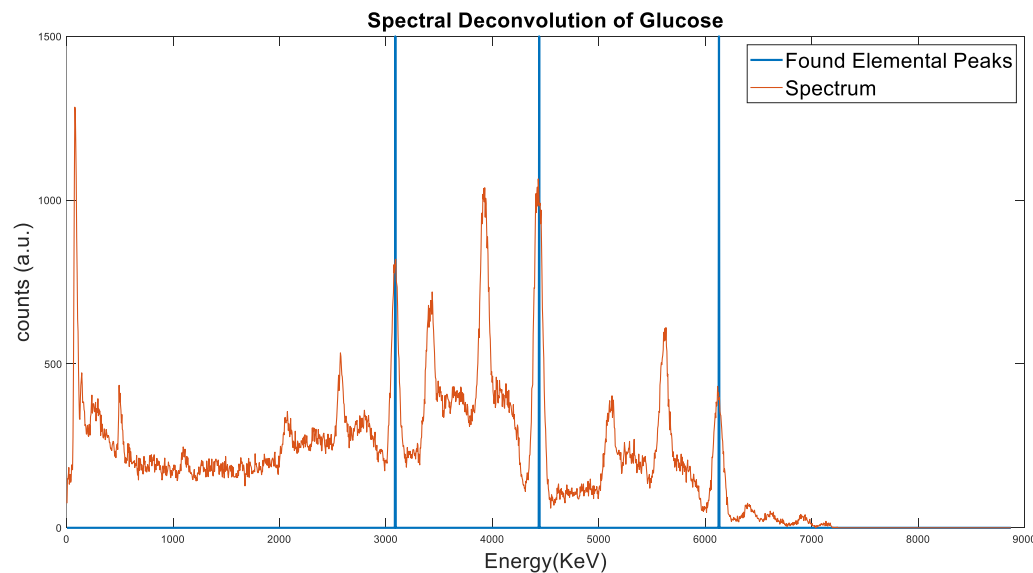


- Gamma-ray spectroscopy
 - Neutron-induced* gamma-ray spectroscopy for accurate and non-invasive substance identification
- Fast neutron imaging
 - High-resolution neutron imaging enables the identification of objects even when hidden behind dense plastic/metal structure
 - Complementary to X-ray imaging
- Innovative compact shielding
 - Compact multi-layer shielding with double door system for safe operations
- Artificial Intelligence
 - Proprietary deep learning algorithms enable automatic detection of dangerous and illicit content

Artificial Intelligence classification

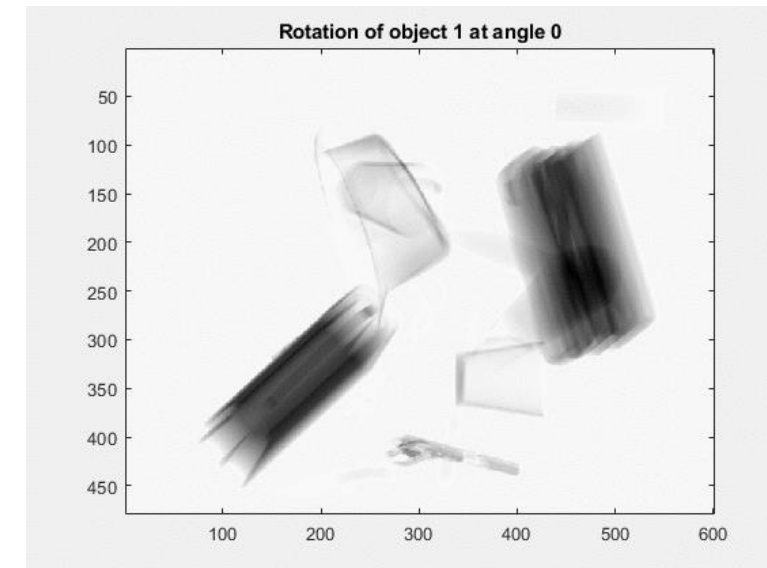
SUBSTANCE IDENTIFICATION

- Training database with 100+ spectra for commonly used materials
- >95% accurate classification
- Explainable AI for trustworthy results



OBJECT RECOGNITION

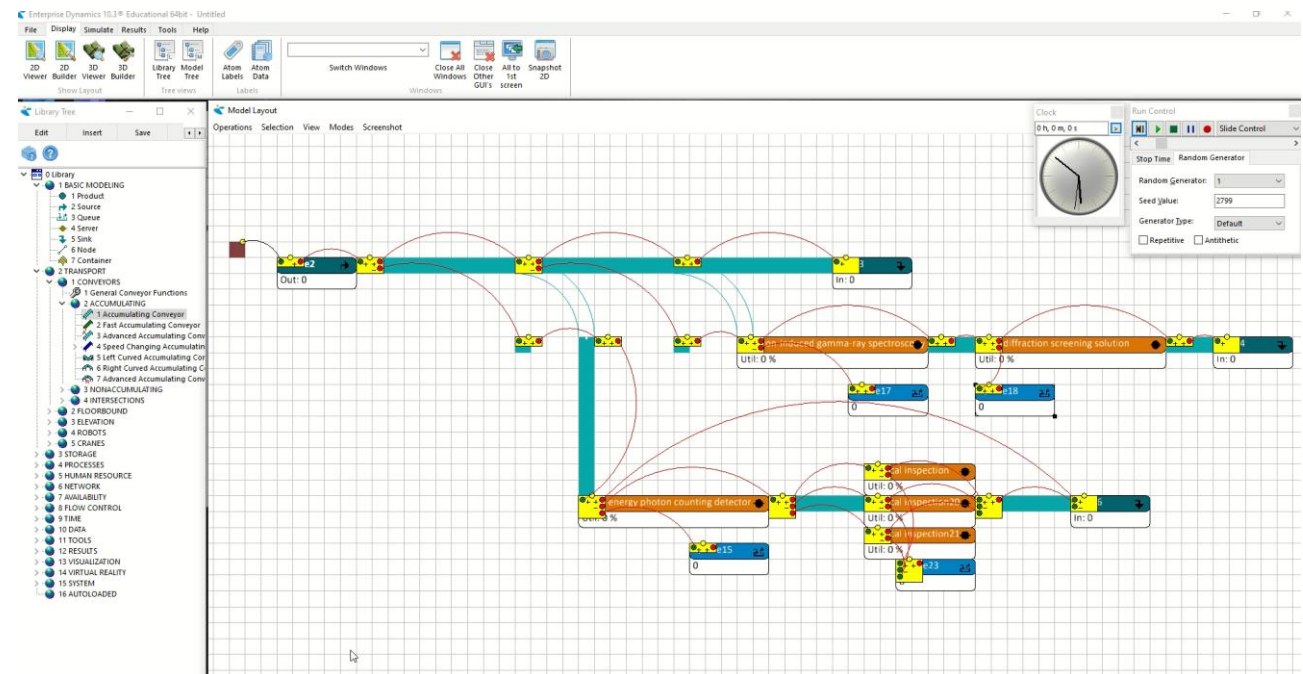
- Database with 50+ objects are randomly distributed inside parcels and multiple 2D projections are created
- Over 20.000 images are generated for training of object recognition algorithm



Flow simulation model and tool

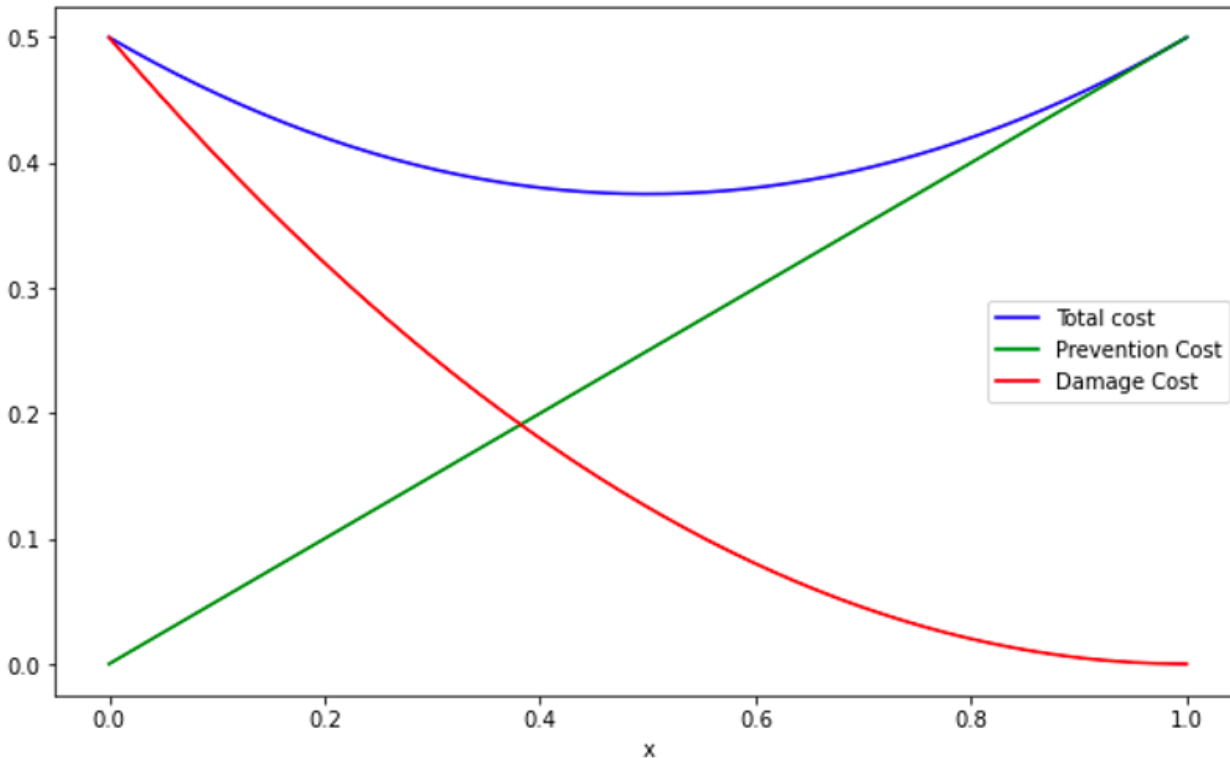
Flow
simulation
(CBR & UNIL)

- The goal is to use a simulation flow tool for designing a "system-of-systems" to efficiently and effectively detect illicit items in the parcel flow
- The simulator will analyze different combinations of detection technologies and scenarios to determine the best operational characteristics for achieving high throughput performance and high hit rates
- ***The model will help to find the balance between speed and security targets under resource and operational constraints***



Total optimisation model and tool

Total
optimisation
(UNIL & CBR)



- First, we seek for 'best available numbers on true scale of smuggling via international postal and express services', across a 'variety of illicit commodities and materials of high customs interest'
- Second, we collate the most realistic numbers on 'comprehensive socio-economic costs caused by success in smuggling', across the chosen set of illicit commodities and materials
- Third, we compile all available PARSEC technology cost and performance data; labour cost, electricity & maintenance costs etc.
- Finally, the model calculates the minimum total cost when combining prevention costs and societal impact costs; the total optimal cost
- ***The model will provide evidence for customs policy makers as well as for strategic decision-making in customs administrations***

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