Results of the EU project for an effective Container Inspection at Border Control Points in Support to Customs

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Abstract

The Effective Container Inspection at Border Control Point (CBORD) project launched in June 2015, was funded within the EU H2020 programme to support a consortium of eighteen partners from nine EU member states in order to develop and integrate various detection and inspection technologies into an efficient non-intrusive inspection (NII) system for containerised freight. Five technologies were selected and developed which are: the next generation cargo X ray, tagged neutron interrogation, evaporation (or sniffer) techniques, advanced radiation portal monitors (RPM) and photofission. These were first laboratory tested at the ITRAP facility of the JRC-Ispra, CEA (France), Symetrica (UK) and MTA EK (Hungary) followed by extensive field testing on targeted use cases at an EU border and two seaports. Most importantly and for the first time, the data generated by the technologies were collated and combined with customs information in a single graphic user interface in order to simplify and speed up inspection while allowing an effective and correct customs decision-making. Following an independent assessment of the project, it was finally concluded, successfully and on schedule with a public workshop which included a demonstration at the Rotterdam harbour.

This paper aims to report on the project and give some of its main results and conclusions.

Keywords: CBORD, Nuclear Security, Detection of Illicit Trafficking, SNM, explosives, Narcotics, Tobacco

§ *on behalf of CBORD partners* http://www.cbord-h2020.eu/

Introduction

An efficient non-intrusive inspection (NII) of containerised freight is critical for customs, as they are potential means of smuggling, illegal immigration or even trafficking nuclear material and chemical warfare agents. Thousands of freight containers and trucks pass every day at any small to medium port or border within the EU which potentially makes them an ideal means for the illicit transport and trafficking of radioactive and nuclear materials (including waste and contaminated commodities) as well as for the smuggling of drugs and narcotics, tobacco, weapons, explosives, chemical warfare and humans. This creates many challenges for customs and border control authorities who must ensure that adequate inspection means and solutions are in place for an optimum interdiction chain that is on one hand safe, practical, and cost-effective and on the other hand remain non-intrusive in order to facilitate trade and ensure safety and security of the society.

Thus an NII of containerised freight is increasingly important to trade and society, as the criminal disruption of supply chains can severely harm the economy, as well as endanger public health and safety. The current methods for container NII combine intelligence-supported risk analysis and X-ray technology to combat illicit trafficking. However, this approach is limited due to health and safety regulations, long operator processing time to manually check containers in case of a doubt and a lack of reliability due to insufficient ability to distinguish between innocent items and threats. There is no single inspection technology available that could adequately cope with the challenge of reliably detecting all of the above threats which containers can be used for.

The objectives of CBORD was thus to enable customs to deploy a set of comprehensive and cost-effective solutions for an efficient non-intrusive inspection (NII) of containers in order to protect the European Union sea and land borders.

Following the success of EU FP7 SCINTILLA project, CBORD was funded (11.8 M€) within the EU H2020 programme to support a consortium of eighteen partners from industry, universities, research centres, users and operators from nine EU member states. The technologies selected and developed are ***the next generation cargo X ray***, **tagged neutron interrogation, evaporation based detection** (or sniffer), **advanced radiation portal monitors** (RPM) and **photofission**. These were extensively tested (against international standards) in laboratories such as at the ITRAP facility of the JRC-Ispra, at CEA (France), Symetrica (UK) and MTA EK (Hungary).

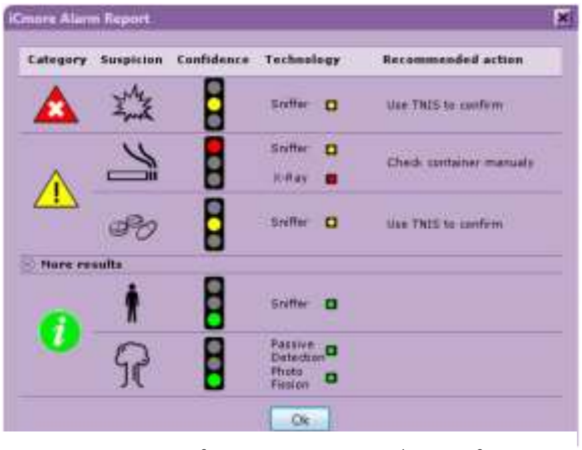
Radiation Portal Monitor Laboratory testing at the JRC, MTAEK, Symetrica

This was followed by thorough and demanding real field testing on targeted use cases at three customs sites namely at a border in Hungary and in two seaports in Poland (Gdansk seaport) and Netherlands (Rotterdam) with a great collaboration from local customs and operators.

Deployment and testing at three customs sites (Border, Seaports)

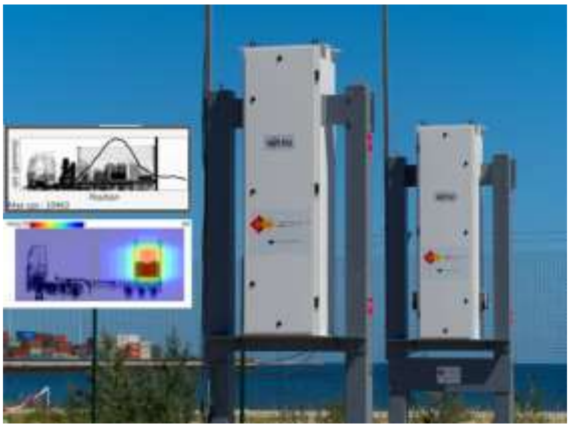
Combining five NII technologies

Within the framework of the C-BORD project, a new generation of container inspection system was developed, combining advanced X-ray techniques capable of locating objects inside a large volume (cargo container) at a high rate, as well as additional techniques more sensitive to specific substances, such as: advanced passive detection technologies, a tagged neutron inspection system, photo-fission technology and artificial sniffing. The data generated by the five technologies were collated in a single graphic user interface which allowed to simplify, speed up and help customs to ensure an effective and correct and reliable inspection and decision-making.

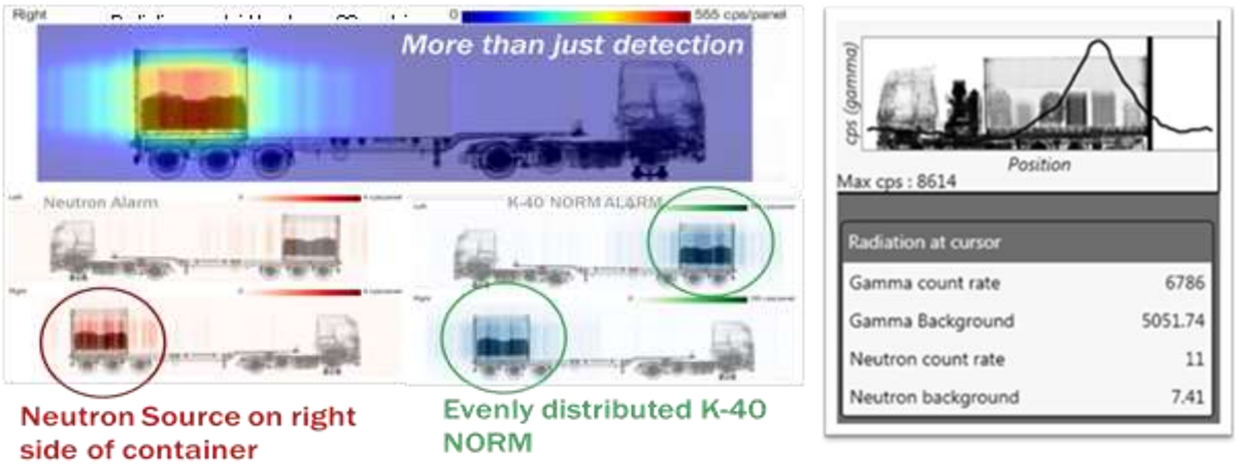


Screen captures from DaiSy, an analysis software tool from Smiths Detection. ©Smiths Detection

Passive detection, neutron and gamma detection sub-systems were designed to demonstrate the feasibility of using isotope identification to reduce false positive radiation alarms raised by naturally occurring radioactive materials, such as fertilizer. This goal was successfully reached.



Passive neutron-gamma detection system



Example of the common Interface merging passive detection and identification results with the X-Ray scanning image:

While previous "artificial sniffing" methods have failed because of the complexity of the problem at hand (notably in terms of sensitivity, due to a wide range of potential targets - the large volume of a potentially contaminated cargo adds complexity), a robust and highly sensitive evaporation-based detector was developed to detect volatile chemicals that may be present in a container. The sampling proof of concept for large volume application still needs to be demonstrated.

Artificial sniffing sampling by introducing canister inside the container

The "Rapidly Relocatable Tagged Neutron Inspection System" (RRTNIS) was a second-line system to be used on sealed containers. These detectors complement X-ray imaging by enabling molecular-specific detection (providing chemical information instead of the object's outline), thus improving the discrimination power of the scanning system.

Within CBORD, the successful detection of targeted drugs and explosive within containers by the RRTNIS was done in real condition, with real targets, explosives and drugs, hidden by customs in containers.

RRTNIS in operation on field test area

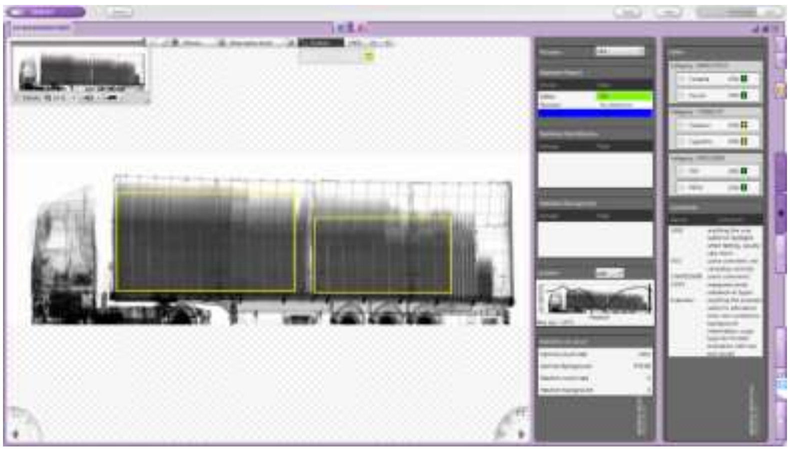
Additionally, the photo-fission technique enabled to detect SNM (Special Nuclear Material – mainly uranium and plutonium isotopes), a crucial issue for homeland security applications. It allows for inspection of the cargo container without opening it, which is a time-consuming and potentially dangerous process. Both these experiences demonstrated the efficiency of the detection capability for these breakthrough techniques and represented a major success for European research and European customs.

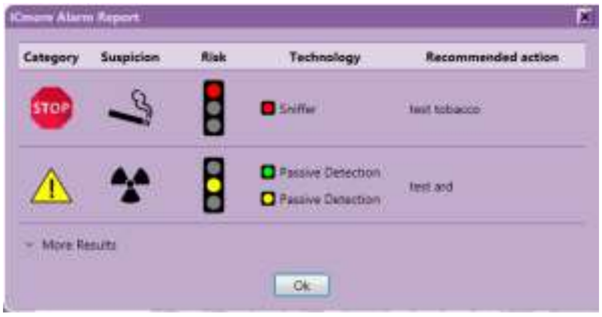
The C-BORD project was also an opportunity to improve X-ray techniques, particularly with regard to the accuracy of material discrimination with progress on radiation scattering treatment and correct x-ray image artefacts caused by movement of the x-ray scanner boom.

Mobile X-ray detection system

C-BORD met critical operational requirements and overcame a number of constraints, which altogether enable for:

- Increased throughput of containers per time unit
- Reduced need for costly, time-consuming and dangerous manual container inspections
- Lower false negative and false positive alarm ratios





Reduction of false Alarms

From the laboratory to customs

As the aim of C-BORD was to develop new and improved NII technologies tailored to the customs' working environment, they were tried and tested in real operational conditions. This is why C-BORD planned field trials jointly with customs partners. The performance of the technologies was tested at three customs sites: Rotterdam, The Netherlands, for testing equipment for a fully automated seaport; Gdańsk, Poland, for implementing a rapidly relocatable checkpoint for ports; and Röszke, Hungary, for deploying mobile equipment for a land border checkpoint.

Tailored and efficient solutions for end users

One of the benefits of the approach is that it proposes tailored solutions for very different customs / border-crossing situations, from mobile devices for a small land border-crossing to fixed installations for an automated system handling large volumes at a major port. Thus, the deployment of C-BORD solutions can address the problem of the weakest link in the control chain.

Euronews Video during Gdansk tests

Thanks to the assessment of the enhanced technologies, and how their combined use allows for a reliable detection of radioactive material, explosives, chemicals, drugs and tobacco hidden in cargo containers, C-BORD supported the decision-making of end users, namely customs services, on how to combine and deploy technologies for different needs.

All activities were governed by the standard research ethical principles relative to the safety and well-being of researchers, the public, private property and the environment. All trials were subject to authorisations from the appropriate national civilian health & safety authorities in charge of hazardous materials and active detection methods.

Summary Evaluation

Technology	Lab Tests	Pre-Trials	Field Trial Röszke	Field Trial Gdansk	Field Trial Rotterdam	End User Feedback
Evaporation Based Detection	✓	✓	✓	✓	✓	😐
Radiation Portal Monitors	✓	✓	✓	✓	✓	☺
X-Ray	✓		✓	✓	✓	☺
RRTNIS	✓				✓	☺
Photofission	✓				✓	☺
Data Fusion	✓		✓	✓	✓	☺

Final assessment of the CBORD solution including the data fusion from a combination of customs information and inspection/detection technologies

References and Credits

References: http://www.cbord-h2020.eu/

Video about the C-BORD project:
www.euronews.com/2018/07/16/how-to-make-customs-controls-more-effective

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Partners of the C-BORD project:
CEA (coordinator), ARTTIC, JRC, BRSU, CAEN, ESIEE, Fraunhofer, MTAEK, NCBJ, OCSS DCA, SYMETRICA, SmithsD, UNIPD, UNIMAN, ICGDy, NTCA, ADM