Produced for: Ms. Stephanie Durant, DG EMRO PS Canada, Insp. Ken Faulkner – Officer in Charge CBRNE Operations, TIS, Tech Ops, RCMP, Insp. Tony McCulloch – Officer in Charge NFISS, IFIS, FS&IS, RCMP, Dr. Mark Williamson, A/DG DRDC CSS, to answer the question on the operational value of recent CBRN S&T investments in a large four-Nation field Exercise.

Scientific Letter

Analysis of the operational test and evaluation of the CBRNE 'Crime Scene Modeller' (C2SM)

Introduction

This document serves to answer the question on the operational value of recent CBRN S&T investments tested in a large four-Nation field Exercise.

The Chemical, Biological, Radiological, Nuclear and Explosives (CBRNE) "Crime Scene Modeller" (C2SM) is the culmination of two projects funded via the Chemical, Biological, Radiological, Nuclear, and Explosives Research and Technology Initiative (CRTI). The first being project 05-0122TD[1], whose goal was to develop a proof of concept prototype [Technology Readiness Level (TRL) 6] capable of data collection in CBRNE crime scenes via the rapid creation of photorealistic 3D models, augmented by geo-located data obtained from CBRNE detectors and high resolution and thermal images[2]. The system provides law enforcement with an improved capability for gathering, storing and visualizing on-site evidence from a CBRNE event and significantly reduces the time required by response personnel to physically be present in a contaminated crime scene[3]. The second project, 07-0216TA[4], further developed the C2SM from TRL 6 to a pre-production system (TRL 8). This project specifically addressed the CRTI priority: CNSIC-4, "Development of CBRNE detector suites and near real-time communication techniques on robotic platforms." This was accomplished by developing an innovative integrated suite of CBRNE detectors, imaging cameras and a non-GPS localisation system capable of deployment on various robotic platforms, adding modularity and portability to the capability[5]. A C2SM simulator enables efficient responder training in realistic scenarios in a game-like environment.

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[1] C2SM: CBRN Crime Scene Modeler. Final Report CRTI 05-122TD, 2008.

[2] Jasiobedzki, P. Instant Scene Modeler for Crime Scene Reconstruction. Computer Vision and Pattern Recognition Workshop, IEEE Computer Society Conference Proceedings, pp.123-125, 25 June 2005.

[3] Kwietniewski, M.; Wilson, S.; Topol, A.; Gill, S.; Gryz, J.; Jenkin, M.; Jasiobedzki, P.; Ho-Kong Ng. MED: a Multimedia Event Database for 3D crime scene representation and analysis, IEEE Conference Proceedings, USA, pp 1592-1595, 2008.

[4] C2SM-FAST: CBRNE Crime Scene Modeler Final Report CRTI 07-216TA, 2011

[5] Jasiobedzki, P., Ho-Kong Ng; Bondy, M.; McDiarmid, C.H. C2SM - a mobile system for detecting and 3D mapping of chemical, radiological, and nuclear contamination. Proceedings of the SPIE - The International Society for Optical Engineering, vol.7305, 730509 (10 pp), 2009.

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It should be noted that these two projects are somewhat unique in comparison to other CRTI projects, as they leveraged another CRTI innovative technology. In its suite of detection systems, C2SM integrated the Directional Gamma Ray Probe (DGRP), which was the product of project 05-0122TD.

The second project produced five C2SMs, which were transitioned and operationalized to the project's law enforcement (LE) partners: Toronto Police Service, Hamilton Police Service, Vancouver Police Department and the Royal Canadian Mounted Police (RCMP)[6][7]. The final component of the project involved a successful testing and evaluation (T&E) phase, conducted by the four LE partners in controlled situations. The RCMP-led National CBRNE Response Team has since integrated and operationalized the C2SM as a component of its robotic capabilities for scene exploitation. Outside of the above 'controlled' conditions for T&E, the systems had not been fully challenged through a blind Operational test and evaluation of the capability in the field. Of particular interest is the C2SM's radiological detection technology that permits rapid deployment, detection and localization of radiological sources prior to the response team's ability to deploy personnel downrange. Whether such S&T investments can provide operational value for law enforcement in a large blind field test was without answer.

Methodology

The goal of this effort was to **answer the Senior Leaders' question: in a blind test, does a CBRNE Response Team have the specific ability to most rapidly detect, localize and measure hidden radiological sources prior to deploying personnel downrange as part of a large CBRNE field Exercise**? The National CBRNE Response Team participated in such a large four-Nation CBRNE Exercise outside Canada in April 2013, which included an opportunity to conduct a blind test of the C2SM in a live operational setting. Specifically, it provided an opportunity to test and evaluate the performance and effectiveness of the capability as well as an opportunity to receive an arm's length peer evaluation by an audience of International expert LE personnel with CBRNE expertise in detection and mitigation.

The radiological scenario of interest involved terrorists attempting to smuggle Special Nuclear Material (SNM) into the country[8]. A plutonium segregate was used to simulate the SNM, but the terrorists also included Cs^{137} and Co^{60} sources and legitimate documents to mask the presence of the SNM. Measurements included the detection and the localization of radiological sources prior to the response team's ability to deploy personnel downrange. Further, a simple written evaluation was also performed by peers in LE.

Results

Upon occupying the scenario site, the National CBRNE Response Team deployed the C2SM within 15 minutes to interrogate the site. The C2SM video and high resolution camera images provided the team with **immediate situational awareness** of the site, but more importantly

[6] Codd-Downey, R.; Jenkin, M.; Ansell, M.; Ng, H.-K.; Jasiobedzki, P., Simulating the C2SM 'Fast Robot', Publisher: Berlin Germany; Darmstadt Germany: Springer-Verlag, pp. 26-37 2010.

[7] Jasiobedzki, P. ; Ho-Kong Ng; Bondy, M.; McDiarmid, C.H. Increasing Situation Awareness of the CBRNE Robot Operators. Proceedings of the SPIE - The International Society for Optical Engineering, vol.7666, 76660N (8 pp.), 2010.

[8] Note: the scenario is aligned with Prime Minister Harper's counter-proliferation of SNM commitment and posture at The International Nuclear Security Summit of 2014 (http://pm.gc.ca/eng/news/2014/03/25/pm-reiterates-canadas-commitment-nuclear-security).

correctly identified and correctly localized three separate sources within the suspect vehicle, faster than any other system of other nations[9]. Two of the sources were contained within shipping containers in the cargo area of the vehicle and the third was located in the rear of the vehicle where there was an absence of a shipping container, suggesting that this source was concealed. The C2SM further and correctly provided **immediate activity readings** associated with the sources, which allowed the scientific support team to determine required dose rates for the initial operator approaches. Armed with this information, the on-site Commander was better informed and better prepared than other teams to send personnel downrange to locate and secure the sources.

The National CBRNE Response Team received very positive peer evaluations in relation to this scenario. In particular, two specific observations were made: i) Reconnaissance - multiple systems were simultaneously operated without issue, validating the seamless use of robotics improving reconnaissance in the field; and; ii) Detection and monitoring – the C2SM enabled the continuous and constant monitoring and assessment of the test environment to the benefit of Operators. The C2SM provided the National CBRNE Response Team with the ability to rapidly and effectively deploy a system that could detect and isolate sources and provide highly reliable information to base prior to further human intervention downrange. The peer evaluators were extremely impressed with the C2SM and expressed an interest in their respective team's ability to acquire this innovative capability. Additionally, a representative from the United States Combating Terrorism Technology Support Office's (CTTSO) Technical Support Working Group (TSWG) made specific inquiries to learn more about the development of unique C2SM capability.

Conclusions

It is concluded that under **operational** conditions, the innovative mature technologies associated with the C2SM robotic capability were successful in rapidly detecting, localizing and documenting live radiological sources. This ability allowed for critical information to be discovered without jeopardizing human operators' health and safety in unknown and potentially hazardous situations. Additionally, the acquisition of this critical information was performed during the lengthy initial phase of preparing for human approach and intervention, a unique time saving attribute of this capability. Recorded event data such as 1) geo-located CBRNE measurements, 2) visible/IR images and 3) 3D models were stored in a database and were immediately available for response planning. The stored data was also used for post-event analysis and training purposes. **This development and operationalization of the C2SM demonstrates the value of the Capability to LE partners**. It also demonstrates the value of the Canadian government's investment in innovative technologies, particularly when the innovation get tested in the field with other nations, and gets transitioned and operationalized by LE partners, to close CBRNE Operational capability gaps.

Recommendations

It is advised that partnerships and methods be explored to further the exploitation of the C2SM to other Law Enforcement in Canada and worldwide thus enhancing the protection of responders to CBRN events, stimulating commercialization efforts, and potentially augmenting the creation of wealth in Canada. It is further advised that Canada continues the posture of

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[9] Vallerand, A.L., Yanofsky, N., McDiarmid, C, Jasobiedski, P. Operational T&E of CBRN C2SM. Securetech Conference poster, Ottawa ON, October 2013.

generating Operational value for S&T investments and documenting it through International Operational Field Exercises.

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