



2014-07-08

DRDC-RDDC-2014-L136

Produced for: Public Safety Stakeholders (see Distribution list)

## Scientific Letter

# Moving from 'outputs' to 'outcomes', through 'uptake'

## Purpose

To inform and make recommendations to the co-Chairs of Program Management Board (PMB), Director General (DG) of the DRDC Centre for Security Science, DG Emergency Management and Public Safety at Public Safety Canada, all OGD DG members of PMB and other senior decision makers, regarding the impact an important shift from focusing on S&T **outputs** to focusing on S&T **uptake** will have on achieving Public Safety and Security **outcomes** and suggested means to facilitate such an important shift.

## Results summary

There is evidence to support the thesis that active S&T **uptake** is a more reliable indicator of success in influencing desired outcomes than is simply the quality of the S&T **outputs**.<sup>1 2 3</sup> While there are barriers on both the S&T output producer and consumer sides, the following recommendations are made to reduce or eliminate key **uptake** barriers:

1. Encourage collaborative partnerships between S&T output producers and consumers as a means to shift focus from isolated S&T **outputs** to informed S&T **uptake** in direct support of identified public safety and security outcomes; and
2. S&T investments decision processes should explicitly consider avenues to exploit available technologies and concepts in innovative ways to bring S&T outputs to bear and facilitate their rapid **uptake** in closing public safety and security capability gaps in a timelier manner.

## Introduction

While DRDC Centre for Security Science (CSS) once had "Science Clusters", CSS now has Communities of Practice (CoP). A CoP exists because practitioners exist. They are mainly self-formed and self-sustained and they primarily serve as vehicles to achieve the **outcomes** of

*In business, **outputs** are focused on production and the supply side, while **uptakes** are focused on the market and the demand side.*

<sup>1</sup> King, D., The scientific impact of nations. Nature 430 (311-316), 2004.

<sup>2</sup> David, P. A., Mowery, D., and Steinmueller, W. E. "Analysing the economic payoffs from basic research." Economics of innovation and new technology 2(1): 73-90, 1992.

<sup>3</sup> Shaxson, L. "Improving the impact of development research through better research communications and uptake" Background paper for the AusAID, DFID and UKCDS funded workshop, London. UK 2010.



the Canadian Safety and Security Program (CSSP) and strengthen Canada's resilience to natural disasters, serious accidents, crime and terrorism. One challenge of the program has been that **outcomes** associated with the CSSP<sup>4</sup> are latent variables that cannot be directly observed or measured a priori but must be inferred from variables that can be. For some time, the measured variable used as an indicator for successful CSSP outcomes was Science and Technology (S&T) **output**; however, the direct correlation between S&T **outputs** and CSSP **outcomes** has at times been rather weak. A tighter correlation may be available linking not S&T **outputs** but their **uptake** by a target community as a better metric of the potential impact on achievement of desired Public Safety outcomes.

### What is research uptake

*Sub-Sahara Universities ... "concluded that no matter how good their research output, if there is no **uptake**, then there is no possibility for impact on outcomes."*

A group of Universities in Sub-Sahara Africa are concerned about a lack of **uptake** of their R&D investments and have joined in an initiative known as 'DRUSSA'<sup>5</sup> that looks at issues related to research uptake. From within this academic environment, they have concluded that no matter how good their

research output, if there is no **uptake** or exploitation then there is no possibility for impact on outcomes.

According to DRUSSA, there have been cases where research communities gave little thought to how their research outputs would be transmitted, received and put to use. It was assumed that if their hard empirical evidence was broadcast from their institutes, a form of passive "diffusion" would occur and somehow their output would find its way to the appropriate audience(s). In many cases, a further assumption was that the content and implications of the findings would be immediately understood and put to use by some unidentified audience. But experience has indicated that this is not always the case and a more active approach may be required.

### What can be done to increase research uptake

In areas where innovative S&T has high potential impact and value, passive "diffusion" needs to be replaced by active "ongoing communication". Ongoing communication can provide a dynamic and negotiated balance between the supply side of S&T **outputs** and the demand side of S&T **uptake**. An iterative dialogue (i.e., spiral development concept) among key stakeholders can inform the selection of relevant research topics as well as shape program design and the method of delivery. Continued engagement throughout the conduct of the work ensures that the outputs aren't seen as coming 'out of the blue' but specifically tailored to meet the target audience's needs and are often anticipated and "pulled" by the S&T output consumers.

Finally, to ensure accountability of both S&T output producers and output consumers, it is imperative that "**advice be formally documented and delivered**". This helps to ensure that the "advice is actually **considered**" by the recipient within the decision-making process and that the reasons for either its acceptance or rejection are also documented. If formal documentation and delivery protocols are not followed, there is no formal record of the S&T output and therefore no traceability within the decision-making process and target outcome it was intended to influence.

<sup>4</sup>[https://buyandsell.gc.ca/cds/public/2013/06/21/2af111ef0f6ec31381316507cccb750d/ABES.PROD.PW\\_SV.B057.E26165.EBSU000.PDF](https://buyandsell.gc.ca/cds/public/2013/06/21/2af111ef0f6ec31381316507cccb750d/ABES.PROD.PW_SV.B057.E26165.EBSU000.PDF)

<sup>5</sup> Development Research Uptake in Sub Saharan Africa: <http://www.drussa.net/index.php> accessed 22 January 2014.



## The supply side – challenges related to producers of S&T outputs

One of the most frequently identified barriers to S&T output uptake is the assertion that if policy-makers or operators want to use the output, it's their prerogative. While technically true, this notion is counter to a focus on the more fundamental desire to influence outcomes. It should not only be the responsibility of policy-makers and operators to seek out S&T outputs - it should also be the S&T producer's responsibility to not only make their outputs accessible, but understandable and timely as well, especially when they can impact public safety outcomes.

A common fallacy that can create another barrier is that one scientist or scientific team must mature in a linear fashion the science and then the technology. In today's fast paced environment, it may not be necessary or desirable to internally develop or "**build**" all the technology components, but rather it may be more important to know how to rapidly "**identify, access and integrate**" the "right technology or technologies" to close capability gaps. In many cases, identification, access and integration of S&T" appears to influence client uptake far more rapidly than slower in-house linear development of S&T outputs.

A third common barrier to uptake of S&T output is a lack of understanding of the significance of the output by the target audience. S&T performers must be willing to acknowledge and accept help and advice from others to ensure that not only their scientific peers fully understand and support their findings but that their target audience can understand them as well. A good editor who can translate across S&T, policy and operational communities is often critical to successful uptake.

## The demand side – challenges related to consumers of S&T outputs

The target audiences for S&T outputs served by the CSSP have been clearly identified as the policy, intelligence and operational practitioner groups. These three groups are quite different and present quite different challenges. When considering them, it helps to recognize they work to different time horizons and probably have different notions of S&T outputs. Policy-makers, intelligence analysts and operators often need definitive findings at key points during the policy-making process or to support capability acquisitions and operations. They may not be interested in S&T outputs that are wrapped in a variety of qualifications and caveats that describe the experimental conditions.

We also know that the interfaces across S&T, policy, intelligence and operations are often complex and dynamic. Those trying to inject **S&T outputs into policy** not only need to have some knowledge about where in a particular policy cycle the research topic is, they must also understand who is working to influence that process, what their drivers are and how they're doing it. Those trying to inject **S&T outputs into analysis or operations** need to not only have knowledge of what the capability gap is, they must also understand who is working to have the gap acknowledged, prioritized and closed.

## CSSP communities of practice

To facilitate active communication across the S&T, policy, intelligence and operator groups, the CSSP has established a number of CoPs. The purpose of a CoP is to serve as a vehicle not only to bring together S&T producers and consumers but also as a means to facilitate collaboration across the practitioner groups to be applied in achieving the outcomes of the CSSP strengthening Canada's resilience to natural disasters, serious accidents, crime and terrorism. The true value of each CoP is the collective knowledge and intellectual capacity of all participants. The CoPs are scalable, reaching out to other groups with different areas of knowledge and expertise as the need for related knowledge and innovative technologies arise



for transition to operational capability. CoPs ebb and flow, forming and expanding to meet needs and collapsing and dissolving once the needs have been met. A key function of the CSS is to facilitate the identification of a need for new S&T or a means to effectively apply current S&T in innovative ways to support the achievement of public safety and security objectives.

The CSSP Communities of Practice have been specifically developed to:

1. Facilitate interaction among members that help define problems and find solutions, thus bringing together demand and supply of S&T outputs; and
2. Where solutions are not yet within reach, facilitate interaction among members to proactively identify what new S&T output needs to be generated to close an identified operational capability gap.

Over time, the CSS has deliberately transformed the early “science clusters” into cross- functional CoPs to connect the four diverse practitioner groups from S&T, policy, intelligence and operations to **facilitate alignment and integration of S&T outputs to end-users’ needs** as well as to understand each group’s unique challenges. No matter how relevant and good the S&T output is or how accessible and open to evidence the consumers involved are, unless there is a mutual understand of each communities’ processes and challenges, chances of **uptake** are slim. Unless the timing fits in with the political timeline or operator’s acquisition cycle, S&T **outputs** may end up gathering dust on a shelf. Maturation of technology to a higher technology readiness level (TRL) or the rigorous operational test and evaluation of mature technologies can be lengthy, whereas policy-makers work to short political cycles and operators focus on the “immediacy of operations”. It is rare for all four to meet by chance with fruitful results which is why the CSS CoPs have been designed to provide both the opportunity and facilitated process to connect S&T, policy, intelligence and operational practitioner groups to ensure the S&T work is appropriate to needs and that timing facilitates uptake in support of desired public safety and security outcomes.

### **S&T uptake success stories**

The Multi Agency Situational Awareness System<sup>6</sup> (MASAS) is an example of S&T outputs focused by interaction of prospective end-users and the innovative use of mature technologies. Canadian Emergency Management organizations stated a need to openly share non-sensitive content within the emergency management and public safety (EMPS) practitioners to increase common situational awareness.

Rather than taking a “build from scratch” approach, DRDC CSS and their partners “accessed” and rapidly adapted available technologies to develop and field MASAS which provides the distribution of authoritative alerts and situational awareness information. Its rapid **uptake** by over 470 federal, provincial, territorial and municipal departments and agencies across the EMPS community in Canada directly supports the CSSP intermediate outcome of ensuring the **“rapid and effective technology transition of new or innovative uses of science and technology** can be quickly brought to bear”.

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<sup>6</sup> Boyd, D., Caplan, M., Howe, W., Verrico, J., Thomas, J., A., McCullough, C., Amoabeng, M., Firtzgerald, B., Lucero, M., Johnson A. (USA), Vallerand, A., Dawe, P., Forbes, K., Hales, D., Couture, C., O’donnell, D., Allport, D., Rebane, A., Neily, J., Frim, J., Pagotto, J., Trudel, P., and Moreau R. (CAN). Canada–U.S. Enhanced Resiliency Experiment Series “CAUSE Resiliency”: A Canada–U.S. Resiliency Experiment (CAUSE Resiliency II) on Enhancing Trans-Border Resilience in Emergency and Crisis Management Through Situational Awareness Interoperability: Addressing the Beyond the Border (BTB) Action Plan . DRDC Centre for Security Science 2013 Technical Report TR-2013-006, 2013.



Similarly, owners and operators within the Critical Infrastructure National Energy Sector voiced a need to close gaps in critical digital infrastructure related to their operations. Rather than providing an S&T study on the issue, or maturing any technology, DRDC CSS and their partners worked with the National Energy Critical Infrastructure Sector to design, develop and establish a dynamic National Energy Infrastructure Test Center<sup>7</sup> (NEITC) as a collaborative partnership. The **rapid S&T uptake** was further facilitated by the continued collaboration between the S&T community and the owners and operators of the National Energy Critical Infrastructure Sector through rigorous testing of operational Industrial Control Systems (ICS) and Supervisory Control and Data Acquisition (SCADA) systems at the Test Centre. It is understood that in the above cases, a range of metrics are needed as some of the uptake or influence may be reflected in behavioral or governance changes that may be more long-term than short-term and thus not in direct line-of-sight of the output.

## Conclusions

If Sub-Saharan universities have recognized and acknowledged **uptake** as a better indicator of influence on outcomes than simply **outputs**, perhaps so should the Canadian S&T community. This document argues for a closer collaborative relationship between the producers of S&T outputs and their intended recipients to increase rapid uptake and the ability to influence outcomes. On the one hand, it was shown that federal S&T performers in some domains seem to build their own S&T internally at their peril, as there is so much readily available science and technology output in today's world (and in our own CoP), that it is often far more effective and agile to **access the competencies of others (collaborative partnerships) and access, modify or integrate the right fit technology to close clients' capability gaps**. It was also documented that the actual S&T needs to be properly targeted and tuned if it is to effectively support Policy or Operations.

## Recommendations

It is recommended that collaborative partnerships (i.e., an "innovation cloud") between S&T output producers and consumers be encouraged as a means to shift focus from the production side of S&T outputs to the demand side of S&T uptake to support the achievement of identified public safety and security outcomes. It is further recommended that S&T investments decision processes should explicitly consider avenues to exploit available technologies in innovative ways to bring S&T outputs to bear and facilitate their rapid uptake in closing public safety and security capability gaps in a timelier manner as opposed to defaulting to develop complete solutions internally.

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<sup>7</sup> Howes, R. and Vallerand, A.L. National Energy Infrastructure Test Center: Value added to clients. DRDC CSS LR 2013-056, 2013.





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