



The 'thinking' firefighter



'From Knowledge to Practice' is an international project that aims to develop training based on a scientific approach to fire dynamics in order to promote operational best practice and develop 'thinking' firefighters, write Katherine Lamb and Peter McBride.

Historically, many firefighting procedures have been based more on tradition within a particular fire service organisation rather than on validated research into fire dynamics. While a firefighter's professionalism, skill, and experience may often mitigate this situation, a lack of scientific understanding of fire behaviour can place firefighters, the public, property, and critical infrastructure at significant risk during fire service operations.

Furthermore, changes in building construction, building height and complexity, building use, occupancy levels, and increased fuel loads have altered the modern fire environment, resulting in faster fire propagation, unanticipated events and more rapidly occurring dynamic fire situations.

When combined with a decrease in the overall number of fires from which firefighters can gain experience, and global firefighter retirement demographics, these factors have resulted in the loss of considerable experiential knowledge. This, in turn, indicates that the tradition-based approach to firefighter professional development has now become obsolete.

Within the past six years, several notable incidents have occurred in Canada during firefighting operations that have highlighted these challenges. These include the death of a captain with Montréal fire service in January 2006, the deaths of two captains with Winnipeg Fire Paramedic Service in February 2007, and the deaths of two volunteer firefighters in Listowel, Ontario, in March 2011.

In addition, in January 2007, five Ottawa firefighters were injured, three of them critically, after being forced to jump from fourth-storey windows during a structure fire. Post-incident investigations of these and other near-misses or critical fire incidents have consistently identified inadequate incident size-up, poor assessment of risk, inaccurate evaluation of the evolving fire dynamics, inappropriate tactics, and insufficient live fire training opportunities as the major contributing factors to the injuries, deaths, and property losses recorded.

During 2007 alone, the financial cost of fires in Canada exceeded US\$1.12 billion (CAD\$1.5 billion). This is an amount that excludes cascading economic effects, the operational costs of responding agencies, and any

From Knowledge to Practice aims to create evidence-based firefighting training programmes.



The project promotes the concept of the 'thinking firefighter' and aims to embed scientific knowledge of fire dynamics into firefighting operations.

rehabilitation expenses associated with injured responders.

Using economic forecasting models, researchers at Arizona State University have demonstrated the significant impacts that successful firefighting operations have on economic sustainability. This includes the ripple effect that fire 'saves' have on averting job and production losses, which impact nationally, regionally and, especially, locally. It has become clear, through these examples and others, that there exists a need to increase firefighting safety and efficacy through a better understanding of fire dynamics and associated mitigation strategies.

The City of Ottawa Fire Service is leading the development of an evidence-based fire dynamics training (FDT) curriculum, focused on closing current critical knowledge and capability gaps. This curriculum and the associated training programme will be incorporated into Canadian firefighting training certification standards for adoption and use by all fire services throughout Canada. Ottawa Fire Service has partnered with the Calgary Fire Department, the Service de Sécurité Incendie de Montréal, and Halifax Regional Fire and Emergency for the duration of this project.

Defence Research and Development Canada (DRDC)'s Canadian Safety and Security Programme (CSSP) has funded the project with a grant of US\$0.89 million (CAD\$1.2 million). An additional US\$1.86 million (CAD\$2.5 million) of in-kind funding has been provided by participants and industry partners. The DRDC-CSSP mandate is to strengthen Canada's ability to anticipate, prevent/mitigate, prepare for, respond to, and recover from acts of terrorism, crime, natural disasters, and serious accidents through the convergence of science and technology with policy, operations, and intelligence.

This innovative project is called '*From Knowledge to Practice*' and it aims to embed scientific knowledge of fire dynamics into firefighting operations.

The project mission patch reflects an overarching goal of broadening what the word 'firefighter' means to include firefighting (which encompasses anticipate, prevent, intervene and recover); instruction; research; and engineering. All four disciplines are needed to manage today's complex response environment and are reflected throughout the project design.

The project goals are to reduce social, economic, environmental, legal and life-safety risks, and their impacts due to fire, through the development of a collaborative, evidence-based fire dynamics curriculum, and safe, realistic live fire training tools. The project will confirm theory and make it accessible to front-line workers, thereby confronting a wide range of existing, inaccurate and potentially dangerous assumptions and replacing them with complex and often non-intuitive research findings in a valid and reliable way, and linking them to appropriate mitigation techniques.

Project transition to the operational level will occur through new industry standards, an endorsed curriculum, and validated technologies. These outcomes will inform fire service investment decisions, policies, procedures and practices, both nationally and internationally, and present innovative commercial development opportunities for industry.

The project has received widespread support from the international fire response and research community, including the Canadian Council of Fire Marshals and Fire Commissioners; the Canadian Fire Service Education, Training and Certification Council; the Canadian Association of Fire Chiefs; the International Association of Firefighters; TSWG; UL; NIST; as well as a number of universities in the US and Canada. Support from the ground is also being afforded from fire and rescue services in the US, Canada, Australia, Belgium, Germany, Republic of Ireland, Netherlands, Germany, Poland, Spain and Sweden. Industry partners include 5.11 Tactical, Bullard, Bullex, DQE, Lion, Logistik Unicorp, Mercedes Textiles, MSA, Streamlight, and Task Force Tips.

The project commenced in 2014 and the final test of the curriculum and training strategies is due in May 2017, signalling the completion of the project.

This project has brought together subject matter experts from around the world, with their home services releasing them from operational duties. Thanks to the innovative way the project has been coordinated, the best international ideas and training methodologies have been pooled together to achieve best practice during the development of this operational fire dynamics curriculum.

In order to educate as many firefighters as possible from both the career and volunteer departments, an e-learning component was added to the curriculum in early 2016. This component was funded by the US Department of Defence, as it was deemed an essential link in the education of the predominantly voluntary fire departments in the rural regions of North America.

This funding enabled additional training material to be captured and integrated into the project. The most significant was the phased burning of a property in Mirabel, Quebec, in conjunction with Ottawa Fire Service, Service de Sécurité Incendie de Montréal, University of Waterloo, Flash Formation, and Service de Sécurité Incendie Mirabel. During this phase of the project each of the tactical options



available to a firefighter were video recorded, with temperature and efficacy of the techniques documented. This material was converted into training materials within both the e-learning and instructor-led segments of the new curriculum.

Professor Beth Weckman from the University of Waterloo, Ontario, Canada has coordinated much of the fire dynamics technical curriculum throughout the project. The challenge here has been to design a curriculum in which the fundamental principles of fire science and recent research findings are blended with existing firefighting strategies and tactics. Since the final curriculum is to be self-delivered by fire service personnel, this must be accomplished in a way that both instructors and students are able to understand, explaining the underlying theory of fire behaviour while applying the new knowledge to confirm or modify the experiences, strategies, and tactics within their own department.

Through a blended e-learning, classroom and hands-on format, it is designed to confront existing, potentially dangerous simplifications and assertions about the phenomena of fire growth, control, and suppression. These are replaced with complex, often non-intuitive research findings, via e-learning, instructor-led theory, self-discovery, and hands-on practical and evaluation components that link the science to appropriate fireground evaluation and mitigation techniques.

Quite how these technical principles are to be taught and applied practically has been determined through the combined efforts of an international team of compartment fire behaviour training (CFBT) experts, coordinated by a team of instructors from Ottawa Fire Service.

Students were introduced to scale models of enclosure fires to inform and confirm the theoretical concepts taught in the fire dynamics curriculum. These sessions, led by experienced instructors, then used peer-to-peer teaching to reinforce and self-discover the theoretical concepts. The scale models are used as a stepping stone for further development within larger scale props (modified shipping containers), wherein safe entry, fire control, water application techniques, extinguishment, and managing controlled retreat are all taught and practised in realistic conditions to confirm understanding and develop competence.

The students are given context that shipping container fires aren't realistic, but do provide a laboratory for self-development and building confidence during the management of the fire environment. The shipping containers and the fuel loads are also being studied as part of a Master's thesis through University of Waterloo. This is to support a key project deliverable to create a reproducible environment for learning outcomes, and to ensure that the learning environment is effective through a philosophy of 'warm to inform' not 'burn to learn'.

Finally, students are challenged with more difficult fire scenarios. These involve approaches from greater distances that require decision making using a novel fire assessment tool, while conducting an overall 360 degree survey of the larger fire complex, and then selecting appropriate tactics to deal with the given situation. Each tactical evolution is then debriefed and recorded so that learning is shared amongst the students to enhance self-discovery and confirm understanding of the tactical options applied.

Through this tremendous international collaborative effort, and the unique way the project has been funded and supported, all project content will be made available free of charge internationally for adoption by interested fire

services and standards organisations.

The final product will consist of a collaborative, evidence-based fire dynamics curriculum that has been born out of the need to address existing gaps between the science of fire behaviour and current firefighting strategies and tactics, translating knowledge into practice and resulting in safer and more effective firefighting operations that reflect the modern fire environment.

For more information contact Division Chief Peter McBride, Ottawa Fire Department, Peter.McBride@ottawa.ca or Dr Katherine Lamb, K Lamb Associates, Katherine@klambassociates.com.

This project has been dedicated to the memory of Shawn Mathieson, Ottawa Fire Service.

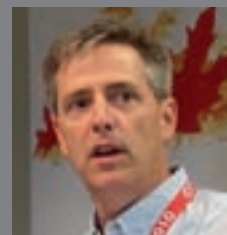
ABOUT THE AUTHORS

Dr Katherine Lamb MIFireE, MSc (Oxon), BSc (hons) is a respected authority on incident command training and assessment. She worked as a research scientist before joining the fire



service in 2004. For the last six years she has specialised in incident command and crisis decision-making. In 2015 she co-founded Effective Command, a charitable organisation that develops the concept of 'the thinking commander'. To find out more about the Effective Command methodology or assessment tools, visit the website www.effectivecommand.org or contact Katherine by email at katherine@effectivecommand.org.

Peter McBride is the Division Chief of Safety and Innovation with the Ottawa Fire Services and serves as the Chair of IAFF Local 162's Research and Innovation Committee. McBride's



mandate is to deliver service excellence by building a learning and safety culture for and with the 1,500 members of the Ottawa Fire Service. McBride regularly advocates for advances in health and safety on behalf of the fire service and has a passion for sharing ideas and seeking insights from others. He has been responsible for initiating many partnerships.

McBride is currently engaged in 'From Knowledge To Practice', the major CAD\$1.2 million (US\$889,937) Canadian Safety and Security Programme grant directed at the development of a fire dynamics programme for the Canadian Fire Service.