

International **FIRE** Professional

The Journal of the Institution of Fire Engineers



FOUNDED 1918 • INCORPORATED 1924

November 2020 Issue No 34



Exploring Modern Methods of Construction



President's Report

6

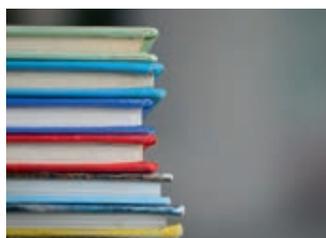
Bruce Varner posts his final report as International President



Post Grenfell activities

13

Read the IFE's involvement in the various working groups



IFE qualifications

19

A new structure for 2021 and beyond is explained



Fire 2020

23

IFP reports from the digital conference hosted by the IFE, FPA and NFCC

FireFront: A new tool to support training in Fireground Situation Awareness, Situation Understanding and Bias

The FireFront Team consists of partners from Belgium, Denmark, Estonia, Netherlands, Spain and the UK including: Thoelen, F. and Vastmans, J from PLOT (Provincial Centre for Education & Training) (Fire School) (Belgium); Blom Andersen, N., Bøhm, M., Holm, L.O.C.N. from University College Copenhagen (Department of Technology, Emergency And Risk Management) (Denmark); Arendtsen, B. from East Jutland Fire Service (Denmark); Polikarpus, S., Taukar, M., Kütt, T. from Estonian Academy of Security Services (Estonia); Fikke, R.C., Geertsema, T., Hazebroek, J.C., Tonnaer, C., Weewer, R. from IFV Institute for Safety (Netherlands); Figueras Masip, A., Fuste Castella, R. from Institute for Public Security of Catalonia (Firefighters and Civil Protection School) (Spain) and; Catherwood, D., Baker, S., Brookes, D., Edgar, G.K., Naughtie, C., Sallis, G., Silcock, G., Walker, S. from University of Gloucestershire (CRACKLE) (U.K.). Here the team report on enhancing situation understanding in decision making by fire and rescue personnel.

Abstract

FireFront, an innovative digital tool for supporting training and self-awareness of decision-making to reduce risk in Fire and Rescue operations, is currently under trial in a new *Erasmus Plus* project. This tool is an important extension to its successful predecessor *FireMind* which featured in the November 2016 issue of *International Fire Professional* journal. The latter provided feedback on Situation Awareness (SA) and Information Bias (IB), but *FireFront* also assesses Situation Understanding (SU) of the *relevance* of information in regard to the incident, with this demanding more extensive cognitive processing than for SA.

As for *FireMind*, the tool will also assess IB (the tendency to either accept or reject information as true), but additionally will include a measure of “Relevance Bias” (RB), the extent to which information is accepted as *relevant* to the incident (with a conservative bias tending to accept less

information and a liberal bias to accept more).

A conservative IB or RB has a risk of “miss” errors (overlooking key information) and a liberal IB or RB of “false alarm” errors (using false or irrelevant information).

Finally the tool will also assess confidence in SA and SU, another key factor influencing operational decision-making. Using the interactive software in the tool, a simulated incident can be presented by various media (video, images, audio, VR, etc) and individual responses to statements about the incident used to compute SA, SU, IB, RB and the Confidence measures and provide feedback for the test-taker. The analysis within the tool employs the well-validated QASA (Quantitative Analysis of Situation Awareness) method. The intention is that feedback on personal tendencies during *FireFront* exercises will encourage self-monitoring of potential strengths and weaknesses during actual incident decision-making.

The *FireFront* project was funded by the Erasmus+ programme of the European Union. “*The European Commission support for the production of this publication does not constitute an endorsement of the contents which reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.*”

FireFront: Background to the new tool

Firefront is the second training tool to be developed using funding from the EU Erasmus Plus scheme and involving Fire and Rescue Services, and researchers, from six different countries. Following the success of the original *Firemind* tool, *Firefront* is being developed to provide extended training capability beyond that in *Firemind*.

Both tools reflect the understanding that effective fireground performance does not rest solely on operational competence and expertise, but also on the ability to deploy that expertise effectively under pressure.

Key to this ability is having good Situation Awareness (SA) or an appropriate mental representation of the incident and also selection of appropriate information for decision-making (appropriate “Information Bias”). Critical errors may occur not from a lack of competence as such, but from poor SA about the particular incident, or even if SA is good, from a failure to make optimal use of the available information due to inappropriate or ineffective Information Bias. A conservative or narrow bias can lead to tunnelling down and accepting too little information and to “miss” errors that overlook key aspects, while a liberal or broad bias can lead to superficial processing, accepting too much or even untrue information, with risk of “false alarm” errors (Arendtsen, Baker, Bertels, Brookes, et al., 2016; Catherwood, Edgar, Sallis, Medley & Brookes, 2012; Catherwood, Sallis, Edgar & Medley, 2010; Catherwood, Sallis, Edgar, & Medley, 2011; Edgar, Catherwood, Baker, Sallis, et al., 2018; Edgar, Catherwood, Sallis, Brookes, & Medley, 2012; Endsley, 2000; Gasaway, 2008; Klein, Calderwood, & Clinton-Cirocco, 2010; Omedei, McLennan, & Elliott, 2005; Sallis, Catherwood, Edgar, Brookes & Medley, 2013).

Tools for training fire crews to appraise and monitor their SA and bias under pressure may offer an important means for improving fireground safety and performance. *FireMind* (Arendtsen, Baker, Bertels, Brookes, et al., 2016) is one such tool that employs interactive software to test and train firefighter SA and Information Bias and has been used, for example, in research into firefighter training in the Netherlands (Bomhof, 2017). Following the success of *FireMind*, a new training

tool *FireFront* is now being developed to further support the training of Fire and Rescue personnel in a wide variety of training scenarios using a range of supporting technologies.

The new *FireFront* tool will consist of an interactive software package that enables feedback on SA and Information Bias, but will also provide deeper understanding and additional feedback about how Fire and Rescue personnel arrive at decisions about an incident. The ultimate aim of this new tool is thus to further enhance the safety of Fire and Rescue operations by strengthening the insights of Fire and Rescue personnel into their own patterns and tendencies in regard to incident decision-making. The intention is that by providing feedback on these patterns and tendencies during the *FireFront* exercises, this will encourage habitual or automatic self-monitoring and attention to potential strengths and weaknesses during actual incident decision-making.

Measuring Situation Understanding:

As well as providing feedback on SA, the *FireFront* tool will also allow the measurement of *Situation Understanding* (SU) in regard to an incident. While SA depends on attention to and memory for aspects of an incident, SU goes beyond this to reflect the individual’s understanding of the *importance or relevance* of information in regard to the incident (Durso and Alexander, 2010). SU decisions thus demand more extensive or complex cognitive processing than those for SA, requiring understanding the situation and how it may develop. This presumably involves linking the current situation to previous experiences and knowledge stored in long-term memory and also exercising both heuristic (knowledge-based) and deductive reasoning about the usefulness of information for the incident operations.

Measuring Bias:

The *FireFront* tool will also provide feedback on an individual’s decision bias, the tendency to accept or reject information, as formalised in “Signal Detection” models of SA such as QASA (Quantitative Analysis of Situation Awareness) (Edgar & Edgar, 2007; Edgar, et al., 2018; Stanislaw & Todorov, 1999). *FireFront* will measure decision bias in two ways.

Firstly, as for the *FireMind* tool, *FireFront* will assess an individual’s Information Bias (IB), reflected in decisions about whether statements regarding an incident are true or false. Individuals may tend towards either a conservative, strict bias (judging or accepting less information as true, with risk of rejecting true information and making miss errors) or conversely, a liberal, lax bias (accepting more

information as true, with risk of using incorrect information and making false alarms).

Secondly, the *FireFront* tool will also include a valuable new measure of bias: “Relevance Bias” (RB). This will reflect the extent of acceptance that information is *relevant* to the incident, revealing whether the individual tends towards either accepting that very little is relevant (conservative RB) or conversely that a lot of the information is relevant (liberal RB). A strong conservative Relevance Bias carries the risk of disregarding useful information (miss errors), while a strong liberal Relevance Bias could mean that unimportant information is used for decisions (false alarm errors).

FireFront could show, for example that, although a firefighter was aware of a large amount of information (good SA) or even accepted it as true (liberal Information Bias), s/he could still have a very conservative Relevance Bias, dismissing most of the information as irrelevant with risk of making miss errors in judgment.

Measuring Confidence in SA and SU:

FireFront will also require individuals to rate how *confident* they are that their SA and SU responses are correct. This provides yet another dimension that may vary independently of the other measures (Sallis et al., 2013). Confidence reflects the individual’s perception of their own SA and SU and may be another critical factor influencing decisions. For example, an individual may be very confident and perceive their own SA and SU to be good, but in fact may have poor actual SA and SU, possibly leading to hasty or unchecked decisions. Alternately a person may actually have good SA and SU but have low confidence in both, possibly leading to hesitant and ineffectual decisions. Such discrepancies between confidence and awareness or understanding may thus lead to judgment errors or lapses and hence may be important in the overall profile of an individual’s performance.

The Methods by which *FireFront* will be implemented:

The *FireFront* tool involves interactive software that is simple to use and easily adapted to specific training needs. A simulated incident can be presented by various means and media (video, images, audio, VR, actual exercises, etc.), incorporating the *FireFront* tool to record responses to statements about the incident. From the individual’s responses, the tool will compute SA, SU, IB, RB and the Confidence measures to provide a summary profile and feedback. The analysis of SA, SU, IB and RB within the tool is based on the well-validated QASA method (Edgar et al., 2017).

Initially, the project team will employ a common incident scenario and subsequently the partners will develop their own scenarios with specific reference to their individual training platforms and needs. The initial common scenario has been developed collaboratively by the project team and consists of a desktop exercise involving a computer-simulated (eExercise in Virtual Reality (XVR) On Scene, XVR Simulation) road traffic accident in an urban environment (see Figure 1 for a screenshot example). A simulation was used as it allowed the development of a scenario that could be used across different countries with as few as possible, ‘cultural elements’. Individuals will launch the *FireFront* tool to view the incident and respond at various intervals via the computer keyboard or mouse to probe statements about the scenario. A web-based version of the tool that will run the scenario, collect responses and provide individualised feedback can be found at:
UK: <https://www.labvanced.com/player.html?id=9894>
EU/US: <https://www.labvanced.com/player.html?id=9511>

The scenarios are currently in English, but other language versions are in preparation. For more details contact Graham Edgar (gedgar@glos.ac.uk).

SA will be assessed by statements requiring True/False responses, but SU will be assessed by asking participants if stated information is *relevant* or *irrelevant* to the incident operations. So for example, SA will be assessed by statements such as: “*There were 4 fire engines at the incident*”, to which individuals would have to choose between “True/False” response options, while SU will be assessed by statements such as “*Knowing how many appliances are at a Road Traffic incident is*”, to which the response options will be “Relevant/Irrelevant”.

As noted, the tool will also require ratings of the confidence in each response so that Confidence scores for both SA and SU will be produced.



Figure 1: Screenshot from the Incident in the Common Scenario for the *FireFront* Tool

Additionally as explained above, the QASA method in the tool will employ the patterns of responses to the SA and SU probes to respectively compute measures of Information Bias and Relevance Bias.

The tool will provide the six measures of SA, SU, IB, RB and Confidence in SA and SU, scaled from -100 to +100 in each case. For SA and SU, positive scores will indicate better awareness and understanding, while negative scores will reveal weaker awareness and understanding. For IB and RB, positive scores will reflect a more conservative bias in each case and negative scores a more liberal bias. For the Confidence output, positive scores will show that the person had stronger confidence in their responses and negative scores lower confidence. Alongside the scores for each variable, the tool will also provide written feedback that aims to explain and offer support regarding the individual's performance. This will be necessarily brief but the associated manual and training environments will aim to extend this to further enhance the

individual's understanding and awareness regarding their performance and bias tendencies.

The *FireFront* tool can potentially identify many individual patterns or profiles of performance across the six variables and such patterns can provide a basis for training self-awareness of response tendencies and potential errors in decision-making. For example, an individual may display the following profile or pattern of response: *Poor SA, Poor SU, High SA-Confidence, High SU-Confidence, with Conservative IB and RB scores* (see Table 2). This could be grounds for concern since there is unjustified confidence in both SA and SU, with a bias that predisposes the individual to tunnelling down on limited information in both awareness and understanding. This pattern of performance may be associated with a high risk of miss errors and failure to check or self-monitor awareness and understanding during actual operations. (See Table 1 and 2 for some examples of other possible profiles for individuals with Good SA and SU or those with Poor SA and SU.)

Table 1
Some Examples of Possible Profiles for individuals with both Good SA and Good SU

INDIVIDUALS WITH GOOD SA AND GOOD SU AND ALSO SHOWING...				
CONFIDENCE EXAMPLES:	Conservative Information Bias (IB)		Liberal Information Bias (IB)	
	Conservative Relevance Bias (RB)	Liberal Relevance Bias (RB)	Conservative Relevance Bias (RB)	Liberal Relevance Bias (RB)
LOW CONFIDENCE FOR BOTH SA & SU	Good awareness & understanding but conservative in accepting information as true or relevant and low in confidence for both SA and SU: given good SA and SU, low confidence is unwarranted, though possibly hesitant decision-making with risk of miss errors for both SA and SU	Good awareness & understanding, conservative in accepting information as true but liberal in accepting it as relevant and low in confidence for both SA and SU: given good SA and SU, low confidence is unwarranted, though possibly hesitant decision-making with risk of miss errors for SA and false alarms for SU	Good awareness & understanding, liberal in accepting information as true, but conservative in accepting it as relevant and low in confidence for both SA and SU: given good SA and SU, low confidence is unwarranted, though possibly hesitant decision-making with risk of false alarms for SA and miss errors for SU	Good awareness & understanding, liberal in accepting information as true or relevant and low in confidence for both SA and SU: given good SA and SU, low confidence is unwarranted, though possibly hesitant decision-making with risk of false alarm errors for both SA and SU
HIGH CONFIDENCE FOR BOTH SA & SU	Good awareness & understanding, conservative in accepting information as true or relevant and high in confidence in both SA and SU: given good SA and SU, confidence is warranted but may have risk of miss errors, for both SA and SU	Good awareness & understanding, conservative in accepting information as true, but liberal in accepting it as relevant and high confidence in both SA and SU: given good SA and SU, confidence is warranted, though may have risk of miss errors for SA and false alarms for SU	Good awareness & understanding, liberal in accepting information as true, but conservative in accepting it as relevant and high confidence in both SA and SU: given good SA and SU, confidence is warranted, though may have risk of false alarms for SA and miss errors for SU	Good awareness & understanding, liberal in accepting information as true or relevant and high in confidence in both SA and SU: given good SA and SU, confidence is warranted but may have risk of false alarms for both SA and SU

Table 2
Some Examples of Possible Profiles for individuals with both Poor SA and Poor SU

INDIVIDUALS WITH POOR SA AND POOR SU AND ALSO SHOWING...				
CONFIDENCE EXAMPLES:	Conservative Information Bias (IB)		Liberal Information Bias (IB)	
	Conservative Relevance Bias (RB)	Liberal Relevance Bias (RB)	Conservative Relevance Bias (RB)	Liberal Relevance Bias (RB)
LOW CONFIDENCE FOR BOTH SA & SU	Poor awareness and understanding and conservative in accepting information as true or relevant and low in confidence about SA and SU: with poor SA and SU, low confidence is justified, with risk of miss errors for both SA and SU	Poor awareness and understanding, but conservative in accepting information as true and liberal in accepting it as relevant and low in confidence about SA and SU: with poor SA and SU, low confidence is justified, with risk of miss errors for SA and false alarms for SU	Poor awareness and understanding, but liberal in accepting information as true and conservative in accepting it as relevant and low in confidence about SA and SU: with poor SA and SU, low confidence is justified, with risk of false alarm errors for SA and miss errors for SU	Poor awareness and understanding and liberal in accepting information as true or relevant and low in confidence about SA and SU: with poor SA and SU, low confidence is justified, with risk of false alarms for both SA and SU
HIGH CONFIDENCE FOR BOTH SA & SU	Poor awareness and understanding and conservative in accepting information as true or relevant and high confidence in SA and SU: with poor SA and SU, unwarranted confidence may lead to poor monitoring of decisions, with risk of miss errors for both SA and SU	Poor awareness and understanding, but conservative in accepting information as true and liberal in accepting it as relevant and high confidence in SA and SU: with poor SA and SU, unwarranted confidence may lead to poor monitoring of decisions, with risk of miss errors for SA and false alarms for SU	Poor awareness and understanding, but liberal in accepting information as true and conservative in accepting it as relevant and high confidence in SA and SU: with poor SA and SU, unwarranted confidence may lead to poor monitoring of decisions, with risk of false alarm errors for SA and miss errors for SU	Poor awareness and understanding and liberal in accepting information as true or relevant and high confidence in SA and SU: with poor SA and SU, unwarranted confidence may lead to poor monitoring of decisions, with risk of false alarms for both SA and SU

The Partnership Team

The *FireFront* project partners have significant national and international expertise in vocational training and higher education for professionals in public safety and security, including firefighters and incident commanders, with extensive experience in crisis and risk management. The teams also have an established background in relevant research and the use of virtual and real simulations to train Fire and Rescue personnel and commanders. The expertise of team members encompasses vocational experience and command in Emergency services as well as experience in training and research in related fields, with a keen interest in mental aspects of firefighting. Importantly the partners also provide diversity in Fire and Rescue Service training policy and practice and will thus be able to trial the

FireFront method across a range of different training approaches and platforms.

Outcomes and Value of the *FireFront* Project

In summary, the final output for the *FireFront* project will be a stand-alone software package, developed and tested across a range of training platforms, that can be used to measure both SA and SU, as well as Information and Relevance Bias and Confidence in responding. The package will run on standard PCs and will run the scenario, collect the data, and provide individualised feedback to the participant. The tool will be able to be used as a complete tabletop training package with 'built in' Fire and Rescue scenarios, but will also have the facility for users to build their own scenarios using their own incident material and training approaches. An online version will also be available to be trialled,

involving the 'common scenario' mentioned above. This version will have the same basic functionality as the stand-alone version (it will run a trial and give feedback on performance) without the scenario self-build capability.

The *FireFront* package can be run either within a supervised training session or by individuals to "self-test". The tool is intended to encourage awareness of personal tendencies and degree of confidence in accepting or rejecting information as true or relevant for making decisions during actual incidents. It is important to stress that the output profiles are intended as a basis for further individual development and not as an appraisal tool, per se.

The responses assessed by the tool may vary for individuals across exercises depending on factors such as degree of stress, although in pressured contexts, individuals may revert to habitual or customary patterns (Sallis, Catherwood, Edgar, Brookes, & Baker, *submitted*). The key lesson from the feedback from the tool however will be that such biases and response patterns do occur and can distort decision-making to produce errors. The *FireFront* tool is thus aimed at training and enhancing the awareness of such tendencies as the first step in being able to monitor for their influence during actual Fire and Rescue operations. When Fire and Rescue personnel are aware of their tendencies and patterns, they can also arrange support and undertake training to tackle these tendencies and patterns and so reduce the possibility of risk and harm during operations. 🔥

References

- Arendtsen, B., Baker, S., Bertels, M., Brookes, D., Catherwood, D., Christiansen, K., Cuypers W., Edgar, G., Krawczynska S., Maes V., Sallis, G., Stegienko K, Van Craybex, G., Vastmans, J., Vorenkamp, F., Weewer, R., & Wenarski, G. (2016). *Firemind*: Trialling a new tool for training Fire and Rescue service decision-making. *International Fire Professional*, November, 14-17.
- Bomhof, L. (2017). Experience says it all! Or not...? *Situation awareness on the fire ground* [Masters thesis, University of Twente] <http://essay.utwente.nl/73492/>
- Catherwood, D., Edgar, G., Sallis, G., & Medley, A. (2010). Scoping the Fireground: the range and bias of information used in decision-making in simulated fireground exercises. *27th International Congress Applied Psychology*, Melbourne, Australia
- Catherwood, D., Sallis, G., Edgar, G., & Medley, A. (2012). Fire Alarm or False Alarm?! Situation awareness and decision-making "Bias" of Firefighters in Training Exercises. *International Journal of Emergency Services*, 1(2), 135-158.
- Catherwood, D., Sallis, G., Edgar, G., & Medley, A. (2011). Scoping and Bias in the Fireground: A new approach to understanding fireground "situation awareness". *Fire*, January, 27-29
- Durso, F. T., & Alexander, A. L. (2010). Managing Workload, Performance, and Situation Awareness in Aviation Systems. In *Human Factors in Aviation* (2nd ed.): Elsevier.
- Edgar, G., & Edgar, H. (2007). Using Signal Detection Theory to Measure Situation Awareness: The Technique, The Tool (QUASATM), the TEST, the Way Forward. In M. Cook, J. Noyes & Y. Masakowski (Eds.), *Decision making in complex environments* (pp. 373-385). Aldershot, UK: Ashgate.
- Edgar, G. K., Catherwood, D., Baker, S., Sallis, G., Bertels, M., Edgar, H. E., Nikolla, D., Buckle, S., Goodwin, C., & Whelan, A. (2018). Quantitative analysis of Situation Awareness (QASA): Modelling and measuring Situation Awareness using Signal Detection Theory. *Ergonomics*, 61, 762-777.
- Edgar, G., Catherwood, D., Sallis, G., Brookes, D., & Medley, A. (2012). "I always know what's going on." Assessing the Relationship between Perceived and Actual Situation Awareness across Different Scenarios. *World Academy of Science, Engineering and Technology*, 71, 1480-1481.
- Endsley, M. R. (2000). Theoretical underpinnings of situation awareness: A critical review. In review. In M.R. Endsley & d. J. Garland (Eds.), *Situation Awareness Analysis and Measurement* (pp. 3-32). Mahwah, NJL Erlbaum.
- Gasaway, R. B. (2008). Making intuitive decisions under stress: understanding fireground incident command decision-making. *Fire Safety, Technology & Management*, 10, 41- 51.
- Klein, G., Calderwood, & Clinton-Cirocco, A. (2010). Rapid decision-making on the fireground: the original study plus a postscript. *Journal of Cognitive Engineering and Decision Making*, 4, 186-209.
- Omedei, M. M., McLennan, J., Elliott, G. C., Wearing, A. J., & Clancy, J. M. (2005). "More is better?": a bias toward overuse of resources in naturalistic decision-making settings. In H. Montgomery, R. Lipshitz, & B. Brehmer (eds.), *How professionals make decisions*. Mahwah, New Jersey: Lawrence Erlbaum (pp. 29-41.)
- Sallis, G., Catherwood, D., Edgar, G., Brookes, D., Medley, A. (2013). The human brain: trustworthy fire-fighting equipment? *International Fire Professional*, 5, 21-24.
- Sallis, G., Catherwood, D., Edgar, G. K., Brookes, D., & Baker, S. (2020, *submitted*). Habitual or Resting Bias in High-Pressure Fire-Incident Training Command Decisions.
- Stanislaw, H., & Todorov, N. (1999). Calculation of signal detection theory measures. *Behaviour Research Methods, Instruments, & Computers*, 31, 137-149.