Introspect Model: Competency Assessment in the Virtual World

Katherine Lamb
Incident Command Development,
Oxfordshire Fire & Rescue Service,
United Kingdom.
Katherine.lamb@oxfordshire.gov.uk

Martijn Boosman
E-Semble bv, Delft
The Netherlands
Boosman@e-semble.com

Jim Davies
Incident Command Development,
Oxfordshire Fire & Rescue Service,
United Kingdom.
Jim.davies@oxfordshire.gov.uk

Abstract

Over the last decade the number of operational incidents responded to, has the UK Fire and Rescue Service has diminished by approximately 40% (Knight, 2013). This reduction in incident number and consequential experiential learning opportunities has resulted in a deterioration of incident evaluation skills by the incident commanders. This paper will detail the application of the 'Introspect model' in conjunction with the use of XVR simulation software, within Oxfordshire Fire & Rescue Service (OFRS). The model has been applied in development sessions and during competence assessment over the last 6 years. In 2009, only 45% of those candidates assessed, demonstrated the desired level of competence, compared to over 70% in 2014. The 'Introspect model' focuses on the understanding of decision rationale, striving towards a state of unconscious competence within the crisis decision maker at the incident, to effectively compensate for the skill fade or inexperience, due to diminished incident exposure.

Keywords

Decision-making, Introspect model, Assessment, Simulation, XVR

INTRODUCTION

In 2006, Oxfordshire Fire & Rescue Service (OFRS) attended a cross-border incident where a fire-fighter suffered life changing injuries; following this incident, significant changes were introduced to improve the understanding and application of the UK Fire Service incident command system. Within OFRS a process was introduced to assess and monitor the competence of all incident commanders within the service. This assessment process is now referred to as the 'Introspect Model' (Lamb, Davies, Bowley, and Williams, 2014), and has effectively readdressed this incident evaluation imbalance, over the last 5 years.

Previously, OFRS incident command assessments had loosely focused on the competencies found in the specific role-maps and were marked subjectively by the incident command trainers. The new assessment system was

created with the intention of assessing competence at all four levels of command throughout the organisation. In August 2005, the roles of Fire and Rescue Service employees were mapped nationally within the Integrated Personal Development Plan (IPDS), and these roles were assigned accredited occupational standards. These role-maps provide the framework for each specific role, and contain National Occupational Standards (NOS), which are the specific elements that underpin each role, from entry level firefighter to strategic manager.

During the early stages of Command competency assessments, it became apparent, those incident commanders who performed well, were proficient in Naturalistic Decision Making abilities. So it was decided to change the existing marking criteria to align to NOS but structured to the decision-making model (DMM), documented by Klein (Department of Communities and Local Government, Incident Command Manual, 2008), so it would become apparent, where in an individual's decision making abilities their strengths and weaknesses lie and individuals could recognize this for themselves.

In order to make measuring competency against the NOS criteria statements, each element of the criteria were spit into 5 easily distinguishable incremental grades, with key measurable criteria within each grade.

The key to 'Introspect Model's' success, is the unique method of self-awareness, which is facilitated throughout a structured debrief. This self-reflection plays the major part in allowing individuals to become metacognitive in their crisis management decision making skills. As during a crisis situation, when the goals are ill defined and situations are unique, it is important for the individual to acknowledge that common 'pattern matching' techniques, usually demonstrated in their normal day-to-day decisions or application of standard policy or procedure, may not be the most appropriate resolution for the crisis situation. Instead, these robust decision makers are confident in their own abilities, and able to be flexible in their approach, bringing clear direction and leadership to those around them, during these highly charged and uncertain circumstances

The Introspect model aims to develop and attain the following mantra with all incident decision makers;

'The right person, making the right decisions at the right time, for the right reasons'.

Attainment of this 'right person' status is the 'utopia' of the safe person concept; by constantly striving towards this goal we ensure we have the safest person available at any given time. The safe person concept is an ideology used by the UK Fire and Rescue Services to manage the risk, personnel at operational incidents are exposed to. Operational incidents are inherently dangerous places so in these environments, where it is impossible to make the workplace safer, fire-fighters and incident commanders are trained to be safe within a dangerous environment. There are two aspects to this approach – organisational responsibility and personal responsibility. An organisation is obligated by Health and Safety law in the UK to provide appropriate support (training, equipment and procedures) to ensure that all personnel are able to remain safe in a hostile environment. The individual has a personal responsibility to utilise these procedures and systems provided by the organization, in order to keep themselves and others safe. In addition, the incident commander needs to make a professional judgment about the appropriate use of available resources and to correctly manage the risks during an emergency situation (Home Office, 1998).

The 'right person' is identified through a series of selection process covering aptitude, knowledge and practical ability for the role. However, the 'right' decisions, 'right' time and the 'right' reasons are much harder to define and measure.

When incident commanders need to make a decision they quickly match the situation to the patterns they have learned, whether from previous incidents, training or procedures. If they find a clear match, then they continue to carry out the most typical course of action or follow a clearly defined procedure. However, there is more to recognised prime decision (RPD) making than just pattern matching. Recent studies by Klein 2008 found that incident commanders evaluate a course of action by using mental simulation to imagine how their decision would pan out within the current context or situation, constantly reviewing the plan until they found the most appropriate option. Therefore the RPD model is a blend of intuition and analysis. The pattern matching is the intuitive part, and the mental simulation is the conscious, deliberate and analytical part. A purely intuitive strategy relying on pattern matching alone would be too risky because sometimes the pattern matching generates flawed options. A completely deliberative and analytical strategy would be too slow; fires would be out of

control by the time the commanders had finished deliberating (Klein, 2008). But how do we train to develop these competencies in lieu of operational incidents, further how do we assess their attainment and subsequently maintain them?

SIMULATION-BASED TRAINING & ASSESSMENT

As fire service incidents are dynamic and their timings unpredictable, it is very difficult to assess the candidates naturalistic decision making (NDM) within their normal sphere of work. To compensate for the inability to assess this decision making at incidents, simulation is routinely used. The value of simulation for training purposes lies in its ability to have candidates experience incident situations in a safe, contained, comfortable, repeatable, controllable, and measurable environment. Simulation has proven itself as a particularly useful tool to help candidates understand concepts by experience, to acquire practical knowledge in a relatively short timeframe, practice decision making in critical situations and experience situations that rarely occur in real life. Virtual reality is cost effective, because it requires less training staff and eliminates the need to build up physical training environments. It is flexible, because instructors can easily build an enormous variety of incident scenarios by picking and combining different environments and objects. But most importantly, modern simulation software allows instructors to create events in a large virtual environment that would be extremely hard to recreate in live simulation – for instance a large motorway accidents or a rapidly spreading fire in a chemical plant. An additional benefit is the ability to replay scenarios for evaluation purposes, for which you would need to set up dozens of cameras in a live simulation setting

In order to facilitate immersion and to ensure credibility, the scenarios created must be realistic, achievable and manageable given a candidate's current level of command skill, expertise, and importantly be appropriate to their role. If a candidate is managing a simulated incident well, then that incident should be well ordered and calm, and importantly the candidate should see themself as in command. However, if the candidate fails to take control and to resolve the unfolding incident, then problems are compounded and the situation worsens. For example, if the candidate is making appropriate command and tactical decisions then the fire will get smaller, and the crew on the fire ground will be well managed and clearly understand the plan to resolve the incident. However, if the candidate is struggling to resolve the incident as a result of poor command decisions or inaction then the fire will worsen and the scenario will become more complicated.. The correlation is clearly evident that the same skills are needed to resolve both simulated and actual incidents. These skills include good communication, effective use of resources and information, and a clear command strategy and are essential if the many problems arising from such incidents are to be identified, prioritised and resolved.

For the past five years, we have used the XVR software produced by a Dutch company (E-Semble), to produce scenarios used both, in assessments and development sessions. The XVR software, used by over 150 emergency services in the UK and worldwide, is incredibly versatile and enables the assessment facilitators the scope to create scenarios that are bespoke to their geographical or topographical area. It is also possible to recreate specific incidents for particular training issues or debriefs and to develop an array of incident types.
The software enables the candidate or a group of candidates to operate within the scenario, as a specific role or as a command team. They can also request actions to occur during the resolution of the incident; these actions are then completed dynamically by the facilitator. This functionality of the software aids the candidate's immersion into the scenario, and the quality and accuracy of the graphics enable the candidate to make operational decisions about the use of the equipment and resources they see on the screen. There is also the ability to change the weather, the wind direction, and the time of day of the scenario; all of these details improve the candidate's immersion into the scenario and provides them with the most realistic environment available for them to demonstrate their competence, and their ability to make appropriate dynamic decisions.

Scenario Development & Familiarisation

All of the scenarios produced incorporate the same six phases which align directly with the 'Introspect model'

- Information gathering
- Incident evaluation
- Objective setting and planning

- Command and control
- Communications
- Review.

The simulated incidents used in both assessment and development sessions are story-boarded by the team, and the level of complexity agreed to fit the phases above and are relevant to the candidate's role. The candidates are then given an opportunity to make a topography visit to the XVR environment where their assessment will take place. This gives the candidates an opportunity to get familiar with the functionality of the software, re-affirm how to communicate with virtual crew members and role players, and to get a feel for the environment. This helps put the candidate at ease, and enables them to get a degree of knowledge about the specific environment, akin to their own knowledge of specifics risks, demographics and building types within their station area.

Scenario Delivery

At a bronze or level 1 incident, the candidate is presented with a situation that needs initial action to prevent its escalation. The candidate will then gather information and assess risk within the scenario, evaluate this information and put into place their initial action plan, thereby naturally and subconsciously using the DMM. Using the functionality of the XVR software, the facilitators alter the visual stimulus of the scenario to reflect the actions detailed to the crews. It is possible to apply water to fires and for the fire to react or change in response to the water, this aids the candidate to make subsequent dynamic decisions as they respond to the altered visual stimulus and become further immersed in the environment (Figure One). We also deliver scripted injects at an appropriate time during the incident to clarify the candidates understanding of the incident or to steer it in a particular direction.

Figure One:
Screenshots from XVR software, depicting the range and functionality available

There is always natural variability within the scenarios as a consequence of the individual's communication and style, and their comprehension and understanding of the scenario. However, through the facilitation this variability is kept consistent by controlling appliance travel times (respective to the geographical location of the incident and the time it would realistically take resources to arrive), crew numbers and their competence levels on additional appliances.

This variability has been questioned by other assessment strategies, however by keeping everything exactly the same it would be possible to make passing an assessment formulaic rather than dynamic. Instead, we run a diverse array of assessments which can all be resolved by applying the DMM and rationale during the decision-making process. The candidates are assessed on their ability to make the 'right' dynamic decision based on their own knowledge and evaluation of the incident rather than learn how to apply a scripted list of incident decisions which may not fit the particular incident they are faced with.

Scenario Debrief and Assessment

The specific elements of the candidate's role-map are used as measure statements for a minimum standard of competence, within the 'Introspect model'. Each of these specific statements was altered in their wording to generate five range statements within each of the assessment elements, to generate a graded standard of competence. We then ask the candidate to reflect on their performance, to rationalise their own decisions and to highlight where their score should be awarded. This cannot be assessed subjectively by an assessor observing and grading the candidate's performance. Instead, a thorough debrief is conducted and a professional discussion of the scenario is facilitated by the assessors, around the decisions and actions made by the candidate (Figure Two). This debrief is a reflective process, which enables the assessors to understand the candidates evaluation of the incident based on their own knowledge and understanding. For example, the candidate with a greater understanding of a car repair workshop (through prior knowledge of car repair workshops), may ask fewer questions of the key holder during the information gathering phase. This does not mean that their knowledge or hazard awareness is any less accurate than a candidate who quizzes the key holder thoroughly. It also provides evidence to the assessors that the candidate understands the measures of the marking criteria – 'You Identified ALL the Major Hazards' – Knowing what constitutes 'major' in the context of the scenario is fundamental to improving the candidate's ability to become 'metacognitive' in their thought processes, and by the individual recognizing what they know, it gives them confidence in their own knowledge. This allows the assessors to understand if the individual is making the 'right' decision for the 'right' reasons – if the candidate has made a decision which would not form the normal response during the incident due to restrictions in software or immersive level of the candidate.

Figure Two:
Images detailing the Introspect Model Assessment process. Scenario based practical application of command skills, using XVR. Structured debrief facilitated the Incident Command team. Which leads to the candidate's assessment of their own competence.

During the debrief process, the assessors are also able to gauge the candidates risk appetite and how it influences their decision-making process. For example a candidate who attended an incident involving an explosion of an acetylene cylinder may take a very defensive stance at all incidents involving cylinders, regardless of whether the cylinder is involved or near to the fire. However their experiences don't make the decision wrong. Instead during the debrief, the facilitators try to assist the candidate in understanding the rationale behind their decisions, to determine if they are making the 'right' decisions for the 'right' reasons, and whether after a period of review the candidate should have modified their plan.

A candidate who has been unable to explain or identify the rationale behind their decisions will have failed to effectively take command of the incident, due to an inadequate incident evaluation. This has generally been

caused by macrocognitive overload, leading to decision inertia and/or the observation of numerous cognitive errors. Macrocognitive overload occurs when the individual is grossly overwhelmed by the volume of information coming in; the high demands placed upon them; the need for urgency and an inability to appropriately weigh up the risk/benefit analysis that needs to occur for before any preventable actions can be implemented. This overload leads to indecision and often an inability to make a decision, better known as decision inertia (van den Heuvel *et al*., 2012, Eyre *et al*., 2008).

Our observations mirror those of recent studies of Australian bush firefighters, by Frye and Wearing 2011 and 2013. They observed that failure to take appropriate command of an incident was caused by one or more cognitive errors, which could result in significant safety critical errors and subsequently a failure to demonstrate incident command competence. Many individuals assessed using the 'Introspect model' were witnessed struggling to accurately evaluate or re-evaluate the incident, and as a consequence were unable to prioritise their actions and commands appropriately. On several occasions individuals failed to appropriately anticipate the progression of the incident or consequences of their actions, or demonstrated too much anticipation, and too little immediate action. Others, who had poor situational awareness and poor information gathering phases of their assessment, were unable to recognise what information they should gather, and this then had a detrimental effect on their ability to form an appropriate action plan and resolve the incident. Poor delegation and management of the crew were other cognitive errors displayed by candidates struggling to demonstrate command competence. Finally, an inability to form an appropriate action plan was often coupled with a poor incident-review process. These observations suggest the competencies and the cognitive errors found within our simulation accurately reflect those found in the operational environment.

The specifics of these cognitive errors are very difficult to define or to train for within a traditional classroom setting. Good incident commanders have a natural aptitude for problem solving, have excellent evaluation skills, are concise and clear communicators, with a natural ability to anticipate a situation, and weigh up solutions or options. These individuals are identified through the rigorous selection processes at firefighter level, and then scrutinised at promotional selection tests before becoming an incident commander. We use the 'Introspect model' as part of the criteria to identify the 'right' people for the role of incident commander. Although these natural aptitudes can't be taught, they can be practiced through simulation and operational incidents until they are natural responses and processes. The assessment debriefs also function as development sessions, to confirm the candidates the understanding of their actions, and to re-address any process driven failings. The discussion over 'why' they made certain decisions reinforces the candidates understanding and acknowledgement of their own actions, confirming that they were the 'right' decisions at the 'right' time for the 'right' reasons and allowing them to become metacognitive in their own decision making.

Candidates who failed to apply processes as stipulated in procedural documents, for example, submitting a tactical mode to Fire Control, to time stamp the legally required risk assessment, are much easier to develop within training to rectify these process driven errors. But, importantly, the candidate who understands 'why' they should have followed the process in the first place, is more likely to exhibit this process naturally at incidents, rather than desperately trying to remember to apply a process they didn't really understand. The 'Introspect model' is a merger of cognitive and naturalistic processes, macrocognitive overload can be caused by trying to remember a list of processes that are poorly understood, which inhibits naturalistic decision making processes and causes decision inertia.

DOES IT WORK?

The application of the 'Introspect model' provides a simulation-based development and assessment tool to identify and monitor nationally recognised competencies, specific to Fire and Rescue Service role-maps. The order of these competency statements at all 4 levels of command were aligned with the DMM in order to demonstrate to the competent delegates that they were subconsciously following the DMM naturally, throughout their command at an incident. Conversely, those candidates who struggled to demonstrate command competence could then align their own decision-making process with a naturalistic model, and hopefully recognise the areas where they fell short, and have a clear defined structure to develop from.

The reflective debrief aspect of the model gives the candidate a specific opportunity to reflect and discuss their own performance with sector-competent facilitators & assessors. The data collected from all assessments are analysed annually, and any trends identified and fed back into the next training year. This introspective review of the assessment process facilitates continuous modification of the model and appropriate development of the incident commanders.

The data is also analysed annually to determine the effectiveness of the training and the success of the model. All candidates are assessed every 2 years as a minimum, and following assessment they achieve one of three graded outcomes using a traffic light system. A green result deems an individual competent, requiring no additional support on the incident ground, and is reassessed every 2 years. An amber result provides the individual with an additional level of support, via an increase in their incident command assessment frequency, monitoring on the incident ground and developmental assistance, and reassessment is every 12 months. If an individual is deemed not competent then a red result is issued, and they are removed from operational response. These outcomes are documented in the organisations procedures and ensure the results of the assessments hold a level of integrity within the organisation. Without this infrastructure the assessment process has no credibility and the individuals can't identify with its importance, and crucially will not support their own development and that of others.

The assessment results from the past 6 years have been analysed and clearly evidence that the assessment tool is working (Figure Three). This data has been collated and represents over 500 assessments at level 1, with the number of candidate's assessment each year, at approximately 100. There has been a steady improvement over the last 6 years in the number of candidates demonstrating a high standard of competence, as evidenced by a green 2 year pass. Conversely, the number of 'amber' 1 year passes is reducing as the individuals get the opportunity and support to develop their decision making skills, and as a consequence, demonstrate a higher level of competence at reassessment. The number of candidates that fail to demonstrate competence remains at approximately 10%, of all assessments conducted, this number represents new candidates being assessed for the first time, as well as those who have failed to demonstrate competence due to skill fade.

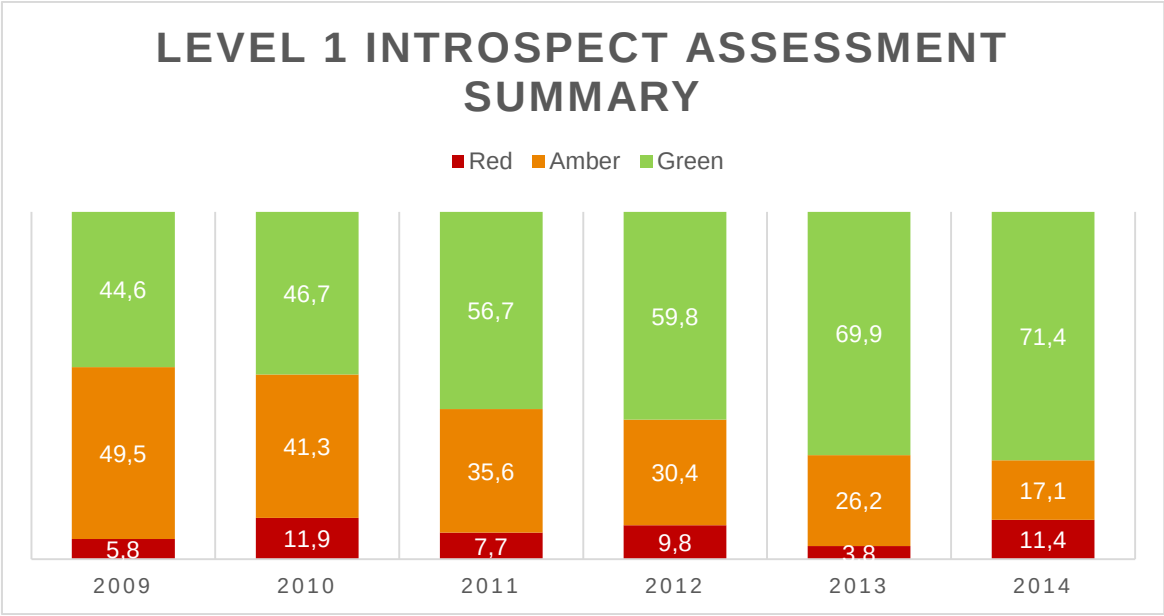

Figure Three:
Graphical representation of the assessment outcomes of 529 Level 1 incident command assessments, completed between 2009 and 2014. On average 100 candidates were assessed each year between 2009 and 2013, and only 29 assessments have been completed in 2014 to date. The data represents the percentage number of assessment grades achieved in each of the 3 outcomes.

CONCLUSION

The competence of the candidates has clearly improved over the last 6 years, with only 44.6% of candidates demonstrating a 'green' competent ability in 2009, through to 71.4% in 2014. This improvement is attributed to the effectiveness of the assessment model in conjunction with the immersive learning environment provided by the XVR software. The familiarity of the 'Introspect model' has increased over the last 6 years, as the decision making language, and the decision making sequence have become subconscious competences of the candidates. In addition, the quality of the graphics, the usability and functionality of the software has enabled the candidates to become more immersed in the assessment process, and subsequently respond to the incident in a natural manner.

The fact that the assessments are variable and responsive to the individual's decision making, removes the possibility that these improvements are achieved by individuals learning a pre-set sequence of actions, and applying them regardless of the situation that they are facing. Some would argue that this improvement could also be attributed to better 'gaming-technique' or 'playing the game'. However, by the candidate verbalising the decision rationale, and the facilitated debrief, it is very easy to see when a candidate is completing the assessment following a distinct set of preconceived decisions or processes, rather than naturally responding to the scenario in a dynamic, but considered fashion. Preliminary data analysis also suggests that candidates who fail to demonstrate competence, struggle with the personal attribute-type competences like evaluation skills, rather than process driven decisions. Conversely, this further provides credence to the process, as individuals who previously struggled with their incident evaluation, have honed these skills to enable them to make better decisions during future assessments, as by becoming metacognitive in their understanding (knowing, that they know), they know they are making the right decisions for the right reasons, and subsequently grow in confidence in their own command competence. The confidence this introduces in the candidates helps create a much more robust decision maker, who is happy to discuss rationale and look at their decisions in a more introspective way.

Whilst using the 'Introspect model' the facilitators have witnessed many 'light-bulb" moments by candidates who, while debriefing and explaining their decisions, have suddenly understood mechanisms related to a process they were doing naturally. Decision-making and command of an incident is a cognitive process. This debrief and self-reflective process, using an understanding of metacognition by the debrief facilitators takes this well-recognised state of competent awareness to a new level. These particular candidates then progress to a conscious awareness of their unconscious competence. Therefore, confirming that they are; the 'right' person, making the ' right' decisions at the 'right' time, for the 'right' reasons". Through further implementation of this model, as an example of best practice the performances of Incident Commanders in risk-critical areas will go from strength to strength, reducing the personal, financial, and moral losses experienced. This will add weight to the acknowledged Fire and Rescue Service mantra of "in a highly calculated manner we will risk our lives to save saveable life" because the calculated manner is about the 'right' person making the 'right' decision at the 'right' time and very importantly for the 'right' reason.

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