

Integrating simulation into Wildfire Aviation Training Alberta, Canada

HOST

Josephine Stirling, Business Manager, NAFC

PRESENTERS

Nicole Galambos, Director of Training, Government of Alberta's Forestry Division

Nicole has been a wildfire management professional since 2005, and has worked in forest fire science, planning and strategy development. Currently, the Director of Training for the Government of Alberta's Forestry Division, Nicole oversees the Wildfire Management Branch training program – including the aerial firefighting training simulator development.

A practicing Fire-Behaviour Analyst and co-Chair of the Division's Diversity and Inclusion Working Group, Nicole's passions include: any-and-all things related to firefighter safety, staff development and the study of fire behaviour!

Scott Elliott, Senior Wildfire Management Training Specialist

Scott is a Senior Wildfire Management Training Specialist at the Hinton Training Centre in Hinton, Alberta.

He has been involved in wildfire management operations for 30 years and is currently certified as a Type 1 Incident Commander.

Greg Boyachuk, Provincial Airtanker Program Coordinator

Greg has been involved in wildfire management for over 27 years, has been an Air Attack Officer for 20, and the Provincial Airtanker Program Supervisor for 8.

Part of Greg's responsibilities include air attack officer recruiting and training.

PRESENTATION

Nicole Galambos

We'll Discuss

Thank you Josephine and good morning everyone. I'm really happy to be able to be here today 'virtually' talking with you about the success that we've had integrating simulations into our aerial firefighting training program. So with Scott and Greg's assistance we're going to run through an overview presentation and flight deck for you; turn it over to play a video demonstration and save some time at the end for questions and answers.

Today we're going to talk about how we manage wildfires in Alberta and the role of the Hinton Training Centre. We're going to walk through some of our experience in designing and developing an aerial simulator and the associated training with that simulator. Along the way we're going to highlight to you the value of simulation training, some lessons we've learned (including some challenges) and where we see the future use and simulation program going.

Alberta's Wildfire program

In Canada, each province or territory has the responsibility for wildfire response, including the training and certification of all of our aerial and ground suppression personnel. Alberta, in western Canada and our forest protection area is about 80 million hectares of forested land where the government has exclusive responsibility for wildfire suppression and response. When it comes to our fire environment, on average we see about 1600 wildfires and 400,000 hectares burnt each year. And as you all know, that number is very variable depending on the severity of the fire season.

We do have an aerial focused approach to wildfire management in Alberta. On any given day we can have 7 airtanker groups with multiple aircraft in each group, and up to 200 or more rotary wing or helicopters on hire throughout the province. When we get into a large fire or contentious fire we can have significant numbers of aircraft. An example might be the Fort McMurray Fire of 2016 where for the one incident we had over 90 rotary wings assigned to that fire.

To round things out on the staffing front, we have about 450 permanent staff, and approximately 750 or more seasonal staff join us every fire season, in addition to hundreds of contractors that we can call on during periods of escalated fire activity.

Alberta's Wildfire Training Program

We mentioned previously that each province has responsibility to train and certify their staff. In Alberta we've taken a centralised training approach where we do train all permanent and seasonal staff out of our facility in Hinton. The Hinton Training Centre is essentially an old college with typical dormitory style rooms that can accommodate 200 people a night, a commercial kitchen that can feed 250 people. In addition to myself we have 7 full time wildfire training specialists and 2 online learning staff that lead our wildfire training program for the province. We have 50 or more training courses, workshops and various simulation events that we put on every year. Our target audience is everybody from our first year crew members, seasonal dispatchers, through to veteran fire staff that are progressing into type 1 incident management team roles or technical specialists such as our Air Attack Officer program. Because we do have the physical space here, our aerial firefighting training simulator is located at the Hinton Training Centre. It works out well because we have the capacity to have various role player and main cockpit facilities and we are about 3 hours from Edmonton where our provincial aviation program staff and aviation specialists work.

That is a little bit of the history of the centre, what we do here, how we train people in Alberta. I will now turn things over to Scott to start to dive into the details of our simulator on site.

Scott Elliott

Alberta's Aerial Firefighting Simulator (AFS)

Good morning everybody. I'm real pleased to be hear to talk to you all about some of the programs we have put in place here. I am going to put it over to Greg to talk about how we use the simulator.

What I'll try and do is give you a broad overview of the system we put in the place, what the physical components and software components are that we are utilizing to develop the simulator program. We've been working on this for approximately 5 years. When we started the project it became pretty apparent that there was no real commercially available off-the-shelf solution to the problems we were trying to solve. Development and training operations happened about the same time. As we were developing the simulation we were also trying to utilise it operationally to make sure we were heading down the right road and that is was serving the purpose that we wanted it to have. Over the years, with lots of specialized contractor support and other support out there, we've been able to develop a pretty sophisticated and robust system for what turns out to be a pretty reasonable price. In 2019 the other provinces across Canada started to get a sense of what it was we were doing, so we are sharing all that information across all the other agencies to create compatible simulation systems.

The system mainly consists of a simplified main cock pit with simplified flight controls. We're not interested in training pilots, we're interested in the firefighter who sits beside the pilot – our Air Attack Officers primarily as the tactical firefighter in the air. Our simplified flight controls consist of reasonably inexpensive gamer quality yoke, throttle, pedals etc. Also inside that simplified main cockpit it's generally a fixed wing aircraft, but we can with some real simple modifications also simulate a helicopter as well through the use of a gamer joy stick for flight control. We've also developed a Directors station which will talk a little bit more about. Networked role player stations because you need to have that interaction to create the realistic simulated environment that we were looking for. The flight platform we use is the Lockheed Martin Prepar3D platform (also known as P3D). It is fully networked and that allows role players and participants from essentially anywhere in the world as long as they are on the same network to be able to participate in the training. The network capability is something we identified early in the project, that we wanted to make sure that we had was part of the build that we were looking for. There is also a communications systems we have developed is integral to the simulation project and the simulation exercises that we utilise. The key software that we have right now is Lockheed Martin P3D and a purpose built add-on software for P3D which is called Lorby Wildfire Response.

Simulator features

The Lorby Wildfire Response software creates a Directors Station which allows the Director of the Leader of the simulation exercise to place fires and then modify the configuration of the exercise. Wind speed and direction can change, we can add new fires, add spot fires, manipulate the scenario to meet the learning objectives of the trainee or the participant that's going through there. From this station the simulation Director can monitor the simulation and modify the exercise as required. The system is full networked which allows our ability to integrate other participants or role players into the system as required. In Lorby Wildfire Response, fire growth is dynamic so it does respond to changes in wind direction and wind speed and a real benefit we got out of the development of the software is that it also responds to the suppression action that the participant in the simulation undertakes. SO when they direct tanker action or air tanker action on to a portion of the fire, the fire does respond to that suppression action as well which is really beneficial, and a nice advancement to the simulation program.

Embedded in the Lorby Wildfire Response software is the Lorby Comms software. That, in my mind, was the game changer that the software provided to create a real immersive environment that allowed us to essentially use a VOIP protocol (using VOIP software) that allows us discrete and distinct multi-channel capabilities for the trainee or participant in the simulation to undertake. They have access to four distinct radio channels that is accessed 'push to talk' as well as a voice activated intercom. The development of that chunk of the software really created the ability for us to mimic the communications systems that our Air Attack Officers utilise inside the actual aircraft. The stack of radios that you see on the right hand side of the slide is the screen shot of the software that we utilise, but it would be exactly the same as the setup our AAOs have inside the aircraft. That was really beneficial to create that immersive environment that we were looking for. A couple of other things that we've integrated into the simplified cockpit is the GPS software that again mimics the functionality of the GPS that is embedded in many of our aircraft, as well as it has the real functionality in the simulation world as well, and be used to navigate to and from the way points. A siren was also integrated as part of the procedures and processes that we want our AAOs to practice. As much real world functionality that we can integrate into our simulated cockpit is kind of what we're after. I will now turn it over to Greg to talk about how we are using the simulator to develop staff.

Greg Boyachuk

Annual simulation training

Thanks Scott, and good morning everyone. We pretty much developed this simulator to train Air Attack Officers, especially new AAOs. Through the development we have discovered other uses for the simulator. On an average year we will probably run 30 to 40 personnel through the simulator, we will do anywhere between 80 and 100 simulations, which probably equals 120 to 140 hours of simulation work. Our fire season in Alberta is generally April to end of September, with probably the busiest time in May and June. The majority of our training gets done in March and April, which is Spring time here leading into the fire season. I currently have 24 AAOs that work for me, so everyone of them does proficiency rides or check rides we call them, usually they'll get 3 to 4 simulations starting from very basic to much more advanced simulations. We have a Helicopter Coordinator program and course that we have developed here as well, and simulations are conducted as part of that course. I have 2 to 3 Air Attack Officer trainees per year, that will do anywhere between 4 and 10 simulations, over the period of 2 years. We also do a national AA training program in Hinton usually every couple of years, involving basic simulation work for those trainees. We've also in the past done some Crew Leaders simulation work, repel spotters etc. The simulation program is used for a bunch of different roles and purposes.

Simulations

When we setup our simulations (pre-COVID), on a typical year, we usually do small groups (approx. 8 per group) when we do the simulations. In that group we will have a Group Leader who is responsible for keeping everyone on time and on track and more importantly determining what the goals of each simulation will be based on the trainee's needs. They'll basically be in charge of the briefings and the debriefings. Quite often there will be a trainer or a check rider at the same time. As Scott mentioned, we have a simulator director station, so there'll be a director in place and their responsibility will basically be to setup the simulation, making sure that the fire or fires that we are simulating are appropriate for the goals we want to achieve, and making sure that all of the role players are in the correct positions and on the correct radio channels, and any sort of trouble shooting things that come along. In terms of

multiple role players, a couple of the AAOs are pilots as well, so we have learnt to fly in the simulation world (both helicopters, air tankers etc.). Occasionally we get some of our helicopter and bird dog pilots into work with us, however, for the most part we do the role playing ourselves. There will be a trainer and trainee within that group as well. Based on the training goals, it could be anything from working a fire in topography. We have a list of simulations (kind of a menu) that we can position fires wherever we want and have certain role players based on those trainee goals. We start every simulation off with a role player briefing which is usually done by the Group Leader, who will brief the role players on what the goals of the simulation are, what the complexity will be and that type of thing. That is followed by a trainee briefing, which is usually just a smaller one-on-one briefing with either the leader or the check rider with the trainee as to where they are positioned, what kind of weather they're expecting that day, fire behaviour and that type of thing. Then we jump into the simulation, with most simulations taking about an hour and a half, especially the AAO ones. We try to do them in real time as much as we can. There is the odd thing we may speed up for the most part we do it in real time. One of the things we do with either our check rider or our trainer who's in the back seat of the main cockpit, they're able to observe the trainee and bird dog pilot interacting, and they'll be able to listen in on all the audio and what we do is we have a group text set up with the role players in the back room. So basically the we can have interactive inputs from that trainer. So if he wants to simplify things or add another air tanker into the mix or make the scenario more complex or whatever, he just has to text the role player room and they'll add that instantly into the scenario. It makes it a very realistic and life like. Then we always follow every simulation with a debrief afterwards, usually as a whole group debriefing with the trainee. Occasionally we'll do a one-on-one with just the trainer and the trainee as well, especially if they are a new Air Attack Officer. Then we always log our simulations so that we can keep track of how much simulation time we're doing, and what works and what doesn't.

The value of simulation training

Obviously there's a lot of value to simulator training besides cost savings, but one of the big ones that we have, to train one Air Attack Officer in Alberta currently takes two years (two fire seasons) and costs about \$75 000 (Canadian dollars), and that's just in flight time and fuel prior to simulation. The cost is substantial and also the washout or scrub rate is fairly high. Probably about 60% of the trainees that try to get into the Air Attack program won't make it. One of the things that simulation gives us is a way that we can find out whether the candidate is acceptable, and find out things such as their communication skills, situational awareness etc. in the simulation, before we invest a lot of time and money. When we look at doing one of our simulations for say an AAO with multiple aircraft, on average if we were to look at the equivalent cost of flight and fuel time it's at least \$33 000 equivalent training costs. On a season like 2019 which was one of our busiest simulator seasons prior to COVID, the equivalent cost of providing that training in the simulator vs how much it would cost us in real aircraft was close to 1.8 million dollars in equivalent costs. Looking at the cost savings, of doing simulator training it is pretty substantial and currently we look at about 25% of our AAO training is now done in a simulator and our goal is to get that up to 50%. We realise that there has to be real life flying in aircraft training done, but I think that where we've come with our simulator, we can greatly reduce that amount. But then of course as soon as you do that you reduce the risk of actual flying in aircraft and the actual wear and tear of the aircraft. It also allows us to do currency training with all 24 of our AAOs, who do 3 to 4 sims every Spring prior to fire season, so they're much more prepared for fire season. It was interesting that this Spring, because of COVID, we weren't able to do sim training and I heard about it from pretty much all of my

AAOs that they really missed that sim training in the Spring. I think there is a huge value to the role players that are in the back room and flying the aircraft. They get just as much value in communication skills and being able to observe and work on the different fires and see how others – whether it's a trainee or experienced Air Attack Officer. Another big benefit that we found is that it allows us to do high risk low frequency event training. So things that are very high risk in our jobs that don't happen very often means out trainees and our even our certified Air Attack Officers don't have that mental model of a certain event. Things like searching for a downed aircraft or doing a multi-fire lightning event and managing that when we have 5 or 6 fires happening in front of you. So we can actually simulate a lot of that for them and help prepare them for when it really happens in real life. It also allows us to test different standard operating procedures. So if we want to look at different ways of doing things we can test them in the simulator and see how well they work and see what the challenges might be prior to implementing them in the field.

Challenges

Some of the challenges that we faced, it's interesting because Nicole, Scott and I are not simulator experts, we're not IT gurus – we're all basically firefighters. We've had to learn a lot along the way. We've certainly had some help from the outside but we've done a lot of it ourselves. Certainly some of the challenges are just operational stability of the system with internet connections and the like, you can be in the middle of a simulation and all of a sudden it will just freeze. That's always been a challenge for us. The ongoing maintenance and development of the system, with constant software updates and new things to be added and improved upon – and trying to keep up with the technology is part of it as well. As is staffing and funding. One thing that's really important to consider is it's one thing to develop the simulator and it's another thing to continuously keep it maintained and operating for many years to come. So that has to be taken into account when looking at staffing requirements for keeping it up and running as well, and just as importantly, funding to be maintained over years to keep it going. Compatibility is another challenge with so many different platforms and other companies and users out there and trying to develop a standard procedures and standard systems that they can all work together and talk together has been a challenge for us as well.

The Future

The future I guess is the exciting part. We basically do two months (March and April being the core months) where we do our simulation work. For the most part our simulator isn't used very much outside of that period. Part of our future is looking at other users of this, other agencies that can come into Hinton and use the simulator and reap the benefits of this tool. Potentially, there is improvement to be made with the fire growth models. Lorby Wildfire Response has some very basic wildfire growth models in it including changing wind direction and speed, but there could be a future of actually using the indices of the day and specific fuel types that you could actually create that in the simulator which would be a big leap forward. The computer and software upgrades, things like Microsoft FlightSim sold their whole flight simulator program to Lockheed and now they've completely started and upgraded another flight simulator program which from what I have seen is incredible. There's always upgrades and improvements in the system and the physical cockpit. One thing we would recommend to anyone starting in the sim world or progressing in the sim world is having the ability to record. In our systems we're able to record audio and video within the system, but currently it can only be played in that system. The whole thought of developing cam simulators for certain training purposes, and maybe more

importantly having the ability for a trainee after they've finished their simulation to be handed a memory stick so that they can go to their computer and watch and listen to their simulation afterwards I think has a lot of good benefits for learning down the road. We're not quite there yet with our system, but we're hoping somewhere down the road that we will be. And I think the thing that excites me the most is the possibility of working with companies and other agencies. We could be flying our bird dog in Hinton, and Conair in Abbotsford, British Columbia will be operating an air tanker, and we can both talk to each other and work with each other on a fire together and that could lead to that whole I guess national/international thought of things like Sim Weeks where we can work on fires across the world; work on some of those compatibility things that sometimes we struggle with. I think that's the end goal; the big vision with simulator programs.

Video

I'll now introduce our video that we are going to play. This is certainly not a Steven Spielberg production. We met a few weeks ago in Hinton and this was basically shot with our iPhones and edited together to show what a simulation might look like. It is certainly not a professional production by any means, but it might give you a bit of an idea of the process of what we go through when we're running a simulation.

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Q&A's

Can the Lorby Wildfire Response cater for different models of vegetation concentration, atmospheric humidity, in addition to the wind speed and direction?

SE: As it sits right now, the Lorby Wildfire Response does not have that refined ability to read the landscape or read the vegetation types of anything of that nature. The potential of adding those features into the future is a real thing but as it sits right now it does not. It does respond to the weather features that essentially are inherent in the prepared platform but doesn't really necessarily see the scenery objects that are in prepared, as in vegetation type changes and things of that nature.

How much would a system like this cost to setup? Any tips about getting government support for investment?

NG: As it is a developmental project that we've undertaken the costs are interesting to describe. Originally we were in for about \$120 to \$150 000 (Canadian dollars) to purchase all the hardware and software and get the system set up. On top of that, \$35 to \$40 000 a year for software costs as an annual consumable. We've probably spent 2 or 3 times that if we looked at dedicated staff time and contractor support. We do have 'techs and specs' which we are willing to share with everybody about what our contractor has setup for a new system build which is in around the \$120 00 mark to setup from scratch.

SE: It really is scalable in that the system we built for the cockpit, we went with a projector system and an outside the window screen system so that it has a 200 degree field of view on a cylindrical screen. There are options to go with an LCD flat panel display to create that outside the window visuals that you might be looking for. If you wanted to do it more cheaply then the flat panel display would be a way of saving some costs. The other thing that we've done is we did go with a full five role player setup which involves 5 different gaming computers and essentially 10 monitors and all the infrastructure that goes

along with that. A less expensive system would potentially utilise less role player stations, but then potentially taking advantage of network capabilities if you had partner agencies or other people you could utilise to be the role players then maybe you don't have to have the capital cost of all the computer stations, while utilizing your neighbours ability to have role players participate in your simulation. To duplicate what we have is in the order of about \$120 to \$140 000, but there are scaled in options that could potentially be a little less expensive.

In terms of recommending that as an investment to our funding partners, you talked about some of the cost benefits. Is that how you sold it to them in that the cost benefits far outweighing the costs of setting it up?

GB: Yes, that was a part of the big selling picture when we do a business case to get funding. Nicole and Scott did a lot of work towards obtaining federal funding. It certainly helped with the buy in when we can show how much money you could potentially save with this avenue. It becomes a bit of a no brainer when to train one Air Attack Officer is \$75 000 and takes two years, and the whole system costs \$120 000. It doesn't take long before its value is shown.

NG: When you are looking at funding partners I wouldn't put your blinders on. We were pleasantly surprised that we actually received a million dollars from our Federal Defence program because they have the mandate for public safety and security and we were able to draw parallels obviously between wildfire suppression and response and public safety.

Is there any simulator of this type currently in operation in Australia?

RA: There is some basic setups in Australia along the same lines but not quite as advanced. There is in fact a couple of mobile setups in trailers that can be taken out into the field. Obviously not as sophisticated but I think in some cases using the same underlying software. The state of NSW has also commissioned a system to be built which is quite similar to the approach of the Alberta system, and that is expected to be underway in the next couple of months. Our state of Queensland is also working on commissioning a system which is not dissimilar. The other thing to keep in mind is that there are a number of simulators around Australia that were probably designed primarily as pilot training simulators, but could be quite easily adapted to this sort of approach, retaining the pilot simulation and all the technical specs that go with that, but could quite easily be adapted to these sorts of activities. There is a lot of opportunity out there.

Did our Canadian friends look at adapting simulators that were already in existence in the way that Richard just mentioned?

GB: I guess we started this program. Shawn Lund from British Columbia had built a simulator in his garage, and at the very start of this project Scott and I went down to have a look at it and to see what its capabilities were and that basically started us down the road of where we're at right now. Then some of the air tanker companies have some simulators that they use for their pilot training in Canada and we did have a look at some of those when we first started the project.

NG: Some of the federal funding we have is to look at compatibility with industry simulators and is there a way to network and report into the same virtual simulation environment. On our slide where we talked about challenges with compatibility between software that's certainly where we are seeing some

limitations to networking. Obviously when you are training pilots the level of simulator compliance with federal regulations is very different than training a person sitting beside a pilot.

How many instructors and role players are required to conduct a simulation for a trainee?

GB: It depends on how complex the simulation is, but typically we'll use a group of about 8 personnel. That includes the trainee, the trainer, 4 to 5 role players. The role playing work is not just flying aircraft; we do role playing of ground crews on radios, of dispatchers, and fire centres and the Simulation Director. A typical advanced Air Attack Supervisor simulation would involve around 8 people.

SE: It's another one of those things that's kind of scalable. There are critical role players that are required and that would essentially be your bird dog pilot and then maybe one or two other role players who play various roles on the radio that the Air Attack Officer would interact with. Depending on the complexity that you're looking for, you have the ability to scale that up or down.

Can you map the terrain database to real world areas or just generic terrain models?

SE: The prepared software does come with some of the real-world terrain. The scenery package that comes along with the prepared system is reasonably generic and maybe not super helpful, but we've had some real success by using some add on scenery software like Orbx which is one which puts out a enhanced scenery package. It doesn't quite hit photo realism but does enhance the immersive environment that people operate in. The software is geographically real, the places that you see are the real thing, and so it gets to the point where our trainees can navigate by map and by looking out the window of the simulation; and the land features they see are for real, but, the additional scenery packages really do enhance the realism because there are limitations to the fidelity that the prepared software offers.

GB: Lorby Wildfire Response has some scenery add-ons as part of the package so that you can add things like fire trucks and ground crews into a scenario at any time.

SE: Greg mentioned the high risk low frequency events. We can use some of those scenery effects to create fires in and around lets say towers and power lines and things of that nature, if we want to create a more complicated scenario to the simulated landscape.

How long do the simulations generally last?

NG: They generally last around an hour to an hour and a half for the more complicated ones.

GB: We try to do everything in real time as much as we can, especially enroute to the fire. The only time we might speed things up a little bit is coming back from the fire. We still want to make sure we do go over things like landing procedures, especially for a trainee, making sure the gear is down and all those standard operating procedures are covered. For longer despatches we have the ability to 'warp' ahead a little bit, usually on the way home.

Does the fire growth in Lorby Fire Response include a random or stochastic element?

SE: Not really. We use a real simplified fire growth model that has been overlaid into the prepared world. With that in mind, the stochastic element probably makes sense in computer land, but to us it sometimes looks like a series of pixels that weren't on fire will all of a sudden be on fire. So sometimes it

looks like it jumps ahead or moves in an unusual or random sort of feature or effect. For the most part it is safe to say that if it is random growth (stochastic growth) it's probably more by accident.

GB: There is a feature in the Director Station where you can change some of the settings in terms of how the fire will affect the next pixel over (I guess they call it), so whether if you want a slow moving fire vs a fast moving fire. So that is a little bit built into it, and also if you do turn the wind up or change direction the fire will increase somewhat growth in that direction. As Scott mentioned, it is very rudimentary and not following any fire growth models.

Can you see the suppression simulation being utilised for scenario planning for ground resources as well?

SE: We haven't really explored the opportunity to simulate ground firefighting on this platform. Our software developer from Lorby Wildfire Response seems to indicate that that would be a doable thing where we would be able to deploy say heavy equipment or fire crews and the suppression action that those resources employ would impact the fire spread and fire growth. We haven't really explored that option yet, but then again, software developers will tell you that anything is doable for a price.