




CAE

AVIATION TRAINING

Embedded Training and Simulation for Experiential Training (SET)

A photograph of a pilot from behind, wearing a headset and sunglasses, looking out of a cockpit window. The pilot is wearing a light blue uniform with gold stripes on the shoulder. The cockpit instruments and controls are visible in the background.

A white paper from
CAE and Emirates

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Authors

Captain Mark Cameron
Former A380 Pilot/CRMI at Emirates

Dr. Nicklas Dahlstrom
Human Factors Manager at Emirates

Dr Richard J. Kennedy
Head of Learning Science at CAE

Background

The ways in which pilots train in the future will look very different to the ways in which they train today. This paper builds upon the ideas presented in the previous White Papers from CAE-Emirates on the future learning ecosystem for pilot training framework which outlined the main ideas and concepts to enable for the pilot training of tomorrow.

This fourth paper is a follow up to the previous three papers - Dahlstrom and Kennedy (2022), Dahlstrom et al (2022) and Cameron et al (2022) - which outlined a vision of a modular training system effectively using different types of training material combined with elements of Artificial Intelligence (AI) with specific focus on Simulation for Experiential Training (SET) as the key component of this system. The ideas and intentions for SET have therefore already been outlined in these papers and so will not be repeated in this paper. Rather, this paper provides a different idea for delivery of training, for which SET is the key enabling technology.

As many airlines aim to make training more efficient there has been an increase in computer based and online training modules provided to pilots. Increasingly, these are provided as “micro-learning” in a short and limited format. These modules are normally expected to be done by pilots on the ground, often at home and on their own time. This means that for pilots, the opportunity for learning often comes at a time when it is not operationally relevant, perhaps in competition with priorities and in a distracting environment.

The concept of Embedded Training was introduced in Dahlstrom and Kennedy (2022). The origin of this idea comes from the armed forces in USA and was brought up in a discussion the authors had with William Voss, former Chairman of Flight Safety Foundation (FSF). The intentions of the Embedded Training are outlined in the section below.



The Intention with Embedded Training

The intention with Embedded Training is to provide training in an operational setting when there is time available that cannot be used effectively for other purposes. This can be imagined for armed forces, police etc. for which operations may include long periods of waiting or preparation that may be difficult to use in any effective way. For the context of aviation, making use of time effectively is still important, but just as important is a focus on providing training when there is an actual need for the training content to be provided.

Here are a few examples of short training modules that could be available as Embedded Training, adapted to the type of long-haul network that Emirates operates:

- Dubai to Beijing, with Himalaya crossing, linked to a module about Himalaya crossings and drift-down procedures.
- Flight across the Atlantic Ocean, linked to a module on this and NAT tracks.
- Route over areas with risk for volcanic activity, linked to a module on volcanic ash and related procedures.
- A polar route linked to a module on Polar Operations.
- Route over Africa with known communication issues, linked to module on loss of communications and procedures for this.
- De-icing, anti-icing protocols and management.

The examples above include Embedded Training that could be carried out either pre- or in-flight. The former could be taken as part of the preparation for a flight, perhaps in the crew hotel when on a layover, while the latter would only be aimed for long cruise segments in areas with minimal other traffic and with the approval of the Pilot Flying to ensure appropriate monitoring of the flight is not put at risk. However, the benefit with taking them as preparation or in flight would be that the training material is then relevant to the flight at hand and corresponds with an operational need for the knowledge and skills provided by a linked training module. This link between relevant knowledge and an operational context would contribute to pilots maintaining a greater situational awareness as well as to more effective learning.

In the previous articles, we have described how SET would be useful for non-normal events, however, there are other instances where SET could be used to address normal but irregular situations. Managing cold weather operations (CWO) is perhaps, one of the most challenging operational situations. The combination of rostering, seasons and operational base can make CWO an infrequent experience. While technical advances have blended with a better understanding of the underlying physics, the dynamic coupling of weather conditions and operational demands make CWO a rich source of human error. In compliance with all the rules and regulations, the flight crew must constantly risk assess the situation and choreograph a team of service providers in order to achieve a particular multi-conditional operational state when cleared for take-off.

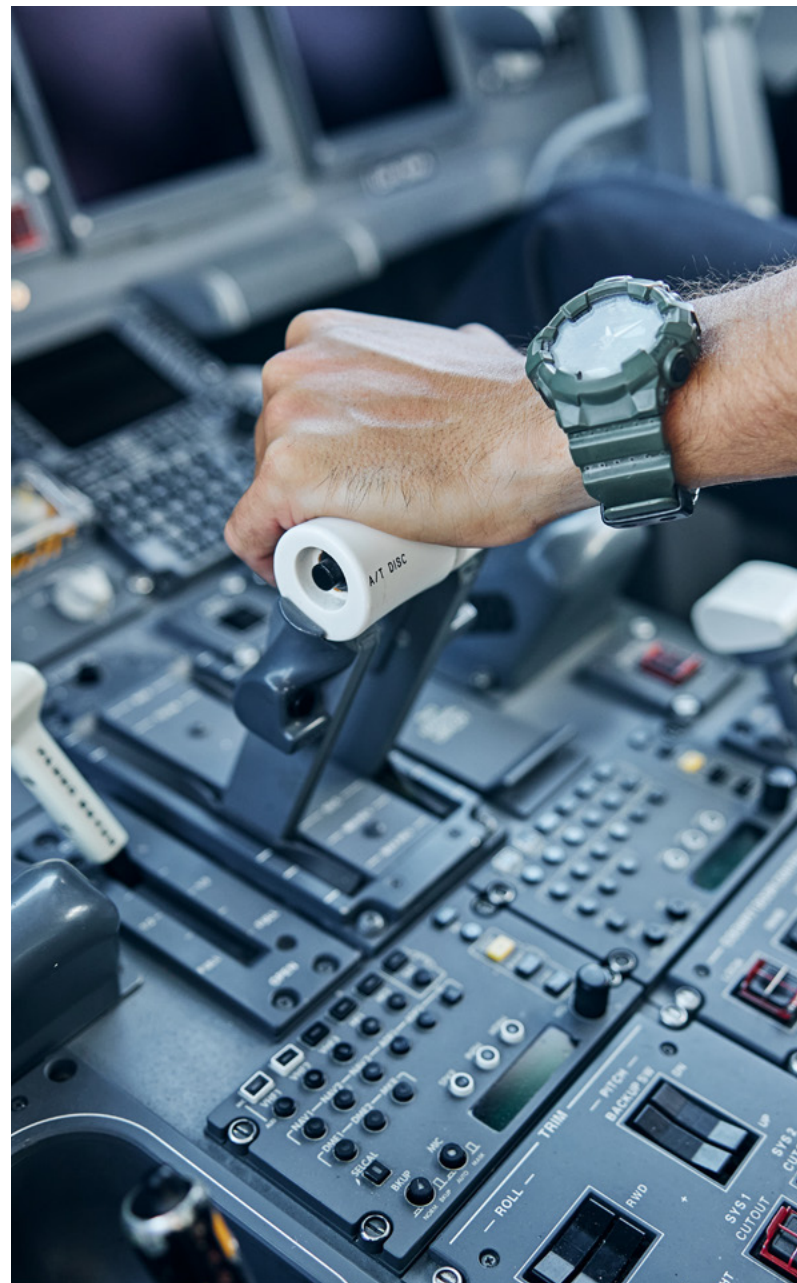
Pilots usually receive a CWO training distance learning package once a year, in the months prior to the northern hemisphere winter. The package is typically in consisting of a review of regulatory and procedural elements related to CWO, along with a test of the acquired knowledge. Precise and exact information describing multiple limitations and regulations governing a diffuse and dynamic situation, is provided in multiple company and aircraft manuals. In order to provide some contextual framework of the CWO procedures, one of the two annual simulator sessions are normally used to allow pilots to practise the training elements in a CWO scenario. This necessitates the use of a full flight simulator training a ground event for a substantial proportion of the session time.

A CWO SET scenario would be an effective and efficient vehicle to both deliver the CWO training while providing the operational context for the pilots and freeing up the full flight simulator for its primary function. The CWO SET scenario would also be useful as a refresher for any pilot who suddenly finds themselves in a hotel waiting for an impending flight scheduled to depart in an unpredicted fall of wet snow.

The modules would be part of an overall learning management system that tracks pilot training and examinations for regulatory and auditory purposes. When linked to the rostering system, suggestions to pilots could be sent out before a flight and reminders provided for the flight. As an example, this system could remind a pilot that he has not done an Atlantic crossing in the last few months and offer the module as a refresher before or in flight, while also achieving a completion of one of the modules that the pilots otherwise would have had to complete at another time. Here is one place where some algorithms, analytics and AI could play a role. The system could then provide different levels of recommendations, based on regulatory requirements (“You need to complete this module by XX, do you want to do it now?”), based on risk (“This flight will pass over active volcanic areas – do you want more information on this?”), operational relevance (“You have not passed over the Himalayas recently – do you want to have an update on this?”), or on peer influence (“Many pilots have recently looked at the module on new approach procedures for Hong Kong – would you like to take this module?”).

One concern expressed with regards to Embedded Training is that it may provide a distraction for the pilots. However, this is a misplaced argument and may be based on a misunderstanding of the intentions for this type of training. Pilots in most long and medium operations already temporarily operate as single crew, particularly when controlled rest is used to protect crew alertness. Additionally, other distractions are accepted as a required part of the operation, such as the reading of route manuals and airport charts in preparation for the next segment of the flight. Given this, there is ample opportunity for the one pilot to engage in a useful and operationally relevant interaction that would provide an attentional benefit on the flight deck, particularly in low workload situations such as during long night oceanic sectors.

While the point about distractions is an important one, there are far more operationally irrelevant intrusions that can threaten cruise flight operations. Given that the intention of Embedded Training is to provide operationally relevant material at a time when it is useful and relevant, this arrangement of training can be seen as a reinforcement of the preparations and briefings which are an essential part of flight operations.



Embedded Training and Simulation for Experiential Training

The main objective for Simulation for Experiential Training is to make the training more effective, engaging and interactive. This is firstly a matter of training quality, but also one that allows a short, concentrated and effective training intervention in a limited time. When needing to refresh knowledge and prepare mentally for possible scenarios, using SET will be far more effective than the passive reception of information via traditional training modules.

In parallel with the previous examples, one can imagine a drift down simulation scenario for flights over the Himalayas, a volcanic ash scenario for a flight passing close to the volcanic areas of Indonesia, a diversion scenario over polar areas and a loss of communication scenario over Africa. All of these can have a brief and debrief part, but the simulation will be more effective in making the relevant information come alive and be ready for use in a situation similar to the one in the scenario.

It should also be stated that Human Factors research related to management of unexpected events has shown that crews that prepare for any unexpected scenario perform better when there is such an event, even if it is not the one they actually prepared for. In this sense the Embedded Training will, on a general level enhance Situation Awareness and prepare pilots for unexpected events the same way that pilots for long have done by playing the “what if”-game and simply talking to each other about possible in-flight risks and scenarios.



How to Start with Embedded Training

Given the sensitivities around providing training, and potential distraction, the implementation of Embedded Training would have to be done carefully. One or a few modules, with clear operational relevance would be offered initially. These could be deployed on a voluntary basis, but with clear information that the reward is that these modules done as Embedded Training will then be completed and not have to be done as part of regular recurrent training.

This way pilots may gradually see the argument of operational relevance and usefulness. Tracking of when the modules are taken can be used to follow-up patterns of usage and adapt the modules and system to fit the needs of the pilots. For a trial period of one recurrent training cycle, one or two modules can be introduced and then evaluated. Over time, an increasing number of modules can then be introduced gradually with each new recurrent training cycle.



The Full System – Embedded Training Implemented

When fully implemented, Embedded Training would be tracked just as other recurrent training is in most airlines today, by functionality integrated in a learning management system. It would simply make use of small chunks of time available in operations, in flight or on the ground, and by doing so offer a relevant connection between training content and application of the content. An additional benefit for pilots would be a lower recurrent training load to handle on the ground and perhaps on their own time, while for both the pilots and the airline the provision of operationally relevant information at the right time would increase pilot Situation Awareness, strengthen learning and decrease operational risk.

The Embedded Training component of training would be followed in the type of AI-driven system envisioned for the full EcoTraining System, i.e., one that tracks, proposes and recommends training based more on operational risk and training/knowledge/understanding evidence than on regulatory requirements. Although regulatory requirements will remain necessary to fulfil, the road to do so can be traced along actual operational knowledge needs. With Embedded Training such needs can be met when they are operationally relevant.

Through focusing on modules that present actual situations found in flight operations, it is possible to imagine an expansion of Embedded Training to other modules of technical and operational character that could be delivered in the same manner. Again, pilots would have the option to take these modules on the ground and at a time of their choosing. However, a ten-minute refresher module on hydraulic system is probably more relevant when sitting in the flight deck and having the system in front of you, rather than taking it in a room in the private home.

Embedded Training would have the possibility to also be used for engineers, Cabin Crew and other professional groups in aviation who have periods of waiting or other inactivity as part of their work. In every case, such training would have to be designed to not be disruptive and to not interfere with the primary aspects of their duty. Still, this could provide a win-win in effective use of time and provision of relevant information in relevant context.

Summary and conclusions

This paper has introduced the concept of Embedded Training and how it may be deployed within Simulation for Experiential Training (SET). It is argued that this approach, which provides highly relevant training experiences in an operational setting, is a particularly effective way of consolidating learning among populations of pilots.

In the future, once Embedded Training is fused with other emerging technologies such as Artificial Intelligence, highly focussed training modules could be delivered which support the learning needs of pilots 'flying the line'. As well as pilots, one may envision this form of training being particularly useful for engineers, cabin crew and other professional groups in aviation. Therefore the potential for Embedded Training within SET is extremely promising and should be pursued as an integral part of the future learning ecosystem in aviation.



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About CAE

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About Emirates

The Emirates story started in 1985 when the airline launched operations with just two aircraft. Today, it operates the world's biggest fleets of Airbus A380s and Boeing 777s, offering its customers the comforts of the latest and most efficient wide-body aircraft in the skies. Emirates inspires travellers around the world with its global network of destinations across six continents, industry leading inflight entertainment, regionally-inspired cuisine, and world-class service.

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