Training in motion

by Owen Zupp

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Title pic – Inside the FSAP 58P. The two arcs of screens that provide the visual displays are clearly visible. (FSAP)

The Victa lawnmower and Hills Hoist have gone down in Australian folklore as symbols of backyard ingenuity. In the picturesque Blue Mountains of NSW, the small team at Flight Simulators Asia Pacific (FSAP) is hard at work carving their own particular niche.

The 2007 Australian International Airshow at Avalon brought together the big names of the world aerospace industry. In the shadows of the main exhibition hall, FSAP’s simple stand belied the significance of the venture it represented – an Australian first in flight training. As a steady stream of epaulettes and business suits climbed the steps into the FSAP 58B synthetic flight trainer, company directors Jeff Roll and Emery Williams were there to welcome them.

FIRST STEPS

Early in 2005, the team perceived what they believed to be a deficiency in flight training as it is currently offered: specifically, the absence of an advanced synthetic trainer.

In an era of PlayStations and Xboxes that offer virtual reality to one and all, the average synthetic trainer at flying schools was still seemingly trapped in a technological void. While fully compliant, the current generation of trainer had evolved little since the Link trainer. In fact, for many the limited motion of the Link trainer had even gone by the way. This point wasn’t lost on Jeff Roll: “It had to have motion,” he reinforces as we sit in the FSAP 58B two years after the concept took its first steps.

So the seed was planted. FSAP set about designing an affordable synthetic trainer with motion that offered high quality ‘visuals’ and the supporting technology that had previously been the exclusive realm of multi-million dollar full flight simulators that grace airline facilities. (Simulators are based on a specific type, whereas synthetic trainers are generic.)

Then Queensland based, FSAP began building a prototype synthetic device at its Toowoomba facility, which it rolled out within a matter of months. Aside from their own blood, sweat and ingenuity, Jeff and Emery credit the rapid speed of development to the funding they received from the Queensland government under the Innovation Start-Up Scheme (ISUS).

"The Queensland government is very pro-technology and pro-aviation under the Minister, John Mickel," Jeff explains.

With the funding, hard work and Australian know-how, the FSAP went from concept to hardware in record time.

A PRACTICAL PHILOSOPHY

Synthetic trainers are usually compact, fixed units located in the darkened room at the back of a flying school, attracting the most attention on days when the weather precludes VFR training. Aside from sitting out in the baking Avalon sun, the most immediate feature approaching FSAP's trainer is its similarity to its big brother simulators. It is a fully enclosed unit mounted atop a series of hydraulically powered legs that permit it to heave and sway in all three axes.

But it is not situated in a multi-floored, air conditioned training centre, but perched upon a trailer. Though it can be anchored to the ground as required, the portability of the trainer is immediately apparent. Measuring about 4.0 x 3.2m and standing 3.4m high, the FSAP 58B occupies a space equivalent to that of a disabled car park and could easily make its home in the corner of any hangar. Weighing in at 850kg, it is about 100kg heavier than a Cessna 152.

Alongside the pitching and rolling trainer, in the respite of a shaded tent, a large screen projects the action from within as yet another demonstration takes place. More than just a marketing tool for those waiting in line, the screen represents a valuable training aid with the ability to play back the session as a component of the de-briefing process.

In fact the FSAP 58B is fully certified by CASA under Part 60, category B enabling significant training to take place, such as:

- 20 hours instrument flight training;
- 15 hours cross country navigation training;
- 5 hours ab initio visual flight training;
- recency, currency and renewal for all navigational aids including VOR, ILS, DME, NDB and GPS;
- multi pilot licensing CRM; and
- general efficiency and pre-test revision.

The FSAP 58B can be configured to reflect the operation and performance of aircraft ranging from single-engined Cessnas to multi-engined jet transports. By re-programming data and changing the throttle quadrant from a constant speed single to a gas turbine twin, the student can be at the helm of any number of aircraft available in Microsoft Flight Simulator 2004, version 9. Herein lies a fundamental aspect of the FSAP philosophy – the use of readily available and affordable components.

The trainer is not dependant upon specialised, type-specific components that can only be sourced through a sole overseas distributor. Jeff explains: "We use high end personal computers and graphic cards. The hydraulics are from Toowoomba and the pneumatics come from Castle Hill in NSW. It's all readily available."

Jeff has a background that extends back past numerous name changes to the Department of Civil Aviation. He appreciates the issues of cost and practicality that are critical to general aviation flying schools, particularly as one of FSAP's most promising customers recently ceased operations. The company goes to great lengths to outline the fiscal justification of such a training aid. Not only in terms of the purchase price, around $300,000, versus an aircraft cost but the potential for revenue in a leasing arrangement.

And what would happen if FSAP went under? As Jeff explains, the components are

"Each scenario is conceived and controlled by a touch-screen instructor panel within the simulator."

An external view of the FSAP 58P atop the trailer that has transported it along the east coast from Queensland to Victoria. (FSAP)

The centre console features an interchangeable throttle quadrant to reflect the aircraft type being flown. (FSAP)

everyday tools of trade. The one FSAP component that is closely guarded is the software used to adapt Microsoft Flight Simulator and the various systems for use in the trainer. The source code for this information is placed in escrow and would be available to owners if things went badly for this pioneering Australian company – a reassuring strategy that reflects the realistic philosophy applied to the entire project from the ground up.

INNER WORKINGS

To achieve the motion that FSAP considered was essential to effective simulation, the trainer calls upon a system of hydraulically powered 'legs'. The system offers between three to six degrees of freedom (DOF), the basic three being pitch, roll and yaw, but also offers heave, sway and surge that can be found in multi-million dollar Category D simulators. Plugged into any 240 Volt outlet, the system operates at the relatively low pressure of 700-2000 psi.

To enhance the realism of the control forces felt by the pilot, the FSAP trainer provides haptic feedback. A growing part of interactive gaming, the enhanced reality in this instance is fed back through the elevator, aileron and rudder by a pneumatic system. This goes a long way to replicate the increase in control forces with increasing airspeed, or the asymmetric rudder forces that occur in an engine-out situation.

Just as with many aircraft today, many of the most significant changes occur beneath the skin, in the silicon chip mind of the machine. Wherever possible, software is used to replicate systems, communications, instrumentation and navigation systems. The 'visuals', based upon the Microsoft database, extend beyond terrain to include traffic and weather. Furthermore, via the internet, the visuals can be used to integrate real time weather and traffic from the destination of your choice. If the workload gets too high in the terminal area, there is also a fully functioning autopilot and electric trim system available.

Each scenario is conceived and controlled by a touch-screen instructor panel within the simulator. In the best tradition of check captains, the instructor can change environmental conditions, initiate systems failures or traffic conflictions and generally load the pilot up to his heart's content. If things aren't going well, he can 'freeze' the action, show a replay or re-position the aircraft to have another crack at that total hydraulic failure with an engine out and weather at the minimum. Should the instructor so desire, the entire work station is removable and can be situated outside the trainer, allowing another observer to sit at the rear of the trainer. In addition to the video footage of the crew at work, the de-briefing can call upon all manner of replays. This includes cross-sectional flight profiles, 3-D displays of aircraft attitude and a graphical display of all flight data.

From the heaving hydraulics to the complexities of computer software, the FSAP 58P is generations ahead of other trainers of its type in design. In many ways, it blurs the line between synthetic trainer and flight simulator.

FLYING THE FSAP 58B

Climbing up to enter the FSAP 58B, the striking resemblance to a large simulator is not limited to the stomach-based angst experienced by pilots as they climb aboard for yet another instrument renewal. Pleasantly, a respite from the Avalon heat is offered by the trainer's air conditioning system. Eight x 19 inch colour screens dominate and illuminate the darkened interior of the trainer with the realistic scenery of Avalon Airport. The screens are arranged in two arcs about the respective pilot's seats to offer the crew an impressive 225 degrees of vision horizontally and 34 degrees in the vertical. This is very comparable to most flight simulators.

Seated in one of the two control seats, the control yoke extends from the floor as is the way in many transport category aircraft. Between the seats lies a centre console of system switches that leads to the interchangeable throttle quadrant and trim position indicators. Ahead on the panel lies the autopilot, 'nav/comm' panels and controls for gear and flap.

Each pilot has a full instrument panel, including a weather radar which appears very similar in type to the common Bendix units. While Microsoft takes care of painting the real world outside, the navigation database is provided by Jeppesen.

Each operating crew station also has height adjustable seats and rudder pedals equipped with conventional toe brakes. Sitting in the right hand seat, the most noticeable difference is the absence of an overlay over the instrument panel that is found over the pilot's side. It also has the various manual knobs to set the QNH subscale and move

the OBS on the RMI. Also, there is no electric trim on the copilot yoke, though a manual trim wheel is within mutual reach of both crew.

Throughout, the construction of the trainer has a polished, but sturdy feel. This design philosophy may be due to the anticipated rigours of training, but has been put to the equally demanding test of Australian roads as it has been towed from Queensland to Victoria.

For my 'flight' the trainer is configured to reflect a Beechcraft B58 Baron piston twin, typical of the performance many instrument rating candidates would encounter. Sitting at runway's end, the trainer definitely has a generic feel to it, but the high quality of visuals outside tend to nullify this perception. Similarly, the combination of two-arcs of screen in comparison to a lone wrap-around is also quite quickly forgotten.

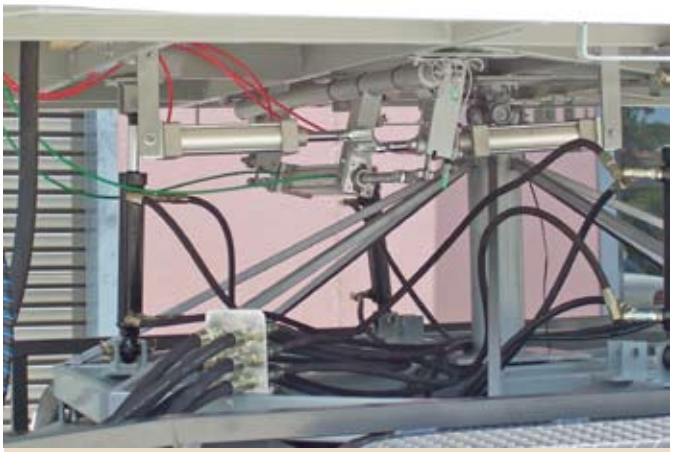
Advancing the throttles, the acceleration down Runway 18 is very realistic with the visuals slipping past the peripheral vision to fill the full 225 degrees of view. On the ground, the nosewheel steering is a little more sensitive than normal, but once airborne the sights, sounds and feel are very much true to form.

In the left hand seat is a QantasLink captain, Roland Parker, and together we head off towards the coast south of Avalon. Levelling out at 3000ft for some airwork, the synchronisation of the propellers can be done by sound, though there is a standard black and white 'synchro dial' to aid the task. Power settings, speeds and attitudes are all as one would expect and the trainer is easily flown visually or with sole reference to instruments. This is a real benefit in training for the difficult transition from dials to eyeballs at the bottom of an ILS.

In a series of turns and steep turns, the visuals had me looking over my shoulder for traffic, so they had succeeded in their trickery. The balance in the turn was as per normal, though the absence of an electric trim on the copilot's side was a bit of a nuisance as the manual trim is, logically enough, closer to the reach of the pilot-in-command's position. The only drawback to the motion was a slight 'bump' at the limit of the trainer's travel. In most instances, this realm isn't encountered though it tends to be visited a little in steep turns. A solution via a damping system is already being considered.

Level again, I handed over to Captain Parker, while I observed an array of visual effects that are available and all accessed from the instructor's panel behind me. There is also the ability to simulate turbulence, a common companion to instrument flight. The FSAP 58B can simulate everything from 'light chop' to severe turbulence by pitching and rolling up to 35 degrees/second. In replicating real world instrument conditions, this cross-over from trainer to simulator is definitely for the better.

Flying north again, we overfly all manner of computer-generated scenery which is obviously second nature to any nine-year old, but still amazing to a mid-life Luddite. Back at Avalon I descend and re-enter the circuit, very impressed at the ability to do this by purely looking out the window. The visuals extend far enough around to allow for the 45 degree angle that is used as a cue for the base turn. Once again, configuring the aircraft to land, the pitch tendencies on the extension of flap and reduction of power make the task straightforward.



The trainer's key to motion. The hydraulic and pneumatic system provides motion with three to six degrees of freedom and haptic feedback. (FSAP)

Aided by the approach lighting out the window, the landing is without fuss, though I confess to flaring a little high and taking a couple of bites at the cherry! Rolling to a halt, I apply the toe brakes smoothly to be met by an equally smooth lowering of the nose as the oleo compresses slightly under the deceleration. Sortie complete.

WHAT LIES AHEAD?

The brakes had just been parked when I turned to Jeff and Emery and expressed interest in flying the trainer in a heavy aircraft configuration. Not only is this possible with the FSAP 58B, but a venture on the horizon may make it a genuine alternative.

In its current guise, the trainer is available to general aviation schools and offers a tremendous training aid. The most affordable option is likely to be a leasing arrangement with FSAP, though if a number of schools on an airfield could work in co-operation, a purchase is not out of the question. Nor is the re-emergence of a small instrument training ground school in the ilk of the now departed Precision Flight at Bankstown Airport.

As flight training in Australia struggles at this time, the burgeoning market in India and Asia is not escaping the eye of FSAP and it will quite possibly be these nations that are first to utilise the technology. In the interim, the team at FSAP is far from dormant with a new proposal recently tabled. It consists of a 'simulator' modelled on the Boeing 737NG and used for 'adventure rides' for keen tourists and the like. Ably assisted by an instructor in the right hand seat, the customer can experience life at the helm of a Boeing. Such a venture has already taken root in New Zealand.

With construction commencing in late June, the venture is still some time off and undoubtedly there will be issues to conquer once again – technologically, financially and operationally. Encouragingly though, the team at FSAP seem well prepared to face the challenges, all the while maintaining their practical, commonsense approach to the task in the manner that has seen it evolve this far. While a Hills Hoist can be found in most backyards and Victa mowers in the shed, the FSAP Synthetic Trainer will be confined to a slightly lesser number. Even so, it has the potential to once again make a mark for good old Australian 'know-how'.❑