PC-based aviation training devices (PCATDs): research, development and certification

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Abstract. *This paper examines the development of two PCATD's (one helicopter, one fixed-wing) and their eventual certification by CAA. Certification has demonstrated the potential these devices have for aviation training in New Zealand. Traditionally FTD's and PCATD's have been sourced from foreign companies, and they represent a considerable financial investment for large flying training organisations. The procurement of these simulator types is generally beyond the financial resources of most small to medium sized flying schools. Aviation training in NZ is facing significant financial constraints as well as an increasing demand to simulate complex glass cockpit systems that are now installed in most new General Aviation (GA) aircraft. The development, utilisation and certification of this type of PCATD technology could solve these difficult challenges.*

Introduction

The multitude of resources required to implement flight training impose a significant burden on the many organisations that form the aviation community. The increasing demand for flight simulators is one area of aviation training that has shown unprecedented growth. Rapid advances in computer technology have continued to accelerate the development of sophisticated flight simulators. By utilising these simulators, aviation organisations have been able to conduct more realistic ground training and reduce training time in the aircraft (Rolfe, 1989). Also the introduction of a new Multi-crew pilot Licence (MPL) for airline co-pilots requires a greater use of simulators as opposed to the traditional commercial pilot's licence (CPL) pathway.

However, the acquisition of a certified Flight Training Device (FTD) is still beyond the financial resources of most flight training schools and small commercial operators in NZ. An alternative strategy that is gaining momentum is the utilisation of low cost PC based training devices (PCATD's) for flight instruction and currency training[1]. A number of research studies have indicated that although the fidelity[2] of PCATD's in comparison to FTD's is low, especially in control loading and flight dynamics, there is increasing evidence of positive transfer of training from the PCATD to the aircraft (Dennis & Harris, 2008).

In the last four years the School of Aviation (SOA) at Massey University has implemented two research projects involving the development and evaluation of low cost PCATD's, designed specifically for aviation research and flight training.

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[1] Pilots are required to maintain instrument flying competency by completing a set number of instrument approaches in the aircraft and flight simulator every 6 months.

[2] Fidelity is a measure of the equipment and environmental cues of the flight simulator and how they relate to the real aircraft.

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Auckland Rescue Helicopter Trust PCATD

The first collaborative project involved the development of a PCATD for the Auckland Rescue Helicopter Trust (ARHT). The PCATD was closely modelled on the MBB/Kawasaki BK.117 helicopter used by ARHT and was developed to assist the trust with currency (IFR/VFR) training for their operational pilots (Reweti, Gilbey & Jeffrey, 2010).

At the time, a survey of commercially available FTD's found that the cost of these simulators ranged from $400,000 to $1 million NZ dollars, well beyond the financial resources of the trust. In fact the PCATD specifications posed significant challenges for the development team as the ARHT's initial budget for the project was only $70,000. Also the PCATD had to simulate a reasonable level of flight control reliability and visual fidelity as well as accurately simulate the complex avionics and navigation systems currently operating in the real helicopter.

Apart from currency training, a secondary aim of the project was to develop the PCATD to a level of fidelity and conformity that would achieve Civil Aviation Authority (FSD2 Synthetic Flight Trainer) certification. Access to a certified PCATD meant ARHT pilots could log up to 20 hours of instrument simulator time towards an instrument rating and also maintain instrument approach currency.

The ARHT Chief Pilot Dave Walley has stated that, "Because we fly a lot on instruments, our pilots have to practice constantly to keep their skills up. Without this simulator we would have to spend large amounts of money utilising our helicopters for skills training. The support from Massey University and Savern Reweti has been a very important factor in successfully completing this project." The PCATD was finally completed in early 2010 and achieved CAA certification in September 2010 (see Appendix 4).

Diamond DA 40 PCATD

The second research project was more close to home, and coincided with the School of Aviation purchasing a new fleet of Diamond DA 40 training aircraft. One distinctive feature of the Diamond DA 40 is that it is equipped with a Garmin 1000 glass cockpit suite (see Fig.1).

Figure 1: School Of Aviation Diamond DA 40 Panel (Real)

The Garmin 1000 is a significant upgrade to the more conventional flight instruments and avionics found in most general aviation aircraft. The glass flight deck presents flight instrumentation, navigation, weather, terrain, traffic and engine data on large-format high-resolution displays (see Fig. 2). This sophisticated cockpit can provide trainee pilots with a high level of situational awareness, flight monitoring capability, and system management skills. An important advantage of this type of training is that after graduation a glass trained pilot can make an easier transition to a corporate jet or even the Boeing or Airbus cockpit of a national carrier.

Figure 2: Simkits & Flight 1 Glass Cockpit Primary Function Display (PFD)

Once again the challenge was to develop a low cost PCATD modeled on the Diamond DA 40 that could be used for aviation research purposes and to enhance the new SOA Diamond DA 40 scenario based training program. A significant challenge in developing this PCATD was the requirement to emulate the Garmin 1000 and its myriad of integrated systems. These included an Attitude and Heading Reference System (AHRS), GFC 700 Autopilot, Terrain Awareness and Warning System (TAWS), and Traffic Information Services (TIS). To assist in achieving a wide range of research outputs the PCATD design would also include a motion platform; multi-screen visual displays, a fully functional cockpit, and a networked instructor station (Fig. 3).

A commercially available FTD with all of these capabilities would have cost between about $300,000 to $1 million NZ dollars. By using innovative design techniques and adopting a DIY philosophy, a research budget proposal of $82,000 was applied for, and approved in 2009 (Pérezgonzález, Reweti & Lee, 2009). The PCATD project was completed in November 2010, and CAA certification was achieved in May 2011 (see Appendix 5).

Figure 3: Diamond DA 40 Motion Based PCATD

One of the important principles in the design of the PCATD was to utilise 'commercial off the shelf' (COTS) hardware and software wherever possible, and minimise the use of proprietary equipment. Another strategy to reduce development costs was to use a variety of inexpensive open source software programs and modify them to achieve the project requirements.

PCATD software engine

The primary software engine that is used to drive the PCATD prototype is Microsoft Flight Simulator FSX Gold (FSX) which also contains several Software Development Kits (SDK's). SDK's are critical as they enable the development of customised software modules that can directly interact with the MSFS SimEngine. The intention is to upgrade the software platform in the near future to Microsoft ESP which is the commercial version of FSX. This is a necessary requirement to protect the intellectual property of the PCATD if it ever reaches a commercial production stage.

The 28 year old Microsoft Flight Simulator franchise is now generally considered to be less of a recreational software game and more a software platform that can generate a complex virtual aviation environment. FSX contains an improved 3D global setting that allows you to fly over the polar icecaps, displays true road data and renders region specific textures. Also the maximum altitude was increased from 60,000 ft to 100,000 ft. The visual database contains over 20,000 airports and an accurate rendition of global scenery with a resolution of 7cm/pixel (Microsoft, 2010). A number of NZ software developers including SOA staff and students have produced high quality add-on locally based NZ terrain and airport scenery.

These scenery modules are detailed enough to be used for Visual Flight Rules (VFR) training. One NZ company, Vector Land Class, has utilised sophisticated mapping techniques to produce high resolution NZ terrain (see Fig. 4). This detailed scenery is accurate enough for cross country navigation and Instrument Flight Rules (IFR) training (Barnes, 2010).

Fig 4: Vector Land Class NZ Terrain

Garmin 1000 simulation

The ability to simulate the real-world Garmin 1000 Glass Cockpit in a cost effective way was a major challenge. Two recent technological developments of COTS hardware and software were effectively utilised in the development of the Diamond DA 40 PCATD.

Simkits replica Garmin TRC1000

The Simkits replica Garmin TRC1000 is a 100% scale replica of a real Garmin G1000 Glass Cockpit System as found in the Diamond DA 40 aircraft. The display functionality is supported by Microsoft Flight Simulator FSX and ESP. The hardware is produced from quality ABS using plastic injection moulding and high quality electronics (see Fig. 5).

A complete TRC1000 system includes two main displays and one Audio Panel. The high resolution TFT screens of the PFD and MFD displays are connected to additional video ports on the flight simulator PC.

The MFD and PFD displays each have a single USB connection, which provides a data highway through which the control of the knobs, pushbuttons, SD Card interfaces and the video information is channelled (Simkits, 2011).

We have found these devices to be robust although there were initially problems with first generation video controllers embedded in the devices. With an upgrade to second generation video controllers the units have performed flawlessly over the last six months of operation.

Nevertheless with more increased utilisation for research and training they will be closely monitored as to their reliability under repeated-use training. The cost of these units plus the audio controller was approximately $16,000. This compares favourably with the overall cost of a commercial Garmin Desktop trainer which retails for $30,000.

Figure 5: PCATD Glass Cockpit Primary Function Display (PFD)

Garmin simulated software

Flight1 Aviation Technologies has recently developed a G1000 Student Simulator software package that interfaces with Microsoft Flight Simulator X and Microsoft ESP.

The Flight1 Tech G1000 Student Simulator was coded to be used for real-world flight training in an immersive training experience. It also seamlessly integrates with the Simkits TRC 1000 Garmin hardware (Flight 1 Aviation Technologies, 2011). Other Garmin G1000 simulations that have been developed for Flight Simulator X and ESP (e.g. Mindstar Garmin Software) have much more limited functionality. Another advantage of Flight 1 Garmin software is that it is a stand-alone application which can be run remotely through a PC based network. The software team have produced a software application that has a high level of compatibility and functionality with a real–world Garmin 1000 glass cockpit suite

Automatic flight control system (AFCS)

The Flight 1 Aviation Technologies Garmin 1000 Student (G1000) Simulator includes an accurate simulation of the Garmin GFC 700 digital Automatic Flight Control System (AFCS) that realistically models the Flight Director and Autopilot. Also Flight Director Annunciations and Autopilot status are displayed on the PFD.

Vertical modes modelled include:

- Pitch Hold Mode (PIT)
- Selected Altitude Capture Mode (ALTS)
- Altitude Hold Mode (ALT)
- Vertical Speed Mode (VS)
- Flight Level Change Mode (FLC)
- Vertical Navigation Modes (VPTH, ALTV)
- Glide path Mode (GP)

- Glideslope Mode (GS)

Lateral modes modelled include:

- Roll Hold Mode (ROL)
- Heading Select Mode (HDG)
- Navigation Modes (GPS, VOR, LOC)
- Approach Modes (GPS, VAPP, LOC)
- Back course Mode (BC)

A stand-alone Failure Generator application can be connected to the G1000 Student Simulator software to provide an instructor with the ability to fail specific components of the G1000 display (including Airspeed, Altitude, Heading, Attitude, Vertical Speed, Nav Radio, Com Radio, Transponder, and RAIM). When failed, each component will display appropriate failure flags and /or visual indications (Flight 1 Aviation Technologies, 2011).

The MFD software includes Waypoint, Navigation, and Nearest page groups, as well as Direct To, Flight Plan, and Procedure functionality Flight plans can be created, saved, and loaded.

Instrument approaches

The G1000 Student Simulator also features an updatable worldwide navigation database. This is provided by a third party company called Navigraph which provides a monthly updated Aeronautical Information Regulation and Control (AIRAC) cycle of instrument approach data. This Navigraph database mirrors the Jeppesen database (real-world Garmin database) to a certain extent but is not as comprehensive. The Navigraph contains 12,500 airports of which 3,751 airports contain complete instrument approaches. The cost of the Navigraph yearly subscription is only 20 Euro (13 AIRAC cycles) and although the database is expanding each year it may take some time before it models all 49,000 of the world's airports (Navigraph, 2011).

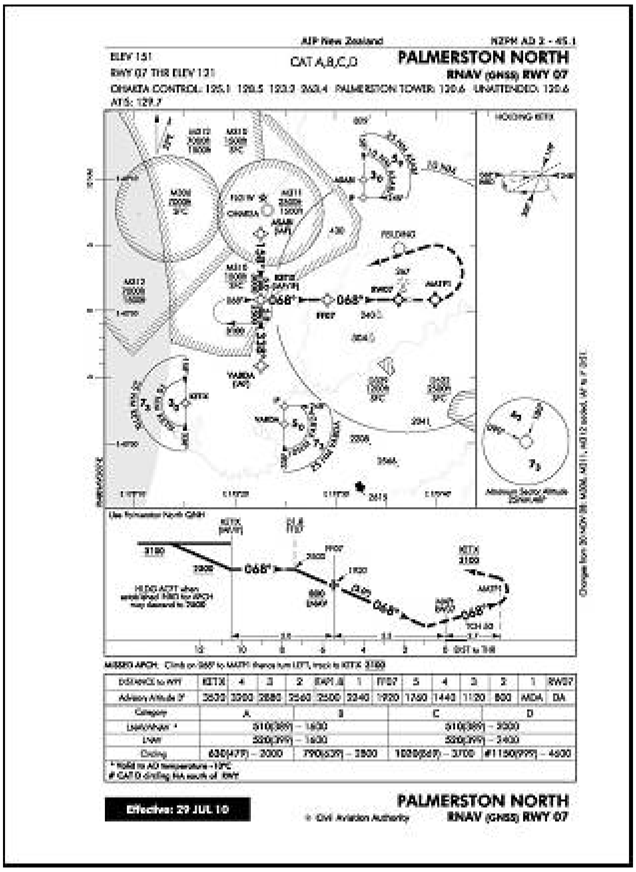
One drawback with the Navigraph database is the limited instrument approach data for New Zealand airports (NZAA, NZWN, NZCH, NZDN, and NZPM). This has meant that instrument approach data had to be generated for local airports such as Ohakea, Wanganui, Paraparaumu, Masterton, and Hawera.

Also a few of the New Zealand instrument approaches that currently exist in the database needed some refining, especially VOR/DME approaches. For example NZPM has one of the most complex VOR/DME approaches in the country and the current approach data needed to be revised[3].

An example of a Navigraph instrument approach format is outlined in Appendix 1. A sample of generated code for RNZAF Ohakea is outlined in Appendix 2. A comparison between the two appendices indicates how the approach transitions and final approaches are constructed Despite the clarity of the Navigraph database format the development of customised instrument approaches has not been straightforward. The G1000 software utilises the FSX autopilot engine and there are some well known issues with this autopilot engine. One example is the NZPM VOR/DME approach (see Fig. 6)

[3] To assist in this area, Steve Hall, a current Air New Zealand 747 pilot was co-opted to assist with this project. Steve has a lot of experience in approach code theory and has assisted the NZ Flight Simulator Community with various projects involving improving NZ instrument procedures in MSFS.

Figure 6: Palmerston North RNAV Approach



In this approach the G1000 software Auto pilot (AP) will instigate a right hand turn into terrain after the missed approach point MATP1. There is a flaw in the FSX auto pilot engine that sometimes appears when completing a 180 degree turn. In this special case the AP will turn the wrong way even though the correct turn direction is specified in the Navigraph database. This kind of flaw can undermine the training of an instrument approach procedure and therefore practical solutions have to be found.

In this scenario a precisely placed dummy waypoint to the left of the missed approach point MATP1 will coax the AP engine to turn left back to the KETIX waypoint and the holding pattern. Nevertheless this is a compromise as the dummy waypoint will be listed in the MFD approach list.

A unique labeling system by which the student pilot can recognise such dummy waypoints in the PCATD will help them to realize that they will not necessarily exist in the real-world Garmin. This should not be too much of an issue as the Jeppesen database (used in real-world Garmins) for NZ instrument approaches also has a number of discrepancies. A certain amount of latitude is required when comparing the official Airways approach plates with the two different databases (Jeppesen, Navigraph).

Other areas that limit the complexity of instrument approaches that can be displayed relate to the type of Transition Approach legs the G1000 software can process. These legs are not supported by the G1000 software (Garmin, 2011):

- CD – Course to a DME distance
- CI – Course to an intercept

- CR – Course to a radial
- VA – Heading vector to an altitude
- VD – Heading vector to DME distance
- VI – Heading vector to an intercept
- VM – Heading vector to manual termination
- VR – Heading vector to a radial

Despite these limitations virtually all SID, STAR, RNAV, ILS, NDB, and VOR/DME approaches can be accurately simulated with a combination of G1000 software and an accurate Navigraph database file for the particular approach.

Diamond DA 40 limitations

The PCATD design includes a 2 DOF motion platform, three 37 inch LCD visual displays, and a fully functional cockpit, combined with a networked instructor station. A design flowchart is outlined in Appendix 3.

Due to budgetary constraints the flight controls do not incorporate expensive force feedback systems. Instead they are directly linked to potentiometers that connect directly to a Haagstrom Keyboard/Joystick Interface Board. Although there is no force feedback on the flight controls the rudder pedals are dampened with small air shock absorbers. Also bungees and a friction screw are attached to the control column to provide some feeling of resistance. The primary aim of this PCATD was procedural training and due to the low fidelity of the flight controls, teaching pure flying skills is not a viable option,

Nevertheless there is sufficient response in the flight controls to teach basic maneuvering that would be necessary to maintain height and bearing when related to instrument approach training. A research project has been commenced to look at cost effective ways of developing a force feedback system driven either by electrical servos or magnetic fields.

The visual displays are high resolution and provide a wide aspect of more than 120 degrees. However they do not provide depth perception for visual scenes as well as full flight simulators can, with their inbuilt collimated displays. New developments in 3D LCD displays may provide a cost effective answer to providing depth perception for low cost PCATD's.

Discussion

The development of these two PCATD's for quite diverse training purposes and their subsequent certification by CAA has demonstrated the potential these devices have for aviation training in New Zealand. Traditionally FTD's and PCATD's have been sourced from overseas based companies, and they represent a considerable financial investment for NZ flying training organisations. The cost of these devices is generally beyond the financial resources of most small to medium sized flying schools in NZ. The development of cost effective PCATD's are a viable alternative for these flying training schools. Also they provide a greater degree of flexibility and versatility by utilising COTS hardware and software. Because of the COTS philosophy, the upgrading of these PCATD's is also less costly and can be conducted more frequently. Aviation training is facing significant fiscal constraints as well as increasing demands to accurately simulate complex glass cockpit systems found in modern GA aircraft. The adoption of this type of PCATD technology could well be an effective solution to these difficult challenges.

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Appendix One – Navigraph Format Excerpt

11. APPROACH TRANSITION

1 APPTR Record identifier string 5 always APPTR
2 ANE4L Approach identifier string 10
3 07L Runway identifier string 3
4 RID Transition fix string 5 Initial Approach Fix

12. FINAL APPROACH

1 FINAL Record identifier string 5 always FINAL
2 ANE4L Approach identifier string 10
3 07L Runway identifier string 3
4 C Approach type string 1 see Approach Types below

13. WAYPOINT TYPE IF (Initial Fix)

1 IF Record identifier string 2 x always IF
2 REDGO Waypoint identifier string 5 x
3 50.10916669 Waypoint latitude double x degrees

4 8.85638906 Waypoint longitude double x degrees
5 TAU Navaid identifier string 5
6 69.0 Waypoint bearing double degrees
7 0.0 Waypoint distance double nautical miles
8 1 Altitude constraint int see Altitude Constraints below
9 4000 First altitude int feet
10 0 Second altitude int feet
11 1 Speed constraint int see Speed Constraints below
12 160 First speed int knots
13 0 Second speed int knots
14 0 Special Waypoint int see Special Waypoints below
15 0 Overfly Waypoint bool see Overfly Waypoints below
16 0 Missed Approach Fix bool

14. WAYPOINT TYPE TF (Track to a Fix)
1 TF Record identifier string 2 x always TF
2 REDGO Waypoint identifier string 5 x
3 50.10916669 Waypoint latitude double x degrees
4 8.85638906 Waypoint longitude double x degrees
5 0 Turn direction int see Turn Directions below
6 TAU Navaid identifier string 5
7 69.0 Waypoint bearing double degrees
8 0.0 Waypoint distance double nautical miles
9 249 Magnetic course int degrees
10 4.3 Distance double nautical miles
11 1 Altitude constraint int see Altitude Constraints below
12 4000 First altitude int feet
13 0 Second altitude int feet
14 1 Speed constraint int see Speed Constraints below
15 160 First speed int knots
16 0 Second speed int knots
17 0 Special Waypoint int see Special Waypoints below
18 0 Overfly Waypoint bool see Overfly Waypoints below
19 0 Missed Approach Fix bool

Appendix Two – Example of partially generated code for NZOH

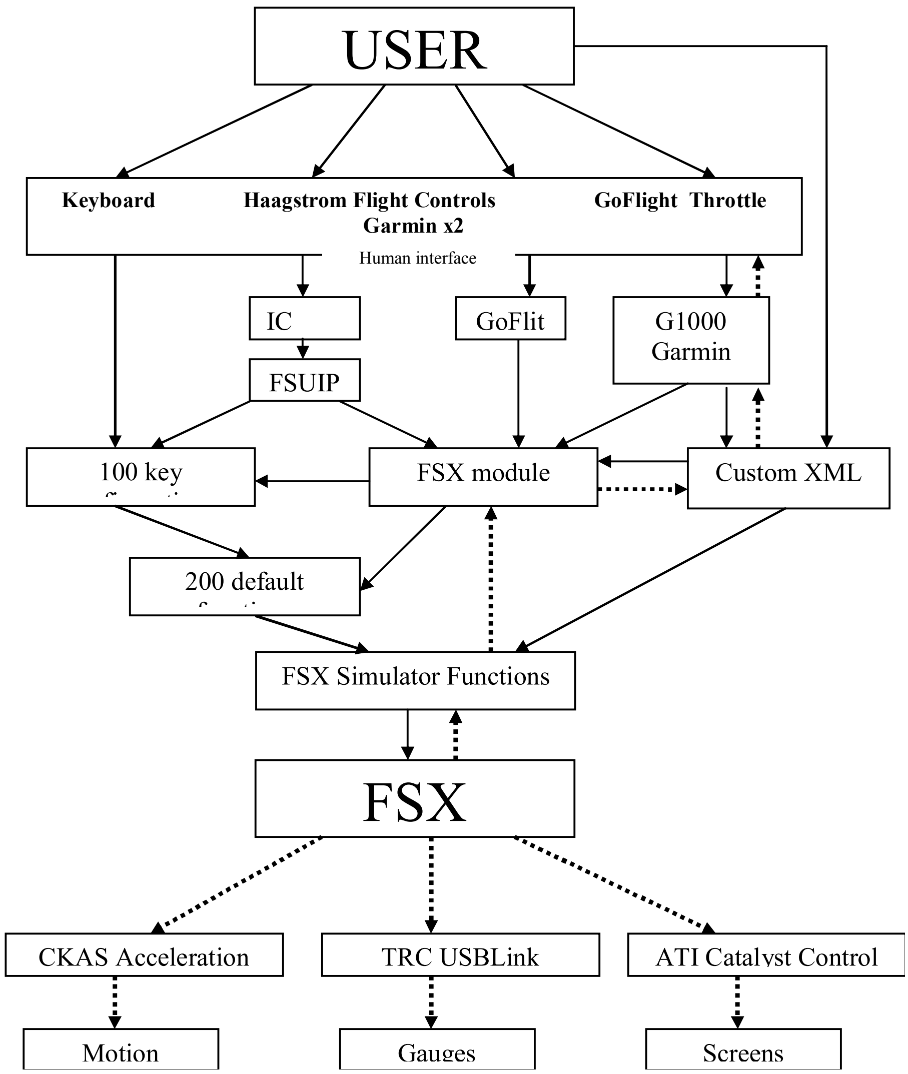
```
APPTR,I09,09,D160O
IF,D160O,-40.459703,175.383400, ,160.0,15.0,0,0,0,1,0,0,0,0
AF,D268O,-40.12086,175.084909,2,OH,108.0,15.0,360.0,2,4000,0,1,0,0,0,0
TF,DME10,-40.149299,175.187521031,2,IRM,0.0,0.0,0.0,0.0,2,2300,0,1,0,0,0,0

APPTR,I09,09,D360O
IF,D360O,-39.976614,175.511208, ,360.0,15.0,0,0,0,1,0,0,0,0
AF,D268O,-40.12086,175.084909,1,OH,092.0,15.0,360.0,2,4000,0,1,0,0,0,0
TF,DME10,-40.149299,175.187521031,1,IRM,0.0,0.0,0.0,0.0,2,2300,0,1,0,0,0,0

APPTR,I09,09,OH
IF,OH,-40.209611,175.391972, ,0.0,0.0,2,4000,0,1,0,0,0,0
CD,OH,-40.209611,175.391972,0,OH,0.0,0.0,242.0,10.0,2,2300,0,1,0,0,0,0
TF,DME10,-40.149299,175.187521031,2,IRM,0.0,0.0,0.0,0.0,2,2300,0,1,0,0,0,0
```

FINAL,I09,09,I,3
IF,DME10,-40.149299,175.187521031,IRM,0.0,0.0,1,2300,2300,1,0,0,0,0
CF,FF09,-40.168963,175.255116,0,IRM,0.0,0.0,88.0,2.3,1,2300,0,1,0,0,2,0
CF,RW09,-40.202650,175.374228,0,IRM,0.0,0.0,88.0,6.5,1,200,0,1,0,0,3,1
CA,0,88.0,2,1200,0,1,0,0,0,0
//VI,1,OH,360.0,330.0,0,0,0,1,0,0,0,0//
TF,MA1,-40.162266,175.416094309,1, ,0.0,0.0,0.0,0.0,0,0,0,1,0,0,0,0
CF,D360K,-40.038758,175.478653,2,OH,0.0,0.0,360.0,11.0,1,3300,0,1,0,0,0,0
HM,D360K,-40.038758,175.478653,2,OH,0.0,0.0,360.0,3.0,2,3300,0,1,0,0,0,0,0

Appendix Three – Design Flowchart of Diamond DA 40 PCATD



Appendix Four – Auckland Rescue Helicopter Trust PCATD certification

4. Approved Purposes:

Purposes:

(a) Two hours instrument ground time towards the issue of a Private Pilot Licence - Helicopter (AC61-3, Appendix I);

(b) Five hours instrument ground time towards the experience requirement for night cross country by a Commercial Pilot Licence - Helicopter (AC61-5, Appendix I);

(c) Five hours instrument ground time towards the issue of a Category C or B Flight Instructor Rating - Helicopter (AC61-18, Appendix I);

(d) Twenty hours instrument ground time towards the issue of an Instrument Rating - Helicopter (AC61-17),

(e) Two hours of instrument ground time towards the currency requirements of an Instrument Rating - Helicopter [CAR Part 61.807 (a)(2)(i)];

(f) One GNSS, NDB, VOR, LLZ or ILS approach procedure toward the currency requirements of an Instrument Rating - Helicopter [CAR Part 61.807(a)(2)(ii)];

(g) One GNSS, NDB, VOR, LLZ (non-precision) or ILS (precision) approach procedure toward approach currency requirements of an Instrument Rating - Helicopter in any one 3 month period [CAR Part 61.807(a)(4)];

(h) Conduct of the cross-country portion and any one approach of every alternate Instrument Rating Annual Competency Demonstration - Helicopter [required by CAR Part 61.801(a)(6)].

Synthetic Training Device - Purposes And Conditions - Auckland Regional Rescue Helicopter Trust

5. Approved Conditions:

This approval is subject to the following conditions:

1. Each instructor shall be specifically approved by Auckland Regional Rescue Helicopter Trust for the purpose of instructing on the ARHTsim09 in accordance with the company's Synthetic Flight Trainer Manual (SFTM);
2. Each instructor shall hold a current flight instructor rating in respect of approvals (a), (b) and (c) and a current instructor rating and current instrument rating helicopter in respect of approvals (d), (e), (f) and (g), and current flight examiner rating privileges in respect of approval (h); Neither instructor nor examiner need maintain a current medical certificate for training or examining in the simulator;
3. The device shall be maintained to a level where it can meet the specific performance tasks required of it and in accordance with the company's SFTM;
4. Instruction details and times shall be entered in the candidate's logbook as instrument ground time, and each entry signed by the approved instructor who gave the instruction;
5. This certificate shall be displayed in the vicinity of the trainer for public viewing.

Unless either surrendered by the holder or suspended or cancelled by notice in writing from the Director this certificate shall remain in force until 15 September 2012.

Appendix Five – Diamond DA 40 PCATD certification

3. Permitted to use the following STD:

Massey University School of Aviation Diamond DA40 Replica S/N 046878-2

4. Approved Purposes:

Purposes:

(a) Two hours instrument ground time towards the issue of a Private Pilot Licence - Aeroplane (AC61-3, Appendix I);

(b) Five hours instrument ground time towards the issue of a Commercial Pilot Licence - Aeroplane (AC61-5, Appendix I);

(c) Five hours instrument ground time towards the issue of a Category C or B Flight Instructor Rating - Aeroplane (AC61-18, Appendix I);

(d) Ten hours instrument ground time towards the issue of an Instrument Rating - Aeroplane (AC61-17);

(e) Two hours of instrument ground time towards the currency requirements of an Instrument Rating - Aeroplane [CAR Part 61.807 (a)(2)(i)];

(f) One RNAV(GNSS), NDB, VOR, LLZ or ILS approach procedure toward the currency requirements of an Instrument Rating - Aeroplane [CAR Part 61.807(a)(2)(ii)];

(g) One RNAV(GNSS), NDB, VOR, LLZ (non-precision) or ILS (precision) approach procedure toward approach currency requirements of an Instrument Rating - Aeroplane in any one 3 month period [CAR Part 61.807(a)(4)];

(h) Demonstration of Garmin 1000 GNSS as a subsequent type and model (AC61-17, Appendix II).

5. Approved Conditions:

This approval is subject to the following conditions:

1. Each instructor shall be specifically approved by Massey University School of Aviation for the purpose of instructing on the Massey University School of Aviation Diamond DA40 Replica in accordance with the company's Synthetic Flight Trainer Manual (SFTM);
2. Each instructor shall hold a current flight instructor rating in respect of approvals (a), (b) and (c) and a current instructor rating and current instrument rating aeroplane in respect of approvals (d), (e), (f) and (g), and current flight examiner rating privileges in respect of approval (h): Neither instructor nor examiner need maintain a current medical certificate for training or examining in the simulator;
3. The device shall be maintained to a level where it can meet the specific performance tasks required of it and in accordance with the company's SFTM;
4. Instruction details and times shall be entered in the candidate's logbook as instrument ground time, and each entry signed by the approved instructor who gave the instruction;
5. This certificate shall be displayed in the vicinity of the trainer for public viewing.

Unless either surrendered by the holder or suspended or cancelled by notice in writing from the Director this cert

Accepted By: .... Dated 17 May 2011

STD32548 Massey University School of Aviation

Page 2 of 2