20 Years of *CPNS / CCNS* Operations

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Summary: The first flight 20 years ago with the *CPNS* is remembered and the actual operation of a *CCNS/AEROcontrol* for map production in Myanmar is described.

Zusammenfassung: *20 Jahre Einsatz von CPNS / CCNS.* Beschrieben wird der erste Flug mit dem *CPNS* aus 20-jähriger Rückschau sowie der aktuelle Einsatz von *CCNS/AEROcontrol* zur Kartenherstellung in Myanmar.

1. Remembering the First Flight

At the start of the nineteen-eighties, air survey navigation was an 'eye-ball' thing and heavily skill-related. ITC in Enschede, The Netherlands, was still involved in aerial survey crew training which involved 'ab initio' navigation students in four months of intensive lectures, up to 100 hrs nav-simulator flying and 35 – 40 hrs actual flight training in the Institute's Piper *Navajo Chieftain* survey aircraft. This would bring them up to a level where they would be capable of straight-forward survey missions, and with an additional, basic knowledge of survey flight without maps. In addition a similar amount of time was devoted to camera, and photographic training.

ITC's survey flight crew already had extensive experience outside the institute with early VLF/Omega-, and Inertial Navigation System-based survey operations in various parts of the world, and were aware of the NavStar Global Positioning System being developed in the USA. The practical aspects of VLF/Omega and INS, (and their drawbacks), were already taught as part of the Postgraduate Diploma Course in Aerial Photography curriculum. In addition, the sparse information on NavStar was introduced as it became available, and was the subject of much

discussion. At that time the only survey flight management system on the market was the Litton *PICS* INS-based system pioneered by Wild Heerbrugg.

Another facet of ITC's operation was a keen interest in research into all aspects of aerial imagery. The aircraft, crew, and facilities were made available, where logistically possible, to other institutes, universities and Government agencies for equipment development and testing. Optimally, these were often combined with student training flights, with obvious, additional benefits.

Thus in 1983, a request landed on my desk, as leader of the Flight Department, that some flying time be set aside for a 'new navigation system'. The equipment would arrive on the following Tuesday morning for an afternoon test flight over the border in Germany. The aircraft was prepared, one of our standard test equipment racks readied, and the crew waited at the airport. Up until then a perfectly normal type of operation.

Two gentlemen arrived, one already known to us, a previous ITC Aerial Photography staff member (whom I had replaced in ITC) and the other carrying the first of several large cardboard boxes, and an early computer. Our aircraft engineer took several steps back and declared, in rather typical Dutch fashion, that 'this equipment would never fly in 'his' aircraft. The total package was brought into the workshop and more closely inspected. A full explanation followed, with appropriate 'talk and chalk', that foretold the changes in aerial survey flight management into the 21st Century. The confidence of the designers was such that we soon became believers, albeit somewhat sceptical on the flight line accuracies being predicted. We were already veterans of years of desert and jungle projects, and thus entitled to doubts.

The engineer, also having been convinced, explained that any equipment being used in an aircraft had to be slightly more than a large quantity of spaghetti-like cables, and un-boxed components. Some changes were necessary. The flight would be delayed for at least twenty-four hours

while the whole system was ‘tidied’ for flight. It was assembled on the bench and each segment examined and measured up. The engineer and assistant (myself), worked overnight and by seven-thirty am the following day the system was pronounced ‘aircraft friendly’. It was then offered up to the aircraft and thoroughly tested and, with final tweaking, seen to operate, although only two of those present actually knew for sure what it was really supposed to do.

Some eight or so years ahead of the introduction of the first minimal GPS network, the Computer-controlled Photo Navigation System (*CPNS*) as it was then known, was to fly over a test area - block Sauerland - which had four portable Thomson-CSF P-DME ground stations, one at each corner. The aircraft system would interrogate each DME simultaneously to plot its actual in-flight position, and to program its onward course along flight lines and across the block, firing the camera.

By this time, the ITC crew had begun to realise that we were possibly embarking on to something rather special.

The pilot had a small monitor screen mounted on the top of the instrument panel and was to follow a VOR-style, standard ‘fly-to-the-line’ instrument presentation. The ‘Professors’ would operate the Digital Equipment computer and generally supervise the in-flight operation. I was added as an after-thought to map-read my way along the flight lines using the navigation telescope as the system showed off its paces. The engineer sat in the co-pilot seat nervously drumming his fingers.

We flew to the block although the weather conditions were far from ideal for high quality air survey. With some assistance from the Profs, the pilot found the first flight line and with an appropriately long run-in, headed towards the first picture. At this point my faith in these boxes of ‘breadboard and spaghetti’ may have wavered, and I was following the flight line on the map extremely carefully, although not giving any usual correction commands. The pilot closed the line on the screen, and my downward view con-

firmed that it was, after all, rather accurate. The system started to take pictures and we sailed along the first flight-line in amazement. By the end of the first line I was becoming somewhat relaxed, although the thought had crept into my mind that I might be looking at serious redundancy in my future career as a survey navigator!

The pilot had no trouble locating the second line and the cheerful faces all around me beamed in triumph. Their job prospects were obviously not at risk. I continued my monitoring task through the Zeiss telescope when I noticed that the aircraft was drifting off to the left somewhat. Up to now my centre line had been within a fifty metre band width, about average for a flight over hilly terrain with varying drift. Well within good medium level survey tolerance for visual navigation (as it was then I hasten to add). It continued to move off left and I was about to mention it when an anguished cry came from the pilot, 'Where's the line gone?'

I looked up and the rest of the crew's heads were busily turning frantically to look at each other, as though on the verge of panic. Then they all turned to look at me, as if it was my fault.

'Three right?' I offered.

The pilot was now back in 'our' territory, getting proper instructions that he was used to. He kicked in some rudder in a perfectly flat 'survey correction' and the aircraft started to move back to the line. Maybe I wasn't going to be out of work after all. A few more metres right and we were back within fifty metres again.

'It's back on again!' shouted the pilot and the heads all craned to see the tiny screen. I relaxed but, for safety's sake (and my reputation), kept a very close eye on the Zeiss centre line. It went off line a couple of times more, again due to thermal updrafts that were beyond the pilot's control, and the screen image again lost the line. The block was eventually finished and PH-ITC headed back in the direction of Twente airfield. The occupants were tired but excited in their triumph. Hands were shaken, backs slapped and everyone felt that something had changed in aerial survey from that moment on.

From what I had just witnessed, I was now seriously concerned about my future career – I was still at least twenty years from retirement and too old to learn new skills.

2. Twenty Years On

Yangon, Myanmar (previously Burma), March 2003.
It is the third season of a National Mapping project to cover the whole country with 1:50 000 mapping. The prime aerial photography navigation system is a *Standard CCNS4* attached to *AEROcontrol* and IMU, and the platform a Cessna *Citation II* jet aircraft with Myanmar pilots. It is almost twenty years since we flew the very first flight of the original *CPNS* and many things are very different.

Fig.1: Cessna *Citation II* survey aircraft

It is now the fourth year that *CCNS4* has been in Myanmar. Its first visit being on a United Nations Drug Control Programme (UNDCP) project in January 1999, identifying and monitoring poppy fields in the Wa region on Myanmar's north eastern border with China. The Myanmar Government have made great inroads into 'alternative crop cultivation' in this region, and the results showed a marked decrease in poppy plantations as a result.
The UNDCP project also served as an excellent demonstration of GPS-based survey flight management, and the Survey Department, already planning a Pilot Project to ascertain scale and method for a six-year National Mapping

Project, selected *CCNS4* as its primary unit. After discussion of the complexities of the later stages of the projected survey, it was also decided that a full *CCNS4* plus *AEROcontrol-IIb* be obtained.

The previous mapping available in the country was based on surveys conducted between 1935 to 1944 by the Survey of India and the British Government Survey Department (later to become the Directorate of Overseas Survey). These maps, in one inch to the mile (1: 63,360), half-inch, and quarter-inch to the mile had been re-printed over the years but with very little actual updating.

Myanmar is a large country, stretching from N 9°30' alongside Central Thailand, to N 28° 30' well into the Himalayas, bordering India and China. It covers 668,000 sqkm (compared to Germany's 356,000 sqkm and France's 544,000 sqkm), requiring some 1111 map sheets. At the time of writing, the stereo plotting for 170 maps sheets has been completed, all by the local Myanmar survey department, and local, private company staff (only one Finnish consultant has been involved on the Project on a full time basis throughout). Aerial photography coverage has been completed for 429 map sheets at the end of the 2002/2003 flying season. Actual map printing of the Pilot Project Area has been completed, and is about to start on the main production areas. The final map quality, considering constraints in budget and general facilities, is well up to European and International standards and considered well ahead of maps produced in neighbouring countries. Quite an achievement since Myanmar is regarded as one of the world's poorest countries.

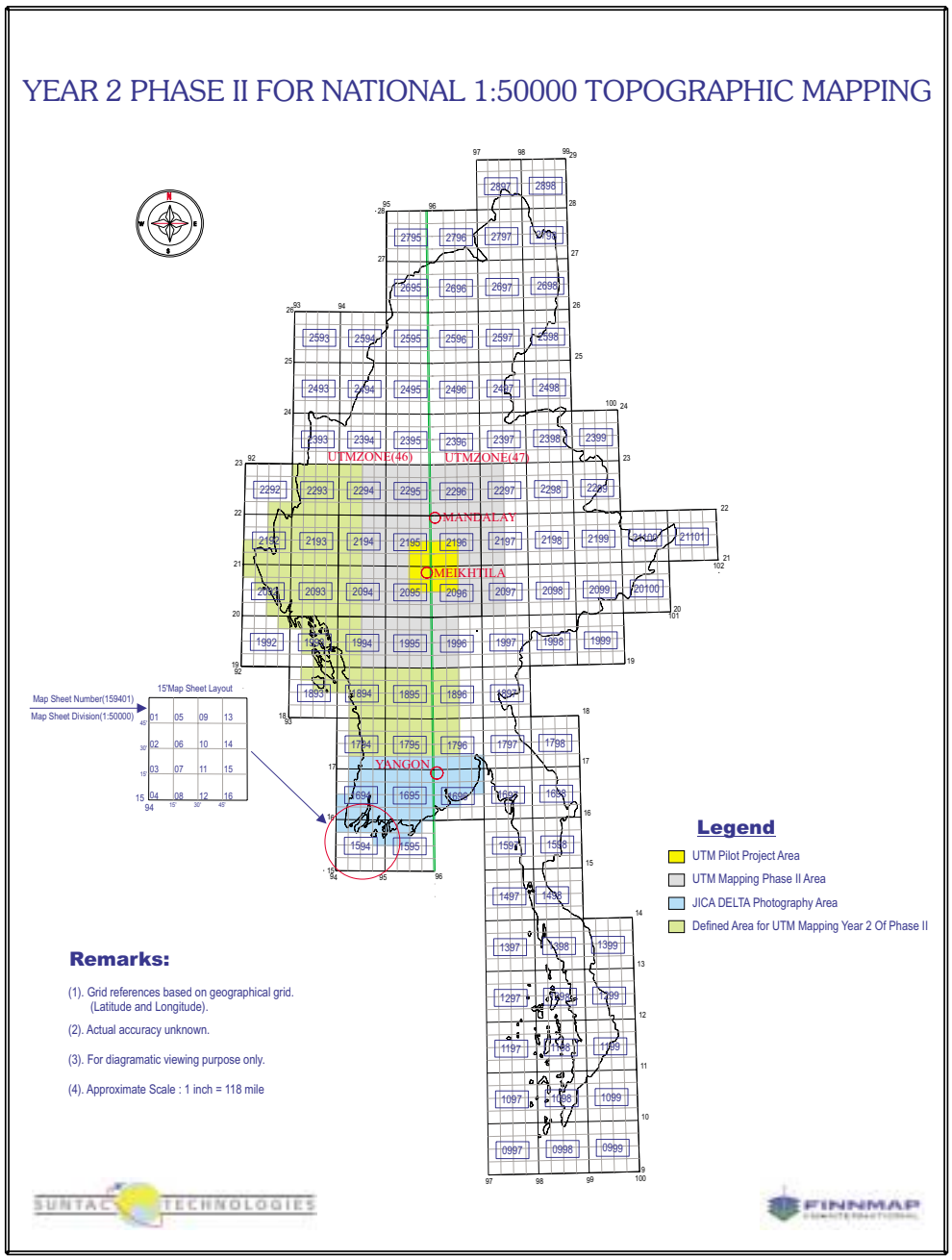

Fig.2: Map of Myanmar with mapsheet-layout for topographic map 1:50.000 and marked operation aereas.

The Pilot Project was a one degree segment in the Meiktila area, south of Mandalay, and was a mixed, central plain area with mountain ridges on west and east sides. Flown at 1: 25000, this was completed in four days in January 2001. The *AEROcontrol* data was studied carefully and compared with other surveys carried out in SE Asia by FM International, Finnmap Oy, the consulting company on the project, and using normal DGPS methods.

In the 2001/2002 season the basic photo scale was changed to 1: 50000 and a further 160 map sheets flown, totally enclosed the Pilot Project area in December 2001 and January 2002. A second area was flown over the Irrawaddy Delta area comprising a further 51 sheets in February 2002. Once again, considerable study was done on the consistency and accuracy of the results against local ground control measurements, on the smaller scale material.

A more difficult area was chosen for Year II (of the main project) and ranged from the plain areas north of Yangon (Rangoon), across the wide range of mountains stretching parallel to the west coast up to the Bangladesh and India borders with terrain heights over 10 000' (3050 m). The Pilot, and Year I areas were regarded as 'accessible' in that ground control from 'post-marking' was possible, there being sufficient roads in each area. Year II coverage in the northern Chin State areas was a different matter. Large areas of steep hills and valleys at between 4000' and 7000' levels, covered in forest, with few settlements and even fewer roads made ground control a virtual impossibility.

Similarly the flight operation was hampered by the lack of available airfields in the area and long transit flights consumed some 20% more flying hours than would have been needed for a similar task in Europe. The lack of available weather information is also a problem in Myanmar. The BBC World Service satellite TV channel provides a limited, but reliable picture (when available), but access to international Internet is se-

verely controlled, although on occasions UK and French weather services can be received, although rarely. A greater hazard in the hill areas is smoke; in mid-February it is common practice to burn off the crops for next season planting and enormous areas of thick smoke make aerial photography totally impossible after 10:30 am or so. Luckily this year's programme was only affected on two occasions although additional survey work on other later programmes has been seriously curtailed as we progress into March.

So far we have completed the easy areas. From here on, the airfields get fewer, the terrain gets more inhospitable, and in some areas the potential for ground control reduces to zero. This is the reason that the *CCNS/AEROcontrol* results, and their consistency are being so carefully studied. The eastern border areas of the country are not only inaccessible for physical reasons, there are also barriers of a different nature. Large portions of these border areas are virtually war zones and completely inaccessible for surveyors and for any form of ground control. In the very north of the country, even higher terrain, up to 19,000' (5880 m) with large areas above 13,000' (4000), of thick forest, again with no ready access.

So far the results with *CCNS/AEROcontrol* have shown remarkable consistency and the possibility to map the totally 'inaccessible' areas to an acceptable accuracy seems highly likely. The results will continue to be analysed, and in the meantime the new, high quality, accurate, and very attractive maps are rolling off the presses after a gap of almost sixty years.

Twenty years, and several thousand hours of GPS flying after that first *CPNS* flight, I am still happy to be involved in survey flying, my fears of redundancy now far away. We imagined great things for the 'spaghetti-and-breadboards' in 1983 but the reality has exceeded those ideas a thousand fold.

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