PERGAMON

Aircraft Design 3 (2000) 217–238

AIRCRAFT DESIGN

www.elsevier.com/locate/ardes

Graduate-level design education, based on flight demonstrator projects

J.P. Fielding*, R.I. Jones

Aerospace Design Group, College of Aeronautics, Cranfield University, Bedford, MK43 0AL, UK

Abstract

The College of Aeronautics (CoA) at Cranfield University believes that the best way of teaching design is for the students to learn design by doing it, in a structured manner. It also believes in the maxim – "the devil is in the detail" and that a design is only complete when it has been built, flown and certificated. Designers need to be aware of, and experienced in, all of the intermediate stages between concept design and certification. They also need to be taught to function as members of group design teams, because that is the usual way that Industry works. All of these factors led to the establishment of a full-time Masters programme in Aerospace Vehicle Design, the focus of which is the Group Design Project (GDP). This philosophy was proved to be successful over many years and was continued and expanded in the design of the Masters course in Aircraft Engineering – the subject of this paper. This programme is a three-year part-time M.Sc. course, which comprises the same major elements as the full-time course. The students attend lecture modules, perform a piece of individual research and work on a GDP. It was this last element that particularly attracted the launch and predominant customer for the course, the then Military Aircraft Division of British Aerospace (BAe). BAe like the basic philosophy of teaching the design process by placing someone in a project group with an individual responsibility but having to cater for the needs of the group and project as a whole. In February 1995 the Aircraft Engineering course was launched with 15 students, who began the first intake, working on major modifications to the CoA's A1 Aerobatic aircraft, which itself resulted from work of former students. The GDP on the full-time course in Aerospace Vehicle Design concentrates on the preliminary and detail design of a whole aircraft, which has been previously defined in terms of basic geometry, mass, performance, characteristics etc. by staff. However, BAe and Cranfield wished to address a greater extent of the full-design process, as mentioned above. In this way the students would, in the space of three years, be given first-hand experience of a much wider extent of an aerospace project than could ever be the case whilst working on major aircraft projects in a manufacturing company. This paper will give details of the Aircraft Engineering teaching programme and describe the first GDP, a major modification programme and flight of the Cranfield A1 Aerobatic Aircraft. The students were set the task of modifying the existing single seat aircraft to a two-seat configuration with performance similar or better than that of the existing aircraft.

* Corresponding author. Tel.: 44-1234-754-741; fax: 44-1234-751-550.

1369-8869/00/$ – see front matter
PII: S1369-8869(00)00006-9

despite the weight increase of a second pilot. At approximately one year into the project, a joint BAe CoA decision was made to progress the project to completion with an 'affordable' set of modifications, providing the basic two seat capability, increased endurance, and approaching the desired performance. The aircraft was modified by BAe and CoA personnel and successfully completed its official first flight on the 30th September 1998 at Cranfield's own airfield, flown by its own Chief Test Pilot, thus completing the first of the 5 GDPs described in this paper. Information will also be given of progress being made on more recent intakes of students. The subject for intake 2 was further modifications to the A1 to further improve its lateral manoeuvrability by means of a new composite vertical stabiliser and rudder. Intakes 3 and 4 are capitalising on Cranfield's extensive expertise in the design and flight-testing of small UAV's, to develop jet-powered UAVs to act as flight-test demonstrators for unstable aircraft with diamond and blended-wing-body configurations. These will contribute significantly to Cranfield's extensive research programmes in these areas. The fifth intake has started to design a medium altitude, long endurance (MALE) UAV which will provide a platform for Cranfield's, and other researchers in the fields of remote sensing and payloads for Micro-Satellites. Ref. [4] gives more details of the 1st and 3rd GDPs. These are exciting, but challenging projects which continue to develop the best of design teaching and relevant applied research. Fig. 1 shows how the above 5 GDPs are integrated into Cranfield's strategic aircraft configuration demonstrator programme. It includes a large number of Ph.D. studies, full-time and part-time GDPs and inputs from government-funded programmes.