AdaTEST 95

DO-178B Testing for Boeing 777

Case Study: Smiths Aerospace

Working with the Electrical Load Management System (ELMS). This system is classified as Lavel B safety category in accordance with DO-178B standards.

Smiths Aerospace located in Cheltenham UK is a prominent supplier of avionics systems to both military and civil manufacturers such as Boeing Commercial Airplanes. . The systems that they supply frequently have safety implications, which mean that failure of the system could endanger the lives of passengers or crew on the aircraft. This places a great burden on software developers to ensure that such systems are produced and tested to the highest appropriate standards.

In the 1990s Smiths Aerospace won contracts from Boeing relating to two systems for the new 777. One system was called the Electrical Load Management System (ELMS) and the other was the Fuel Quantity Indicator System (FQIS). These systems were both classed as Level B safety category according the avionics industry software safety standard, DO-178B. The code for both of these was to be written in Ada (as was much of the software on 777 systems), and full testing at module, integration and system levels was an integral part of the development plan.

EVALUATION

Smiths had some existing tool sets in place at the start of the development projects but it shortly became apparent that these were not quite up to the job. They failed to make the testing efficient and to provide the all important certification evidence to satisfy the systems' safety auditors. At the end of 2000 project leader, Anne Lowe, contacted IPL about use of AdaTEST 95. By the start of 2001, an evaluation copy of AdaTEST 95 had been installed on Smiths target development kit, and two engineers had been trained in its use.

One of these was Martin Halls, who spent the next few months working his way through a series of evaluation exercises intended to satisfy him and others that the tool really would work. By the summer of 2001 Martin was satisfied that AdaTEST 95 was the right tool for the job.

OUTSOURCING

Around that time Smiths made a strategic decision to use an Indian company (Silver Software in Bangalore) for the bulk of its module and integration testing. This fact necessitated the construction of a robust mechanism for generating and running tests and being able to get the results out, showing both the outcome of functional (logic) and stress tests on the code, as well as the all-important coverage information.

An initial batch of AdaTEST licences was bought in September 2001, which then allowed Martin to develop the process around which all subsequent work has been carried out. This involved the Smiths team sending work packages to Bangalore containing code modules (corresponding to Ada sub-programs) and code specifications. Using Smiths supplied software test procedures, the Silver staff developed test specifications for scrutiny back in the UK, and then performed the automated generation and execution of the tests themselves.

AdaTEST 95 TOOL AUDIT

An important part of satisfying the DO-178B development process is being able to demonstrate that the tools are suitable for the jobs they are being used for. For verification tools (such as AdaTEST) the requirement is for the developers to satisfy themselves that the tools 'meet their operational requirements'. Quite early on in the ELMS and FQIS projects Smiths asked IPL if they could do an audit of AdaTEST on this specific issue. In April 2003, a small team from Cheltenham visited IPL to spend a day going through the product quality records in detail. The conclusion was that, "**AdaTEST 95 … is documented, controlled and verified to a level beyond that required by DO178B**."

ELMS AND FQIS UPDATE

For the last three years the person in charge of ELMS software has been Steve Coates, assisted by John Sobkowicz. During this time around 600 Ada code units (comprising a total of about 22 KLoC) have passed through the ELMS development process,. Steve was pleased to find a development process in place which seemed to be functioning very smoothly. He notes, "With minimal fuss we can now send our code modules to Silver Software for either fresh test or re-test, and be sure that within the allowed time we will get the results that we need. Our process has quite a lot of safety margin built in. For example, module test plans always stress a module's functional envelope using extreme values. In reality, we know that these values would never occur, but the fact that we have tested all modules beyond their normal limits gives us a great deal of confidence that they will work correctly under all circumstances."

John Sobkowicz adds the observation that test results tended to expose non-functional errors in the code. In the early days of ELMS there were also some interesting discoveries about the test environment used, in particular the revelation that the target simulator used was not in fact wholly accurate! John has continued to improve the testing process originally developed by Martin Halls. The necessity for stubbing external calls is an occasional vexation, but the mechanism now allows for most stubs to be generated on the fly from the test specifications, used, and then deleted. It is only in rare cases that manual intervention is needed and more permanent stubs have to be produced.

On FQIS, the engineer in charge of software testing has been John Parrott. So far, about 730 module tests have been performed using AdaTEST 95, comprising about 41KLoC. According to John the most significant change to their process was the decision to unit test all modules (except for the most simple) regardless of coverage results obtained during integration testing. Of the tool, John says, "AdaTEST will continue to be used on this program. It has proved to be an effective and efficient tool for module testing."

Electrical Load Management System (ELMS)

CONCLUSIONS AND LOOKING AHEAD

Steve and both Johns are pleased that Martin's testing process designed around AdaTEST has worked so well. The fact that a clean interface is available allowing the smooth handover of testing work packages to Silver Software in India, and the easy receipt of results, is a tribute to both the tool and their predecessor on the ELMS project. As for the future, there are many years left in ELMS with a freighter version of the B777 aircraft just about to start development. FQIS is already into the B777-200LR variant development, which will continue until next year. Asked whether there are any plans to change the current use of AdaTEST 95, Steve is confident that things will stay pretty much as they are now.

IPL wishes to thank Smiths Aerospace for their cooperation in the production of this case study, and we take this opportunity to wish them well with ongoing and future programs.

The text for all IPL product case studies is agreed and approved by our customers.

FURTHER INFORMATION

Software Products Group
IPL Information Processing Ltd
Eveleigh House
Grove Street
Bath
BA1 5LR
United Kingdom

Telephone: +44(0) 1225 475000
Facsimile: +44 (0) 1225 444400
Email: tools@ipl.com
Web: http://www.ipl.com/tools