29th Congress of the International Council of the Aeronautical Sciences
St. Petersburg, Russia; September 7-12, 2014

UNIFIED TOOLS OF DEVELOPMENT OF THE ON-BOARD EQUIPMENT BASED ON THE INTEGRATED MODULAR AVIONICS

Koverninskiy Igor V., Kan Anna V.
State research institute of Aviation systems (FSUE GosNIIAS)
Keywords: *certifiable on-board equipment, unified tools*

Abstract

The report focuses on creation of the unified tool environment designed to support the IMA-based on-board equipment development. The creation of such tools will allow automating of the processes that guarantee the coordination of efforts to develop certifiable on-board equipment by cooperated Russian and Europe avionics companies.

1 Introduction

Last years GosNIIAS participates in researches under the Federal Targeted Programme " The development of civil aviation in Russia in 2002-2010 and for the period up to 2015 ". One of the key activities in this area is to produce the technology to automate the processes of the IMA-based on-board equipment development. The importance of this task increases taking into account the extending international cooperation of avionics companies.

A unique feature of the international cooperation requires the rigorous formalization of the requirements development processes addressed to potential subcontractors, the product quality (either being developed or purchased), plans and standards, as well as quality control and analysis of supplied products and services.

To summarize, should be noted that the processes of design of the open architecture IMA-based on-board equipment should be performed following the ARP4754A standard. This document requires that the following processes should be implemented:

- The development of the hierarchical requirements, starting from the system requirements (the source) and ending with the low-level requirements (component and function requirements)
- End-to-end planning of the on-board equipment development
- Change Control process performed during the whole on-board equipment development life cycle
- Process of providing of the rigorous configuration control of the equipment being developed.

This standard combines the following ones (fig.1):

- ARP 4761 (system safety);
- DO-297 (IMA);
- DO-254 (hardware);
- DO-178B(C) (software).

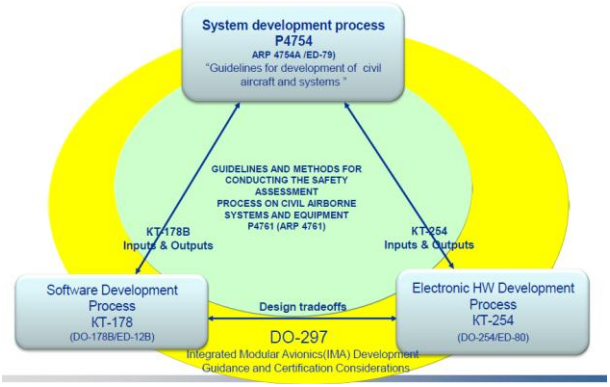

Fig. 1

Further we will identify how these standards are implemented in the tool environment that supports the on-board equipment development life cycle.

1.1 Problem Analysis

The foreign market offers a set of COTS and free tools that partially implement the

required functionality. All of these tools, however, have weak points. As an example let's examine the tools that support DO-178B software development. The analysis detected the following weak points:

- The market does not offer a tool that guarantees the satisfaction of DO-178B objectives in respect of the software life cycle support and, at the same time, that operates the software requirements. As a consequence, the end user is forced to integrate several tools, and the resulting toolset is not useful and ergonomic enough.
- The tools being offered are not originally targeted to satisfy DO-178B and require additional customization. Therefore, some DO-178B objectives can not be satisfied at all, or can be satisfied in an artificial and non-transparent way.
- High cost of COTS.
- Free tools turn out to be too complicated and non stable at run-time, they lack good documentation and guaranteed developers' support.

So we needed to develop a tool environment allowing to:

- Automate and formalize the integration between companies involved in joint on-board equipment development. And the toolset must be unified as much as possible.
- Provide the end-to-end configuration control of introduced changes for all developer companies.
- Provide a common procedure of data exchange between developers.
- Reduce the time consumed for on-board equipment development.
- Help in certification.

The tool environment can include available recommended COTS and specific tools developed under Russian and European research programs.

2 Tools developed under "IMA Integration" research program

The following environment tools have been developed under this research program to support the open-architecture on-board equipment life cycle:

- MASIW, aimed to create the system design of a product.
- ISUT, informational system of requirements management
- E178B - DO-178B software development life cycle support environment.

2.1 MASIW

MASIW is model-based tool chain to automate IMA System Group (IMA-SG) activities. It can be used in developing IMA architecture from system-level specification down to implementation details of hardware and software components. By request of the customer the system can be flexibly configured under specifics of its projects.

IMA-SG includes (fig.2):

- ✓ IMA System Designer
- ✓ IMA System Verification Group
- ✓ ATA-XX Coordinator
- ✓ Platform Component Supplier (PCS) Coordinator
- ✓ IMA System Integrator

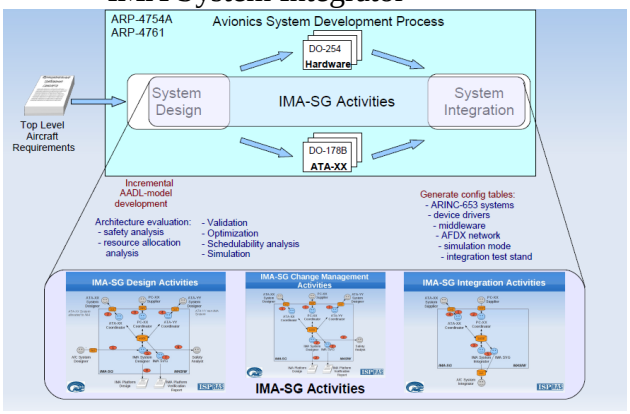

Fig. 2

Tool intended:

- modeling of IMA architecture from system-level specification down to implementation details of hardware and software components;
- static schedule building for periodic ARINC-653 partitions and specialized middleware tasks;
- verification of resource allocation consistency, usage domain rule and project-specific constraints;
- AFDX static analysis and simulation framework;

- generation and import of configuration tables for VxWorks-653 RTOS and AFDX network elements.

2.2 ISUT

ISUT is ready for use realization for requirements management processes, change and configuration requirements management of regulated aviation standards ARP4754, DO-178B, DO-178C, DO-254, DO-297 and their Russian analogues.

It can be used in developing requirements for avionics. By request of the customer the system can be flexibly configured under specifics of its projects. The system can reduce the costs of implementing new processes and the time of the implementation. ISUT combines the standards and functionality of IBM Rational tools that strengthens a positive effect of IBM Rational tools implementation.

ISUT provided with detailed and complete manuals and documentation that allows to methodological approaches proposed by the system quickly learn.

Documented procedures, based on the role of participants in the project and their functions, consistently describe the necessary organizational steps to achieve purposes requirements management processes, change and configuration requirements. ISUT makes easier certification of end products and achieving the target level of assurance of design and quality of developed systems and complexes.

Informational system of requirements management based on IBM Rational tools and consists of three parts:

- Requirements management and configuration subsystem (DOORS)
- Requirements change subsystem (RTC)
- Requirements publishing subsystem (RPE)

Main functions:

- Tracking of changes in requirements list and single requirements
- Setting and tracking the links between requirements
- Execution control
- Tracking of and test-to-requirement coverage and test results
- Reports and documentation creation.

Functions of Requirements management and configuration subsystem (DOORS)

- ✓ Tracking of changes in the requirements list and sole requirements
- ✓ Linking the requirements and tracking the links
- ✓ Control of implementation status
- ✓ Tracking of test results and requirements coverage
- ✓ Creation of documentation and reports

Functions of Requirements change subsystem (RTC)

- ✓ Combining of all information repositories of version control systems and modification management under the control of the one server
- ✓ Wide possibilities of reports generation , analysis and visualization of trends
- ✓ Convenient and user-friendly interface for creation, tracing and evolution of change requests
- ✓ Flexible tuning of the changing management process for maximum adaptation to existing user's requirements for the project organizing.

Functions of Requirements publishing subsystem (RPE)

- ✓ Connection possibility to any XML source
- ✓ Support for the number of inputs formats and flexible tuning of the documents' external view
- ✓ Parallel generating of different formats documents based on the one pattern
- ✓ Reports creation, which contain data from several sources
- ✓ Built-in default patterns, which provide fast implementation
- ✓ User-friendly patterns correction graphic environment

2.3 E178B

E178B is ready for use realization for configuration management and quality assurance processes of regulated aviation standards DO-178B, DO-178C and their Russian analogues. It can be used in developing SW for avionics.

E178B provided with detailed and complete manuals and documentation that allows to methodological approaches proposed by the system quickly learn.

Tool intended (fig. 3):

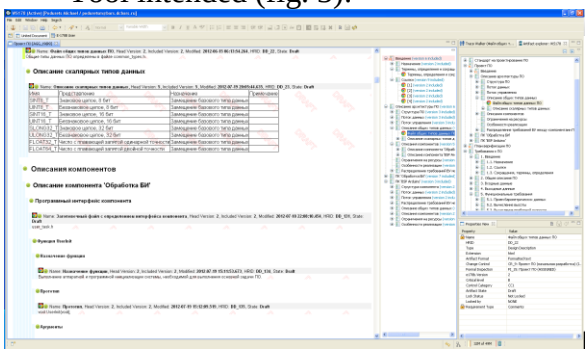

Fig. 3

- Support of all CM processes and QA audits
- Integration with DOORS
- Full-functional document editor and publishing
- Project management basic functions
- Box version

Conclusion

Implantation and providing of developed tools and methodologies trial performance at the aviation industry enterprises.

We are planning to develop work procedures with requirements for system engineering different processes supporting, and also procedures of management requirements configuration and requirements interaction with all systems designing life-cycle processes (according with ISO 15288-2008, ARP 4754A based on free SW.

Copyright Statement