



Business challenge

To develop its next-generation flight management systems, CMC sought a new object-oriented, model-based process that would help comply with the DO-178C and ARP 4754A/4761 aviation industry standards.

Transformation

With full traceability from requirements through to delivery, CMC's new development process boosts productivity, reduces defects, accelerates development, and dramatically simplifies compliance.



Claude Provençal
Program Manager SFM
CMC Electronics

Business benefits:

Accelerates development by fostering the creation of portable, reusable components

Reduces defects by testing components earlier and creating fewer complex dependencies

Automates documentation for DO-178C and ARP4754A compliance

CMC Electronics

Fast, streamlined, compliant development of next-generation flight management systems

Owned by Esterline Corporation, a specialized manufacturing company that principally serves the aerospace and defense markets, CMC Electronics designs and produces leading technology electronics products for the aviation and global positioning markets.

“Greater traceability helps facilitate compliance, eliminate defects, and deliver quality products.”

Claude Provençal
Program Manager SFM
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Next-generation flight management

CMC Electronics is well known in the aviation industry for its flight management systems (FMS) – the sophisticated navigation systems that help modern aircraft manage flight plans without the need for a human navigator or flight engineer.

Over the years, CMC has developed a comprehensive range of FMS products, designed to meet the specific needs of different sectors of the aviation market.

The benefit of this approach was that each product satisfied a unique set of requirements – but from a systems and software engineering perspective, it takes more time and effort to develop and maintain separate software for each target market.

For its next generation of FMS products, the company decided on a different design strategy: it would build a core system that would be used by all of its FMS products, and supplement it with customizable, reusable components that could meet the specific requirements of different markets.

Don Paolucci, General Manager of Navigation Systems at CMC, explains: “Instead of continuing to develop separate FMS software branches, we decided to focus on the development of a single, core architecture and then, using a Product Line Engineering approach, rapidly create new peripheral components to meet evolving customer and market needs.”

Ronald Houde, Senior Systems Specialist, adds: “To support this strategy, we realized we needed to modernize our development process. A model-driven, object-oriented approach would be the best way to accelerate delivery – and would also help us meet the new requirements of industry standards such as DO-178C.”

Transforming development

To support its new development process, CMC needed a new set of tools that would provide a collaborative environment for software and systems design, development and testing. After reviewing options from various vendors and the open source community, the company chose IBM® Rational® Rhapsody®.

“Rhapsody was the best option to support all of our different needs and integrate the whole process from end to end,” says Ronald Houde. “We have also been using IBM Rational DOORS® for many years, so it seemed like a good fit.”

Working with IBM, the CMC team tailored the IBM Rational Rhapsody solution to its requirements. IBM helped to identify best practices for model-based, object-oriented development in compliance with DO-178C and other aviation standards such as ARP4754A.

IBM Rational Rhapsody was used during the system design phase for system requirements analysis, system design and high-level design requirements development.

During software design, IBM Rational Rhapsody was also used for software design and automatic code generation using the simplified C++ execution framework, which is ideally suited for safety critical development.

To ensure that the software design was properly verified, CMC used IBM Rational Rhapsody Test Conductor with the Unified Modeling Language (UML) Testing Profile to automate aspects of the unit testing process.

CMC and the IBM team also implemented IBM Rational Publishing Engine to extract data from the Rhapsody environment and automatically generate documentation – such as DO-178C compliance reports for the Federal Aviation Authority (FAA), European Aviation Safety Agency (EASA), and Transport Canada.

CMC then embarked on a small-scale pilot project, measuring the productivity of the team that was using the tool, compared to another team that was using the legacy development process.

“We chose a project that was small in scale but broad in scope, so that it would be a good test of our new workflows throughout all the stages of the development process,” says Martin Gagnon. “So far, we have seen some very encouraging results.”

Taking flight with continuous engineering

Compared to its traditional legacy development process, the early indications are that CMC’s new model-driven, object-oriented approach is faster, more efficient, and delivers higher-quality results.

“Our legacy code-base is large and very complex, so some of the improvement can be attributed to the fact that modern, object-oriented code is cleaner and easier to manage,” says Martin Gagnon. “But better tools make a big difference too.



“Equally, it is much easier to develop reusable and portable components. We were able to port one component onto a new platform in two weeks – which was a significant breakthrough, and something we had never been able to achieve before.”

Ronald Houde adds: “Some of the engineers working on the pilot project were object-oriented programming specialists, not FMS specialists. We were concerned at first that their lack of FMS experience would hold them back – but Rhapsody makes it so easy to understand how the architecture works and what the requirements are, that they were able to start working productively very quickly.”

“For example, it is easier to identify and eliminate defects earlier in the development process, because we can use simulations to test new components even if other dependent components are not available.

Unprecedented transparency

In general, CMC has seen a marked improvement in productivity, which it measures in lines of code generated per person-hour.

In part, this productivity gain is connected to another of the advantages of the new process: the fact that automatic end-to-end traceability is built into the toolset, rather than being a separate manual workflow that distracts engineers from their core development and testing tasks.

“Traceability is critical for safe development that complies with aviation industry standards, as well as for ensuring a high-quality product with zero defects,” comments Ronald Houde.

“We showed one of our customers a demo of the traceability features of the new process, and they were very happy with what they saw. The scope for human error is completely removed, and many hours are saved by eliminating the task of updating traceability spreadsheets and producing compliance reports.”

Martin Gagnon concludes: “As we build our next generation of flight management systems, the ability to develop more portable, reusable components quickly, efficiently and safely will become more and more important, and will help with our Product Line Engineering vision.

“The work that we have done with IBM so far suggests that with IBM Rational Rhapsody, we are heading in the right direction.”

Solution components

- IBM® Rational® Rhapsody
- IBM Rational Rhapsody kit for DO-178B/C
- IBM Rational Rhapsody Test Conductor
- IBM Rational Publishing Engine
- IBM Rational DOORS®
- IBM Software Services for Rational

Take the next step

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RAC14385-USEN-01

