Paving the road to DO-178B compliance with COTS tools

By Mark Hawthornthwaite and Luc Marcil

When it comes to DO-178B compliance, companies face a tough decision: Forge ahead with DO-178B compliance following an entirely hand-coded process and avoid the perceived additional risks and costs of using a third-party resource, or take advantage of COTS tools. Before making a decision, companies first need to revisit commonly accepted wisdom associated with DO-178B.

Those in the avionics industry face many choices when it comes to DO-178B, the standard for software development that has evolved into the *de facto* approach for commercial, and occasionally military, avionics. While compliance is important, even necessary, the work required to achieve it can appear daunting.

This leaves companies with a tough decision between two options, both of which involve unknowns. One choice is to forge ahead with DO-178B compliance following an entirely hand-coded process and avoid the perceived additional risk and cost of using a third-party resource. On the other hand, developers can take advantage of COTS software tools to support in-house processes. The choice can even be difficult for experienced developers who have been meeting DO-178B regulations for years but still need to find ways to reduce the time required to complete important but mundane tasks, such as performance testing, bug detection, and traceability. Other key considerations include cost, transparency, third-party reliability, and technology's increasing complexity, and COTS is proving itself a viable remedy to these issues. The authors explain the challenges behind the DO-178B process, then make their case for the COTS choice.

Painting a clear picture

While its complexity is sometimes overstated, achieving DO-178B compliance is nonetheless a major undertaking. It affects core software systems and all applications that integrate with them – and leaves little room for shortcuts. It also requires extensive changes to the way developers work.

With so much hinging upon DO-178B compliance, it should come as little surprise that some companies are hesitant when it comes to choosing between relying entirely on traditional in-house development practices without using any third-party support, or using a mix of COTS and in-house know how. A closer look at some of the key factors is beneficial.

The bottom line: How much is it?

Foremost among vendors' concerns is cost, as it is widely believed that DO-178B is an inherently expensive process. This belief is not entirely unfounded – avionics programs typically run in the millions of dollars and involve teams of developers and testers following complex schedules. The work required to meet DO-178B represents a portion of that total cost; however, the exact percentage is debatable. A closer inspection of the facts shows that it doesn't have to be a substantial percentage. In fact, an experienced DO-178B compliant organization with many years of certifying avionics and using COTS tools would see very few additional costs, whereas a new company not employing COTS tools could run delays costing in the tens of millions on a major aircraft program, depending on the scenario.

DO-178B entails five different levels of criticality, ranging from the most critical (Level A) to the least critical (Level E). Each step requires an investment of time and money, and each requires ever-more rigorous documentation of coding and review processes. Companies worry that as they move up the DO-178B criticality chain – and in particular from Level B criticality to Level A criticality – that their costs will rise accordingly. But this is not necessarily true.

First, Levels E and D comprise industry-standard software engineering principles; as such, successfully completing them should involve little to no additional costs for most mature avionics firms. As well, the cost of moving from Level B to A, widely seen

as the most expensive of the transitions, may not be as severe as some might think. According to HighRely, a provider of embedded solutions for the avionics industry, the biggest cost driver in this stage is Modified Condition/Decision Coverage (MCDC) testing. However, by using structured COTS, thoroughly training developers, and doing a careful round of testing, the costs can be largely contained.

Transparency and DO-178B

Transparency is a pivotal issue in DO-178B compliance and demands that all processes and stages be fully documented in a way that can be easily reviewed and approved by regulators. It's imperative that this process takes as little time as possible and is completed as accurately as possible to avoid delays in certification.

Those dreaded iterations

Companies may not consider the cost of the endless iterations caused by potential processing and documentation mistakes. Developers may dread the code iterations that come with large projects, and it's not uncommon for teams to undergo dozens of versions. DO-178B guidelines do not provide instructions on how to proceed – only what needs to be done at each criticality. COTS can generate DO-178B certifiable code and help support in-house development practices by helping developers get coding right the first time.

Third-party vendors: Worth the risk?

One reason why organizations are wary of turning to outside COTS and training programs is the perceived costs of using outside help. They may have worked with software vendors who over-promise and under deliver, and are reluctant to expose themselves again. These are valid concerns, but they are far outweighed by the potential benefits of COTS.

The case for COTS

The decision of whether to hand-code entirely or employ a mix of COTS and hand coding is important. Qualifiable software that can help ease DO-178B efforts is available, and that those who use them can strengthen their development practices and increase their chances of success. Despite a preference in some quarters for a strictly in-house approach to DO-178B (that is, relying entirely on developer know-how with little to no automation), new approaches supported by COTS tools have proven to be more effective.

Reducing long-term costs

Implementing COTS tools does require an investment, and companies must accurately assess their needs and spend the time necessary to identify the combination of tools that will produce the best solution. Monetarily, the majority of the investment is made up-front instead of in the development stage. But time and again, successful DO-178B compliant companies have shown that this investment pays off in the long run by using DO-178B qualifiable COTS software. Businesses can amortize the investment over several programs, easily reuse designs from project to project, and easily make modifications without having to put in the extra effort otherwise required.

In fact, a conservative estimate shows that by using COTS, organizations can slash DO-178B project times by as much as 25 percent, and reduce the costs involved by as much as 70 to 80 percent. To cite one example, Ultra Electronics Datel, a software maker based in the United Kingdom, turned to a COTS tool to reduce the amount of effort required for DO-178B compliance. Using VAPS Qualifiable Code Generator (QCG) software from Presagis, Ultra Electronics Datel reduced the requirements specification and the design and test phases of avionics display development, resulting in 25 percent faster time-to-market, and 87 percent lower development costs. Figure 1 shows how users can realize time/cost savings by using a qualifiable code generator, such as VAPS QCG, to model graphics from the generation of system requirements through to the design phase of a project.

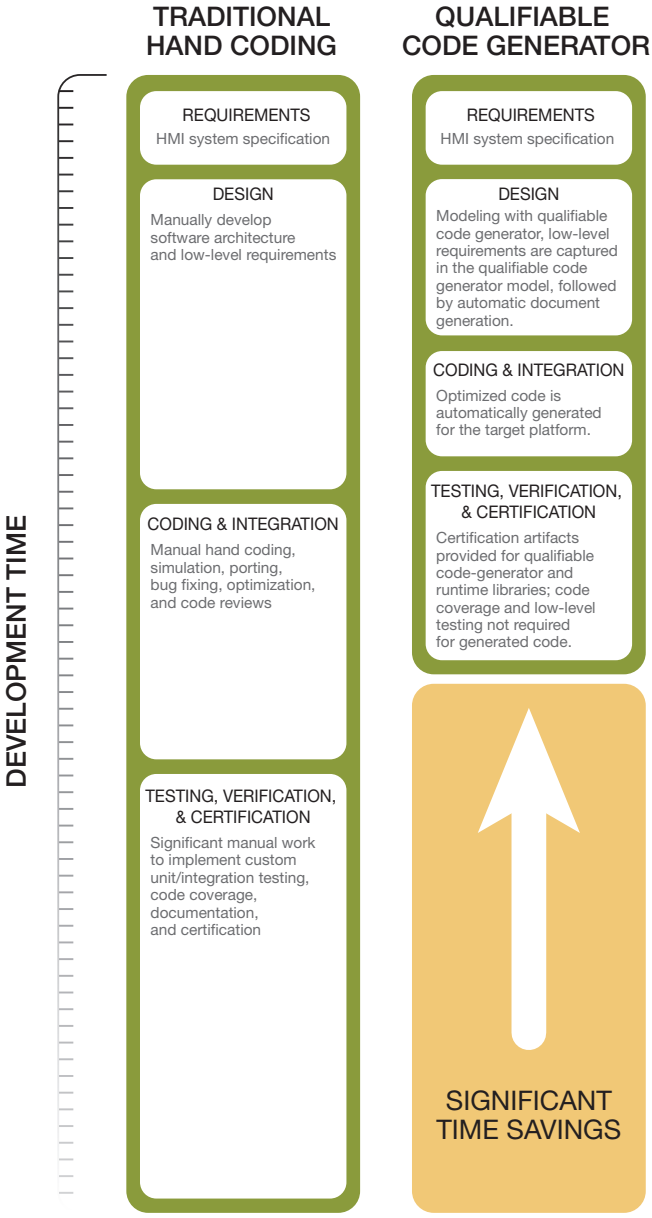

Figure 1

How transparent is it?

Then there is the issue of transparency and COTS. A key driver behind DO-178B is to give regulators clear and transparent access to software development processes. Hand coding by itself can enable this kind of visibility, but not easily. It also can't provide flexibility. Last-minute change requests that invariably have to be made can put previous standards work in jeopardy. More importantly, at each criticality, developers would be responsible for creating and managing their own documentation.

Without the benefit of tools or guidelines, regulators will face a difficult review and approval process. COTS solutions can help streamline this process by providing qualifiable code generators,

automatic document generation, and other mechanisms in order to reduce effort wherever possible for routine updates or changes. Furthermore, once a hand-coded application is certified and flying, it can cost a substantial amount to change a line of code due to the recertification process. COTS guarantees a seamless approach to recertification.

Fewer iterations: Software and hardware harmony

By leveraging the latest software techniques, companies – whether they're new to DO-178B or have years of experience – will benefit from fewer coding iterations, which also means less testing for bugs, a notorious problem area when it comes to achieving DO-178B compliance. They will also face less and easier regression testing and improved hardware integration, the latter being an often-overlooked consideration. This is a critical oversight, as DO-178B is designed to help hardware and software operate in harmony.

Handling increasingly complex technology

Companies also need to consider the rapidly evolving sophistication of the avionics industry. Cockpits today are markedly different from their predecessors – the newest commercial aircraft cockpits feature access to live video, high-end menu-based graphics, and a growing dependence on displays in general. An example of a smart display found in modern cockpits is the multifunction display from Barco, shown in Figure 2. This makes it even more imperative for avionics developers to use the right tools to help them certify their systems as quickly and easily as possible. In this way, the effective use of COTS can help them build a stronger competitive advantage.

Figure 2

Enlisting help

Although COTS can prove invaluable to DO-178B, organizations must still critically assess the options available to them. First, when reviewing tools and vendors, be sure to check their track record. Assess how many organizations they have helped and who they are currently working with. Also, be sure to check upfront about their certifications – make sure they have been certified on an actual DO-178B avionics program.

COTS tools pave the way

Regardless of the decision made, it's important to have all the facts at hand from the outset. For experienced DO-178B developers, that means reviewing existing approaches and determining whether more and better use of COTS tools will make the compliance process more efficient. Those new to the standard will find it to be one of the most important projects they will undertake. It's also one of the most complex. By taking advantage of all the expert resources available, developers will not only ease the transition to DO-178B, they will do so in a way that keeps costs and time investments to a minimum and speeds the time to full regulatory approval. **CS**

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