

**In this Agile Minute, Suzanne Miller discusses one of the pitfalls seen in implementing Agile in government settings.**

**For the video, go to <https://resources.sei.cmu.edu/library/asset-view.cfm?assetid=635239>.**

Hello, this is Suzanne Miller from Software Solutions Division with your SEI Agile Minute.

Today I want to discuss a pitfall that the SEI has seen in implementations of Agile in large, complex acquisition settings, especially those that are part of embedded systems, like airplanes or satellites. In those kinds of systems, software is embedded in the actual hardware via sensors and firmware, and often is responsible for mission or safety critical functions like navigation. The shorthand for this pitfall is "Agile at the Bottom of the V". Let me explain what this means.

Especially for complex embedded systems, the systems engineering community often presents the development life cycle as a V model -- on the left side of the V are the activities of requirements definition, architecture, and design, with implementation being at the apex or the bottom of the V. And going up the right side are verification and validation activities that are meant to be the test and evaluation companion activities of the decomposition going down the left side.

We have seen several graphics depicting Agile implementation as a circular, iterative diagram centered on the apex of the V, down at the implementation level. The thinking that this represents is that the systems engineering and development activities -- the requirements decomposition, architecture, and design activities -- should occur in a traditional manner in a large batch mode. What I mean by this is that all the requirements are completed down to a fairly low level of detail

before design is completed, and design is completed before software implementation (where Agile comes in) is undertaken.

What this mode of development means is that the learning cycles inherent in short batches and short iterations -- hallmarks of Agile development -- will be limited to AFTER the major analysis and design work is complete. Further, it means that there will be a large monetary, intellectual, and time investment in getting to a set of requirements and design artifacts that are perceived as correct. This makes it much harder for the learning that occurs via implementation to be folded back in to the architecture and requirements for the program. This in turn often leads to challenges in getting necessary software requirements and design changes accommodated by the change management and control systems.

We have seen multiple instances now of systems engineering staff adopting a small batch, incremental, iterative approach with their own artifacts, which I have started calling the "Spinning V". This approach includes stakeholders in other elements of the V (software, hardware implementation, as well as test, evaluation, and certification entities). It's a different way of looking at requirements and architecture, but one that reaps many of the benefits of Agile and lean approaches.

For those unfamiliar with applying lean and Agile principles in hardware-dominant settings, a very good reference that is almost entirely hardware-related is *The Lean Machine*, a book about Harley Davidson's transformation to embrace lean engineering. It had some ideas that were definitely counter-intuitive, but are ones that clearly influence some of the leaders in the lean and Agile engineering communities today.

Thanks for watching this SEI Agile Minute. For more information, please visit our website or send me an email at [info@sei.cmu.edu](mailto:info@sei.cmu.edu).

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