



Using Quality Attributes to Improve Acquisition

featuring Patrick Place interviewed by Suzanne Miller

Suzanne Miller: Welcome to the SEI Podcast Series, a production of the Carnegie Mellon University Software Engineering Institute. The SEI is a federally funded research and development center sponsored by the U.S. Department of Defense and operated by Carnegie Mellon University. A transcript of today's podcast is posted on the SEI website at sei.cmu.edu/podcasts. My name is [Suzanne Miller](#). I'm a principal researcher here at the SEI. And today, I'm very pleased to introduce to you to [Patrick Place](#) who is a senior member of the SEI technical staff. He spent time at the SEI working on development methods and tools, communication standards, COTS [commercial off-the-shelf]-based systems, systems of systems, service-oriented architecture, and direct support-to-government programs, and I've had the privilege of working on several projects with him.

Patrick Place: It's been fun.

Suzanne: In today's podcast, we're going to be talking about research that Patrick conducted along with fellow SEI researchers to answer the question, "Is the probability of a program's success improved through deliberately producing a program acquisition strategy and software architecture that are mutually constrained and aligned? Moreover, can the SEI develop a method that helps government program offices produce such alignment?" We will hopefully find out the answers to these questions and more in today's podcast. Welcome, Patrick.

Patrick: Thanks for having me, Suzanne.

Suzanne: So let's start off by letting you give us a little background on this research. What is it about the government acquisition process and how it might benefit from a mutually aligned and constrained architecture that drew you to this kind of research? And, how do these two forces, acquisition and architecture interact in what you found?

Patrick: In all the work we've done in [independent technical assessments](#) and various other direct support-to-government programs, we've noticed that a significant cause of failure and one of the things that causes a lot of government programs to fail is that the acquisition strategy—and I'll say what I mean by that in just a second—and the architecture don't much up, that they have incompatibilities between them.



We're pretty used to understanding the architecture and what that is that governs the system and the software. The acquisition strategy is one or more documents. It's usually many documents that actually govern the structure of how the software is acquired.

When those two go in different directions, which they often do because the government has a tendency to have one group of people develop the acquisition strategy, because they are acquisitions specialists, and a completely different group of people develop the architecture, because they are software or system specialists, and they never talk to each other. When you start to get interactions between these things—for example, we might have an acquisition strategy that states we are going to award the contract to six different companies but essentially, building one large monolithic structure—it just doesn't fit. Those mismatches are what we are trying to resolve.

Suzanne: For those that don't know sort of the breadth of what an acquisition strategy covers, it covers things like, *are we going to do competitive prototype, fly offs? What kind of contract structure are we doing to use?*

Patrick: Sure. It's everything that governs the way the software or the system is going to be acquired.

Suzanne: So you use very different strategies if you're acquiring an airplane versus acquiring an ERP, Enterprise Resource Planning system, generally speaking.

Patrick: You'd like to think so. Unfortunately, the government typically uses the same structures and same approaches for acquiring software, and essentially software-intensive systems, that it uses for aircraft and ships and tanks and other things that are very physical. This gets into a lot of difficulty because the physical components have different kinds of needs in development for the software. Part of what we're trying to do is to stop being more thoughtful about the way the acquisition strategy is developed.

Suzanne: OK. So what I understand is that early in this work—I was interviewed as part of these so I know a little bit about it—you identified seven patterns of misalignment, so seven different ways in which misalignment might occur. Across these, you saw some major contributors to the misalignment. Tell us a little bit about the anti-patterns and how you developed them.

Patrick: OK. Well, before I get into what the patterns are, I'll talk about how we developed them. We did that by going to the SEI and reading reports of technical assessments of red teams, pestering people by email, pestering people in person...

Suzanne: I remember that part.

Patrick: ...I think everyone does—and getting as many instances as we could possibly find of causes of program failure. We always try to focus people on architecture and the acquisition strategy. As we did that focus, we started to see recurrent failures, places where something had been done in multiple programs. So, every one of our patterns was exhibited by two or more of the programs that people were representing when we talked to them.

We are certainly not saying that these are the only patterns, but the seven that we came up with are all ones where our initial data said, *Hey, here is a problem*. As we worked through that, we ended up with a model of how the world should be, and that is documented in our [technical notes](#). It turned out that each of our seven patterns shows a weakness in the relationships that should hold, that is kind of a bit technical. What I'm trying to get at is that if the anti-patterns weren't there, then all these good relationships that we think should be in the ideal world would hold, and people would end up with acquisition strategies aligned with their architecture.

Suzanne: So, the anti-patterns became the foundation for a new method for doing this alignment between the architecture and the system-acquisition strategy. Tell us how you are dealing with that. Where are you in terms of where that method is and then how you're using it?

Patrick: OK. This is going to back to the patterns themselves. The biggest anti-pattern, the one that we found most commonly occurring, was the fact that business goals weren't well-documented. We're pretty used to—in the architecture world with the SEI's past history in architecture—of understanding how business and mission goals flow into the software architecture and how they influence them through the use of software quality attributes. What we did was we essentially asserted that we could find a similar concept, an acquisition quality attribute that would also help shape the acquisition strategy. If we could identify from the business and mission goals—to the extent that they have been documented—the acquisition quality attributes, we could use those to actually drive the acquisition strategy. So, you would have an acquisition strategy that met people's goals as opposed to one that just copied from the last acquisition that was successfully approved.

Suzanne: So, for those that don't know about software quality attributes, these are often called, in other settings I've heard them call it non-functional requirements, but they are things like reliability, sustainability, and security.

Patrick: Sure.

Suzanne: Those are things that cross the system for software. So, give us some example of what you mean by something that would have that same kind of function in an acquisition.

Patrick: Just picking one purely at random, staffability, which has to do with how you staff up the program office. It has nothing to do with the system that is being acquired, but it is crucial to the structure of the acquisition. For example, if I have got a program with a very complex

acquisition and multiple contractors, I probably need more contracting specialists in my office. That is what we're trying to get at. We have these meaningless words like staffability. Just as they are meaningless in the software world, we are trying to give them meaning using scenarios. So, we have an exact analog of the architectural side of the house, the software-architecture side, to try and structure the acquisition strategy.

Suzanne: When we are talking about scenarios in terms of quality attributes, there is actually a structure. It is not just a story, the way you might think of it in terms of the scenario for a movie script. This is a structured way of looking at the things that are present in the environment and the things that sort of are what we call stimulus to get something going and that result that you expect. You can analogize that from the technical world into the business world.

Patrick: In fact, we have done some experiments and now have a list of about 70 scenarios that we have captured from real programs. Some we did in a very focused exercise with a couple of SEI people who were representing a program office. In the course of a couple of hours, we got 20 scenarios from them that were all in the same structured form, and it is the same structured form that the software side uses. That is important for our future hope. So we'll get to that, but we want to have that same structure. Otherwise we culled through all of the interview notes and have another 50 or so unique equality attribute scenarios. It is not a huge body of scenarios, but it is rich enough that we think this is a good way to be able to reason and represent the business goals. We have also done some work on actually how to elicit the business goals and make sure that we've got enough people...

Suzanne: When they're not documented you need a way to get them or else you can't do the alignment analysis.

Patrick: Yes. Absolutely. They have to be documented in some way and although there's no formal process to do that, we're trying to invent a piece of formal process by using something called PALM, which is the Pedigreed Attribute eLicitation Method. And, then, spending some time focusing on its representation of a goal where a goal also has a goal subject, the person who has the goal, and the goal object, which is might be a different individual. By analysis of goal subjects and goal objects, we start to see have we, in fact, spoken to enough of the stakeholders to be able to have all of those influences on the structure of the acquisition. That is work we have been doing.

Where we are at right now is we have the method, and we are really ready to push this out as a pilot. We are actively seeking people to pilot this with.

Suzanne: So, tell me a little bit about the requirements for someone to be a pilot for this work because I think we probably have some listeners that are very interested in figuring out their own scenarios of selecting a business acquisition strategy.

SuzannePatrick: Sure. For us, it would be a program office that is about to undergo something major. So, if it is Pre-Milestone A, you are not a program office. But, it is one or more individuals who are acting like a program office, and they are setting up the acquisition strategy.

Suzanne: And that is the timing that is typical for...

Patrick: That would be good timing but equally well, Pre-Milestone B, that is another significant event in the government acquisition that would be a good time. Well, possibly in a program that might be in a sustainment but is about to undergo some major modernization, and so they're going to have a large scale acquisition at the restructuring of what they are doing. That is when we'd like them to be able to think more consistently about the strategy.

Suzanne: So the government side of the house as opposed to the contractor's side of the house would be the place that you would be looking for pilot candidates?

Patrick: Yes. Though you could do this independently in a world of commerce where an organization, a commercial organization, is acquiring a new system. But, they have fewer rules than the government does so it might be easier on them.

Suzanne: One of the really unique aspects of this is that it is taking some of the things that you might do as part of strategic planning in a commercial space and accounting for some of the constraints that make that a very different process in the government space.

Patrick: Sure. Because the government laws and all the rest of it are rules that now govern the acquisition and structure that acquisition, so that their influence is on the structure.

Suzanne: So, what's next? You are pretty busy with getting ready to pilot. I assume you have some ideas of where you want to go after you get some pilots done and understand what works and doesn't work in your method. What comes next?

Patrick: Right, well, everything we have talked about is about how to develop a good acquisition strategy. That still doesn't get us to our end state. Our end state has to be able to compare the acquisition strategy with the architecture. That is what we'll be doing, we hope, next year. What we plan to do is to look at what artifacts in the architecture, what artifacts in the acquisition strategy can we even usefully compare against each other to identify where is the misalignment.

If I think of this year's work, we are really trying to just focus on, *How can I be thoughtful about my strategy?* The goal for the future work is, *How can I make sure that this two things really do align?* We have got two touch points. One is with the scenarios. It is one of the reasons that we have kept the scenarios in the same format because our goal is that if they are all in the same format then there is some hope of being able to compare acquisition quality attribute scenarios with system quality attribute scenarios and software quality attribute scenarios to see

inconsistencies. We are pretty sure that if you have got inconsistent scenarios, anything that is developed from them will be inconsistent.

Suzanne: That makes sense although you still have to test that.

Patrick: We have to test it.

Suzanne: There are always counter-intuitive results.

Patrick: Well, yes. I mean, you could have serendipity, a very happy accident and something that doesn't work at one stage comes together. If you genuinely derive the architecture from the software and system quality attributes, and you genuinely derive the acquisition strategy from the acquisition quality attributes—and those sets of scenarios and attributes are not consistent—I am pretty sure that the genuine derivation is going to be problematic. We can't say that having success there is still going to be useful, if you know the scenarios can be harmonious and things can still diverge. That is why we want a second instrument to be able to test the actual acquisition strategy and the architecture itself.

Suzanne: I see tons of directions that this work could go, so I hope that you continue being able to evolve this. I look forward to seeing some of the results from the pilots. When you start comparing the different kinds of scenarios, I think that will be very exciting.

Patrick: Thanks. We're very hopeful. I mean, it is an area that is rich in problems. If we can be a little bit more consistent and a little bit more thoughtful about the way people do things, then perhaps we can avoid a lot of the major government failures or acquisition failures.

Suzanne: I know there are-is some other work that has been published on this. Most recently, there was a blog by one of your colleagues, Lisa Brownsword that talked about the method so there are resources available for people to read related to this.

Patrick: Yeah. Absolutely. I mean, Lisa is leading this effort, and so she's done some of our other public posts. It is just fun stuff to do.

Suzanne: Excellent. Patrick, thanks so much for joining us today. If you, our listeners, would like more information about the research that Patrick and Lisa's team is conducting in this field, you can download their technical report [Results in Relating Quality Attributes to Acquisition Strategies] on this topic. Go to resources.sei.cmu.edu/library. In the bottom left-hand corner under the SEI links, click on the [Author A-Z Index](#) and find [Patrick Place](#).

To read the series of blog post that Lisa Brownsword wrote on this topic, please visit blog.sei.cmu.edu, and click on [Lisa's name in the right-hand author's column](#).



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