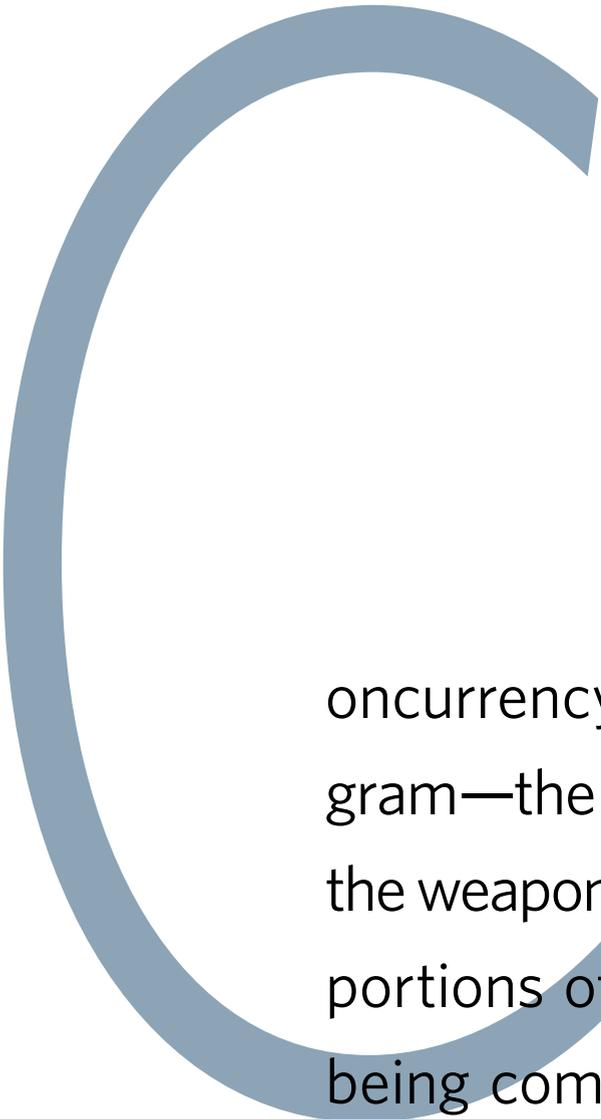




Investigating Concurrency in Weapons Programs

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oncurrency in a weapons program—the actual production of the weapons system while some portions of the design are still being completed—has been a topic of debate for decades. The assistant secretary of the Navy for research, development, and

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acquisition's Feb. 6, 2006, memorandum, "Design/Build Concurrency," identified the high degree of concurrency in the littoral combat ship as being a large contributor to its cost growth. More recently, in a March 2010 written testimony presented to the Senate Armed Services Committee concerning the Joint Strike Fighter, Government Accountability Office Director Michael Sullivan stated, "We have consistently reported on the elevated risk of poor program outcomes from the substantial overlap of development, test, and production activities and our concerns about the government investing in large numbers of production aircraft before variant designs are proven and performance verified in testing."

Concurrency is still commonly cited as a driver of program cost and schedule growth, and the debate on just how much concurrency a program can experience before significant cost increase is incurred rages on.

Advantages and Disadvantages

Intuitively, one can see the advantages that concurrency would bring to a program. In some cases, there is an urgent need for a weapons system, which forces a program to build certain components of the system while still developing others. In programs requiring cutting-edge technology—such as combat aircraft, missiles, or electronic countermeasures—waiting to go into production until all design and tests are completed could introduce the additional risk of obsolescence. Finally, concurrency allows a system's timeline to be significantly reduced, which lowers exposure to requirements creep and may actually save money.

On the other hand, there is the case that concurrency adds risk to a program by exposing it to expensive rework resulting from major redesign. That was essentially the argument made in the case of the littoral combat ship program. In a Feb. 8, 2007, statement to the House Armed Services Committee, representatives from Lockheed Martin, echoing much of what was argued in the 2006 Navy memorandum, stated that "these challenges forced significant program inefficiencies through out-of-sequence construction, excessive unplanned concurrency between design and production, and significant rework, all of which are still impacting the [*littoral combat ship*] cost and schedule."

History of Concurrency

The history of concurrency shows that, regardless of whether it adds risk (and cost) to a program, it has been relatively common for years. In a 1988 study entitled "Concurrent Weapons Development and Production," the Congressional Budget Office documented several examples of concurrency in weapons programs dating back to World War I. Depth charges, for example, were developed under a very short timeline that required a high level of concurrency as a result of the urgent need to defeat the German submarines. In the 1950s, in response to the Soviet's successful launching of Sputnik, concurrency was a common practice in many new missile programs. The study also found that, as one would expect, concurrency was more accepted in times of war than in peace because requirements were more urgent.

According to the Congressional Budget Office study, beginning in the 1960s, concurrency became more common under Defense Secretary Robert McNamara, who encouraged a "total package procurement" approach to weapons acquisition. But problems with some systems led the Department of Defense to restrict concurrency, which, inevitably, led to longer acquisition times that forced DoD to lower the restrictions. This back and forth in DoD acquisition policy, according to the Congressional Budget Office study, was reflected in regulations and legislation concerning weapon system procurement. For example, some DoD basic acquisition regulations encouraged concurrency. On the other hand, the 1987 Defense Authorization act forbids a program from proceeding past low-rate initial production until initial operational testing and evaluation is completed.

Does Concurrency Lead to Cost or Schedule Growth?

Clearly, from a policy point of view, the advantages and disadvantages of concurrency seem to have been acting against each other for decades. However, while there have been some studies and investigations into certain programs that point to concurrency as a possible culprit for some cost growth, there have been few systematic studies that measure how closely related the two are.

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The 1988 Congressional Budget Office study is one of the few studies that we could find that actually did try to measure this relationship. In the study, the Congressional Budget Office defines concurrency as the proportion of time spent in operational test and evaluation after production begins. The logic behind this metric is that successful OT&E should always precede production of the system. Thus, if OT&E is occurring during production, then the program is experiencing some level of risk, which may lead to redesign and, ultimately, cost or schedule growth. Examining 14 major programs that were deployed in the 1970s, the Congressional Budget Office found that the statistical relationship between concurrency and cost growth was very low. The relationship was even lower for schedule slippage. Another study conducted by the RAND Corporation in 2006, using the same definition as the Congressional Budget Office study, also identified the possibility that concurrency does not have an impact on cost growth. Unfortunately, the RAND study did not pursue the finding

further, as the main thrust of their paper did not deal with concurrency.

However, it may be that the Congressional Budget Office and RAND findings are a result of how they defined concurrency. After all, many programs, especially ships, begin spending money on production much earlier than when OT&E commences. In these cases, if concurrency is an added risk, then there exists even more room for some problem to occur much earlier in a program, when research, development, test, and evaluation (RDT&E) money is being spent outside of OT&E.

Our Findings

We examined the relationship between cost growth and concurrency again in response to a request by assistant secretary of the Navy for research, development, and acquisition. In contrast to the Congressional Budget Office and RAND studies, we defined concurrency as the percentage share of RDT&E money that was being spent while procurement dollars were also being spent. The logic behind this definition was simply that any deviation from perfectly serial RDT&E/production is a potential source of risk. That is, if a program spends all of its RDT&E money prior to making a production decision, then the program should experience little or no technical risk at all. Thus, cost and schedule growth should be at a minimum. Any concurrency, under these circumstances, entails risk, which, in turn, could yield cost growth.

For our study, we considered concurrency in two ways: planned and actual concurrency. Planned concurrency was what the program envisioned when it published its first system acquisition report at milestone B. In theory, how a program plans to execute spending may impose risk at the very outset regardless of how the money is actually spent. If this were the case, then we would expect to see a relationship between the planned level of concurrency and cost growth.

Actual concurrency is what the program actually executed as reported in the last system acquisition report. The theory here is that it does not matter what program managers said they were going to do. It only matters how they actually spent their RDT&E and procurement dollars. If they actually incurred a high level of concurrency, then they increased the risk, which could have led to high levels of cost growth.

Our Results

Our results (located at <http://www.cna.org/search/node/concurrency>), based on examining 28 programs across all Services, are very similar to those of the Congressional Budget Office and RAND studies with one surprising exception: While from a purely statistical point of view we found that the relationship between both planned and actual concurrency and cost growth was very weak, in both cases, there seems to be a "sweet spot" of about 30 percent concurrency. That is, programs that plan on spending 30 percent of RDT&E funds while concurrently spending procurement funds actually experience the lowest average cost growth. Similarly,

those programs that actually do spend about 30 percent of RDT&E funds while concurrently spending procurement dollars, even when not originally planned, also experience lower cost growth. Furthermore, programs with planned or actual levels of concurrency below 30 percent experienced higher cost growth than those with higher levels of concurrency. In other words, lower levels of planned or actual concurrency were actually worse than higher levels of concurrency. This is the complete opposite of what many in the acquisition community believe. We speculate that lower levels of concurrency may expose the program to higher levels of external changes.

Finally, we calculated the difference between planned and actual concurrency and named this new metric unplanned concurrency. We then examined the relationship between unplanned concurrency and cost growth. Again, from a purely statistical point of view, unplanned concurrency is not very closely related to cost growth. However, what little relationship existed showed that deviations from planned concurrency often led to higher cost growth. Even when programs experienced less concurrency than planned for, cost growth appeared to be slightly higher.

In sum, our study suggests that programs should plan for some moderate level of concurrency (somewhere around 30 percent) and then stick to the plan. Deviating from the plan is a sign that something adverse is happening within the program.

What to Do About Concurrency?

So far, no conclusive evidence exists that concurrency (no matter how it is defined) is generally a problem. This does not mean that concurrency is never a problem. But most likely, concurrency leads to cost and schedule growth under very particular circumstances. What these circumstances are is not very clear just yet. Nor is it clear why in our study, the sweet spot for concurrency is somewhere around the 30 percent mark. What is clear is that there are definite advantages to concurrently designing and building a weapons system that most program managers take advantage of, to some extent or another.

The Congressional Budget Office study advised that "Congress may wish to take no further action regarding concurrent programs as a group," given the very weak relationship between the concurrency and cost growth. Instead, the office argued that Congress should simply ask that DoD develop a consistent measure for concurrency to be published in a program's acquisition report and then monitor programs to see how they are performing relative to their planned level of concurrency. More than 20 years later, this advice still seems to be appropriate.

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