

Risk, Uncertainty, and Trouble

Escaping the RUT of Program Instability

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When we say we are stuck in a rut, we imply our often repeated actions are forced on us by things outside our control. As if to say, we are not really as crazy as we look. But what if we build our own rut and then act as if we have no choice?

When we talk about things that will happen in the future, we must remember those things have not yet happened. Because they have not happened, we must allow for the possibility they may happen differently from the way we expect, at different times, or not at all.

We cannot relieve ourselves of the need to plan for the future just because the future is uncertain. For our plans to be reasonably accurate and reliable, it is prudent we base them on rational analysis and not on wishful thinking. Unfortunately, we do not always think clearly about the future. Our assumptions are often clouded by lapses of judgment, eternal optimism or dark pessimism, and trepidation about admitting risk and uncertainty to those around us. In many instances, we shy away from accepting the full impact of risk and uncertainty on future conditions because we become overly concerned that our ideas will be rejected unless we can guarantee successful results.

When we talk about the future, “risk” is the term used to discuss a possible negative outcome of an unfavorable event or action, while “uncertainty” refers to the unknown variability around a prediction of a future state. Potential risk causes us to set aside resource reserves to help overcome possible setbacks. Uncertainty causes us to make assumptions about what may happen and estimate how valid our assumptions will prove to be. Risk and uncertainty are not what get us into trouble. We get into trouble when we ignore, or unwisely discount, risk and uncertainty. I call that Risk, Uncertainty, and Trouble—and it is a RUT of our own making.

Making Assumptions

The Department of Defense is upgrading and improving its capabilities. To fund this investment, the department is looking for efficiency and taking reductions across all areas of operations. It is vitally important we understand



“However beautiful the strategy, you should occasionally look at the results.” —Winston Churchill

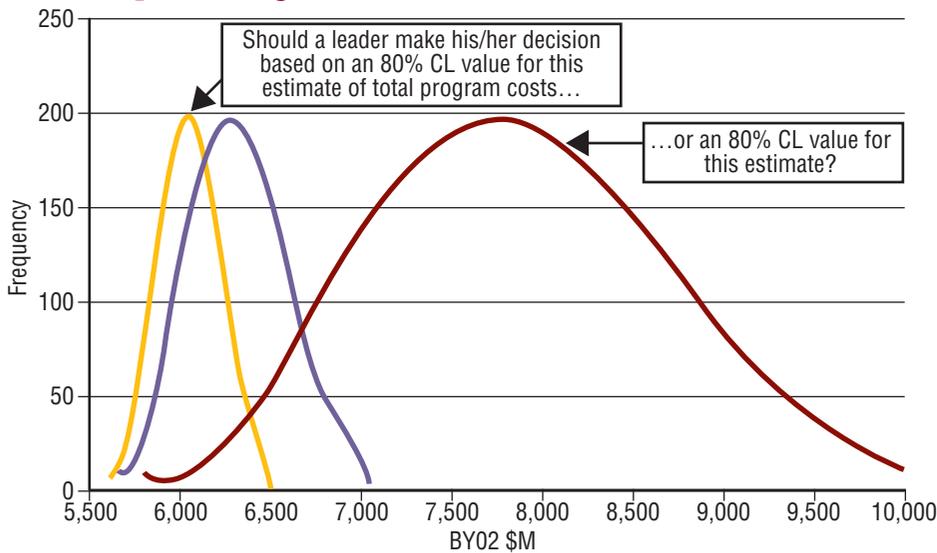
how our modernization money is being spent so we can get the best possible results from our investment and minimize the impact to the rest of the department.

Financial instability is a problem. Budgets are tight, the pace of operations is high, and short-notice changes pop up against a list of requirements. Leaders in acquisition are trying to insulate programs from financial instability. To avoid overruns, they have asked for extra funding to reach a higher confidence level in costs and scheduling. Many acquisition programs have moved from funding at the traditional 50-percent confidence level estimate to an 80-percent confidence level to provide better budget stability and avoid costly program failures.

The biggest problem we have in establishing a baseline and predicting the cost of a weapon system to develop and deliver it to the warfighter is that we know too little about the undeveloped weapon system and the difficulties we are going to face getting it into the field. While it may be human nature to worry excessively about things

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Actual Space Program Cost Distribution



we do not understand well, another common reaction is to discount the impact of uncertain challenges.

Even with the well-documented loss of organic cost analysts, we still often perform reasonable, initial analyses of risk and uncertainty. The RUT of program instability is caused more by our resistance to fully communicating risk and uncertainty to decision makers than by our lack of ability to capture it. As information is entered into our approval and decision-making system and rises through the corporate process, the underlying risk and uncertainty are often watered down in a series of negotiations forced by severe budget, time, and resource competition. We fear that risk or uncertainty will weaken our chance to gain funding or approval for our proposed course of action, and we back away from clearly expressing measures of risk and uncertainty that are subjective by their very nature.

Like it or not, the system drives us towards a point estimate, and when a budget is laid in against it, all future programmatic success or failure is measured against what is only a reasoned compromise. Time and time again, that is what gets us into trouble.

Embracing the Full Picture

One reason we shy away from fully explaining risk and uncertainty is that they are perceived as bad news. We often discount their very existence or impact. Failing to embrace the true condition of any situation leads to a cycle of mistaken assumptions and improper priorities that can sabotage a manager's chance of addressing the real issues, and the chain of command's chance to provide meaningful support early enough to make a difference.

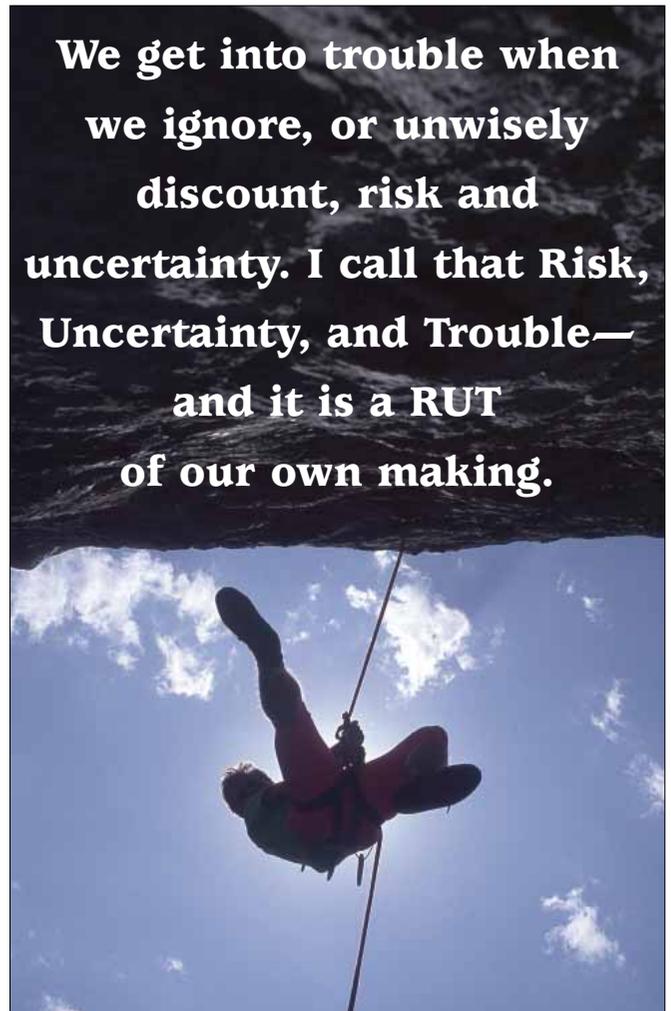
Assumptions must be correlated with evidence in order to build a realistic baseline. If we are to avoid the RUT of program instability, we must accurately describe the uncertainty and risk a program faces, and we must ad-

dress those items. That is how we will gain the smooth traction of high-confidence acquisition programs.

For example, if we develop a plan to solve a technical problem and give ourselves a reasonable time to accomplish the task, we tend to discount the risk involved in actually solving the problem. As schedule risk and technical risk are highly correlated, this tendency leads us to assume away a significant portion of the risk by planning a development timetable that appears reasonable to us but, in many cases, is not when seen in the context of what must be accomplished and in the context

of real-world capabilities. So, we end up underestimating that portion of the risk. Next, we estimate the 80 percent confidence interval of a fraction of the risk—the risks associated only with the estimating equations—and declare we have 80 percent confidence in the development

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estimate. When we minimize the risk and uncertainty of our program to the approving officials in our chain of command, they make biased decisions based on “optimistic assumptions” (our current euphemism for poor judgment).

Getting into Trouble

Because of the amount of risk and uncertainty inherent in a weapons system development program, the amount of extra money needed to go from a 50 percent confidence that the program will not exceed a certain cost to a higher confidence level is often unaffordable. For example, look at the Actual Space Program Cost Distribution figure on the previous page, which illustrates three different estimates made of its total cost.

The scale of the figure is millions of fiscal year 2002 base year (uninflated) dollars. The contractor bid to deliver this program at a stated 50 percent confidence that the cost would be \$6 billion or less. Given the narrow range of uncertainty assumed by the contractor (the yellow line), it would take only another 3 percent of funding to gain 80 percent confidence that the program would finish at or under \$6.2 billion. The program office did its own estimate and predicted that the cost of delivery would be approximately \$6.4 billion at 50 percent confidence (the blue line). Given the program office’s assumed uncertainty, it would take only an extra 6 percent of funding (\$400 million) to reach 80 percent confidence. The program then went through an independent review. The independent cost estimate predicted a cost of \$7.7 billion with another 10 percent, or \$8.5 billion, to reach 80 percent confidence (the red line).

Many would look at the range of costs developed for the independent review as being surprising when compared to the earlier estimates. It is easy to imagine the program office and contractor complaining bitterly that the independent estimators did not fully understand their cost-saving initiatives and managerial skill.

And it turns out, the independent estimators were wrong: Even *their* distribution was far too narrow. In fact, when predicting the price of a commodity as simple as a carton of eggs five years into the future, there is a standard error of 15 percent.

Because one standard error represents roughly the difference between 50 percent and 80 percent confidence, in order to be 80 percent confident that you will have enough money to pay for a dozen eggs five years from now, you will need to hold 15 percent more than the expected price. Now imagine how much larger the standard error is for our sophisticated, state-of-the-art weapon systems that will take more than a decade to develop and procure. Because the example in our graph is based on real numbers, you might be curious to know that the latest cost estimate for the program exceeded \$13 billion before it was de-scoped. But it’s not all about the cost estimate!

The cost growth in this program was the result of optimistic assumptions associated with technology levels, integration complexity, and cost. Risk and uncertainty were underestimated and the program was funded at something less than even the 50-percent confidence level.

It does not mean the cost estimators should have estimated an 82 percent increase in costs to go from 50 percent confidence to 80 percent. Successfully bounding



the upper limits of a program estimate requires programmatic control, not throwing good money after bad. The summary purpose of that example is to show that nobody fully understood or communicated the cost and technical risk associated with the program. Decision makers were hamstrung by poor information and a culture of optimistic assumptions. We got into this trouble by minimizing the risk and uncertainty of new technology that was being developed for this system.

Keeping an Eye on the Customer

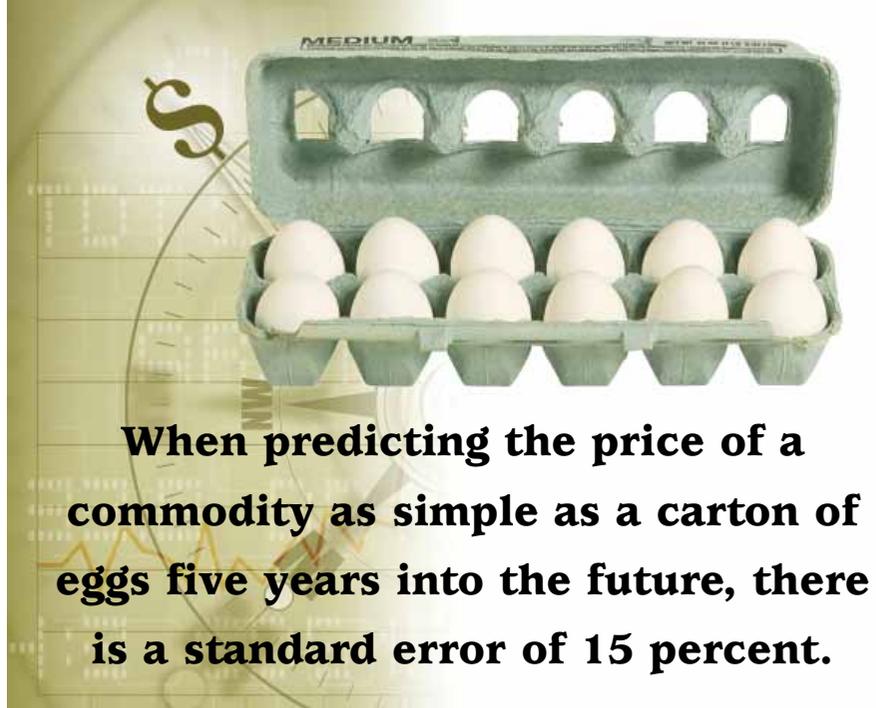
Sometimes we have good reasons for rushing things to the field. An extremely important part of this discussion must be that new programs are often built from urgent warfighter needs. There is no way anyone in the business of DoD weapon systems development wants to let our troops in theater down! Both in the heat of the battle and in the heat of getting better capabilities to those in the battle, cost and schedule risks are all too often understated under the pressure of mission accomplishment. It is a disservice to our leadership to think they won't accept the risks if we communicate them and let them debate whether the potential benefits are worth it—or not.

Accept and Control, Not Escape

Risk and uncertainty are perceived as bad news. We fight risk and uncertainty tooth and nail. It would be wiser to consider risk and uncertainty as a giant rubber band—the more you pull away from them, the harder they pull back on you. Failing to admit that things may not proceed exactly according to plan is a recipe for trouble. Many things in our business are unknown and will stay unknown until we attempt to execute a program. After all, don't we try to put state-of-the-art technology into new weapon systems?

We are developing risky technology on aggressive schedules and claiming stable management environments. It just doesn't make sense. Adding money to the top line of an effort that is not fully understood is prohibitively expensive. Optimistic assumptions must be correlated with evidence in order to build a realistic baseline.

It is a disservice to present a decision maker with an estimate for a new groundbreaking weapon system that claims the system can be developed for a certain price and that the confidence can go from 50 percent to 80 percent confidence with only a 3 percent or a 6 percent increase in funding. And it is foolhardy for a decision maker to accept that estimate.



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The decisions that make a system affordable must be based on more than wishful thinking. We should be straightforward about the risk we are proposing to take on. Strongly and clearly communicating risk and uncertainty up the chain of command will help leadership make better strategic decisions. That will result in improved use of resources and greater combat effectiveness. If we are to get out of our RUT, the first step will be to recognize we are *in* one. We should be motivated to take the risk of communicating better and more balanced information to decision makers. Not every idea is worth a full-scale development effort, and there is nothing wrong with admitting that. We must think clearly about uncertainty and risk, and we must fight the temptation to discount those factors when communicating the real conditions of our management situation. We don't get in trouble because of risk and uncertainty. We get in trouble for not admitting to ourselves—and those who rely on us—all of the risk and uncertainty that inherently exist in everything we plan to do.

Note: Between December 2007 and August 2008, the price of eggs increased by more than 30 percent!

The author is especially indebted to assistance from Jay Jordan, technical director of the Air Force Cost Analysis Agency. The graph is from Jordan's excellent briefing, "Cost Estimate Quality and Confidence."

The author and Jay Jordan welcome comments and questions and can be contacted at brian.shimel@hanscom.af.mil and jay.jordan@pentagon.af.mil. (Please send the hard questions to Mr. Jordan!)