From The Telegraph to the F-22

Insulating Your Program Against Manufacturing Challenges

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You, as a new program manager, will be tempted to place manufacturing low on your long list of issues. It might seem the least of your worries. You could reassure yourself in several ways:

"Development planning is going to take up all the team's time; we'll just have to build it after we figure out what we want. That's what we pay the contractor for, anyhow – he's the manufacturing expert."

"We'll incentivize the contractor and he'll be so motivated that he'll jump right past all those manufacturing challenges (whatever the heck they are) to get that extra incentive."

"Let's hit him with a liquidated damages clause and get our money back for late deliveries; that'll ensure performance!"

"He signed up to deliver. If he has to work everyone overtime and go into debt, so what? We're getting our production units cheaply!"

If you're thinking this way, congratulations – that's the sun shining through your porthole on the *Titanic*. We design and build complicated systems – or at least, we design them. Yet it's all too easy to forget what it takes to build an F-22, a C-17, or a satellite. The program manager is well advised to assume that risks exist in manufacturing; in this case, assumed guilty until proven innocent!

Perhaps the story of another "no-risk" manufacturing effort would help you remember the risks you face. We can learn

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a lesson, surprisingly, from a manufacturing effort early in this century. It was a commercial, off-the-shelf technology, just like the "future" of defense acquisition. You've seen the product, and benefited from its use...now you can benefit from its history.

"What Does This Have To Do With Acquisition?" You Ask!

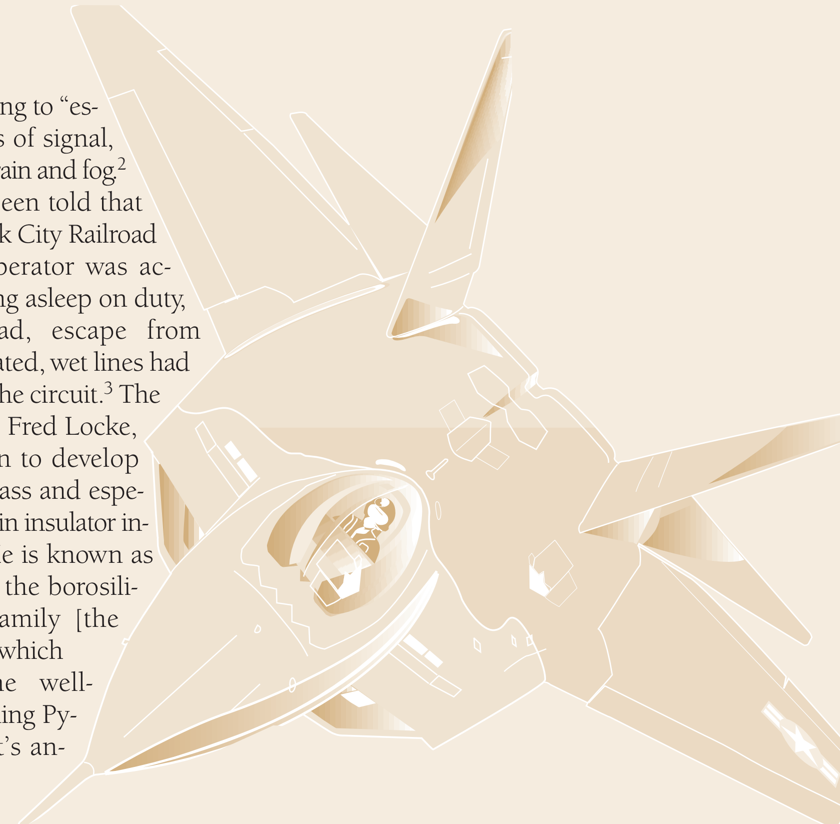
Insulators are those gizmos you see at the top of power poles. Most today are porcelain. However, in the late 1800s and early 1900s, porcelain manufacturing and materials technology hadn't advanced sufficiently to give reasonable cost, performance, durability, etc. Glass was therefore the material of choice. Many of these faithful glass insulators made in the late 1800s and 1900s (up to about 1975, when domestic production ceased in favor of the now state-of-the-art porcelain) are still in service. You've probably plinked at them – [admit it, now! –with a BB gun or rocks]. Your granddad had some in his barn. They're everywhere. If you wanted to buy them, they'd be perfect for a streamlined acquisition: after all, they're commercially produced and have been available "off the shelf" for over a century. Could risk be lower?

Stay with me on this; I have a destination. But first, a bit of history.

A Long Production History

The simple "bureau knob"-shaped insulators of the first telegraph line in 1844, between Washington, D.C., and Baltimore, Md., gave way to a myriad of improved designs.[1] All were based on capping the wooden, conductive pin with a glass cover (sometimes covered itself with wood in the case of the Wade-style insulator). Insulators designs ranged from an egg-shaped insulator to one shaped like a teapot. The Union and Confederate Armies were extensive early users of insulators for battlefield telegraphy.

Like the birth of many industries, the time was ripe for innovation. Some designs worked well; others allowed dirt buildup and did not adequately isolate the pin, leading to "escape" or loss of signal, especially in rain and fog.[2] In fact, it's been told that one New York City Railroad telegraph operator was accused of being asleep on duty, when instead, escape from poorly-insulated, wet lines had shorted out the circuit.[3] The operator was Fred Locke, who went on to develop numerous glass and especially porcelain insulator innovations. He is known as a pioneer of the borosilicate glass family [the same family which includes the well-known Corning Pyrex; but that's another story].



Regardless of their insulating effectiveness, insulators in production through the American Civil War shared a practical problem: there was no reliable method to keep them from popping off the pin from the effects of wind and weather [helps illustrate the difference between planned performance and performance in use, doesn't it?].

The answer came in 1865, when Mr. Louis Cauvet patented a method of producing screw threads in glass.[4] This was not a trivial production problem – the glass has to have time to cool sufficiently to allow the screw thread-producing mandrel to be removed without deforming the object, yet mass production demands speed.

State-of-the-Art Changes

Cauvet's Patent doomed the threadless insulator. Several other notable manufacturing patents were issued in the next 35 years, including those by Oakman, Pennycuick, and Hemingray, for methods of producing threaded glass insulators.

It was a great market to be in around 1900. As manufacturing methods proliferated and expertise increased, burgeoning construction of telegraph, telephone, and electrical lines caused a huge demand for insulators. High-speed

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production was required to meet that demand; yet, the maturing glass insulator industry was also held to increasingly rigid quality requirements. Then as now, speed (schedule) competed with quality (performance) and as always, cost.

Many patents were obtained. Now that the screw thread problem was conquered, the insulating quality, structural integrity, durability, and cost of insulators began to receive additional attention. Various designs were produced and sold to line construction firms, some of them quite whimsical, ranging from glass "hooks" to oil-filled insulators with names like "Fluid Insulator." Several manufacturers emerged as the front runners in North America, notably Hemingray in Covington, Kentucky; Brookfield in New York City; and Dominion Glass Company in Montreal.

Brookfield ceased production in 1922 after 53 years of successful operations. Their demise was attributed to an energy crisis caused by World War I, which caused a coal shortage; further, a shipment of insulators overseas for the Allies was destroyed by saboteurs. Increasing competition claimed its share of the company's viability.[5] It's a situation akin to today's consolidation of the defense industry. Naturally, other companies hastened to fill the gap left by Brookfield.

A Sure Success — With an Emphasis on Quality

In November 1923, a state-of-the-art plant dedicated to insulator production opened in Lynchburg, Va. The Lynchburg Glass Company employed experienced managers from defunct Brookfield and other companies, who set out to compete with the front-runner, Hemingray, on a quality-of-product basis. Much of the equipment included insulator molds used at other plants.

So, Lynchburg boasted a new plant, seasoned managers, proven-successful designs, tested equipment, and continuing strong demand...most managers would agree that production was a low-risk concern. Furthermore, the Lynchburg slogan was "Supreme Where Quality Counts."

A quality product seemed a "sure thing."

However, the initial euphoria departed early, as it often does in complex projects. Although Lynchburg scaled up to producing some 150,000 insulators each week in just 12 weeks, representing 14 styles of insulators, no profit was produced.

By the middle of March 1924, the company was in trouble. Production was halted the first week of April after only 16 weeks of operation [like today, reorganization seemed to be the answer], after which production resumed in November 1924. However, there were still problems with glass quality, resulting in a large number of rejects, which pushed production costs higher.

At this point, if this was a DoD contract, we would undoubtedly initiate a bottoms-up review. But such studies, though they may unveil problems, hold little chance of recovering lost ground, particularly in a competitive commercial environment.

Lynchburg was unable to identify, let alone remedy the problems, despite the advantages of a simple product, made with simple materials, in a mature industry, with experienced managers. The plant closed forever in May 1925, after only 44 active weeks of production. The plant was eventually demolished.

What had gone wrong?

Only then, during the demolition, was it discovered that a valve in a gas line feeding the main furnaces had been improperly installed in an inaccessible place and was partially closed. This had caused low gas pressure resulting in improper heating of the glass in the furnaces. The Lynchburg plant had been doomed to failure the day it was built![6]

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Consider the product you are attempting to bring to the DoD. It's probably more complex than a glass insulator, and almost assuredly, a lot more expensive. Your career rests on its cost, performance, and delivery schedule. A vastly complex system has to operate smoothly just to define the requirement, make the item, and give it the requisite quality and affordability. Why should you be sure that when development and testing are done, your problems are over?

Consider also those slick presentations on the advanced hardware systems now available for your system. Have you looked beyond the hardware itself to determine when it can be built, how long it will take to do so, and whether the contractors can deliver a quality product on time? You may find manufacturing and production are unproved steps, and their risk is unknown.You can't rely on negative incentives such as "liquidated damages clauses" to assure manufacturing readiness. The utility of a positive incentive in assuring production readiness is equally low if the contractor's manufacturing capability is fundamentally unsound, or if processes are unproved and therefore potentially high-risk.

Bring Out the Checklist of Questions

If you can answer these questions, prior to production, with a firm basis for your answers, you've got a chance to avoid unpleasant surprises.

Q
Are you sure that materials are available? Are you confident in the reliability of their sources?

Q
Are the manufacturing processes proven? By the current contractor?

Q
Are the manufacturing facilities proven? With your program's processes?

Q
Did production readiness reviews assure you the contractor is ready to scale-up to full-rate production?

Q
Is slack time built in to allow for startup problems (regardless of your confidence)?

Why should your customer tolerate your ignorance in these areas? You might argue that asking these questions at Lynchburg wouldn't have ensured success. Indeed, you can't fix everything. But a small-scale initial production run to prove the process and facility, with proper monitoring, would have revealed the temperature profile problem. Surely a pressure gauge on the gas lines would have pinpointed the source of the temperature problems through poorly regulated gas.

Lynchburg's facilities had not been proven; instead, having committed to full-rate production concurrently with plant startup, there was no chance to effectively react. There was also no time to decide on a strategy to fix the problem.

Experienced Program Managers Think Ahead

Next time you're assured of the readiness of a product to be fielded quickly – off the shelf – think beyond the glossy brochure you're presented. Ask some of those questions posed earlier in this article. It won't take long to discover whether that product is really ready to go in production quantities, or just another terrific concept awaiting someone else to work through the manufacturing problems.

- Build in slack time whenever you can. Many schedules start out as notions and end up unalterable, so give your project the most "time insurance" your customer can live with.

- Ask for more than assurances: ask for evidence of production readiness. If this means a pilot or low-rate production run, ensure one is programmed.

- Don't expect that "sanctions" (or incentives) will overcome poor planning.

- If Lynchburg had this problem despite all their advantages in producing a low-tech product, what risks do you face?

Your program's manufacturing challenges – known and unknown – are like icebergs. Don't try to insulate yourself from icebergs – instead, turn up the heat – ask the smart questions early.

References

1. McDougald, John and Carol, *Insulators – A History and Guide to North American Glass Pintype Insulators*, Vol. 1., 1990, p. 2.
2. Ibid., p. 7.
3. McDougald, John and Carol, *Insulators – A History and Guide to North American Glass Pintype Insulators*, Vol. 2, 1990, p. 217.
4. McDougald, Vol. 1, p. 24.
5. Ibid., pp. 24-25.
6. Ibid., pp. 116-119.

Former Vice President Receives William J. Perry Award

Photo by Richard Mattox

Dan Quayle, 44th Vice President of the United States, is the second recipient of the William J. Perry Award. Sponsored by the Precision Strike Association (PSA), the association presented Quayle the award on Jan. 15 at its Winter Roundtable, held at the Crystal Forum in Arlington, Va. Presented annually, the William J. Perry award recognizes leadership or technical achievement that results in significant contributions to the development, introduction, or support of precision strike systems. Pictured from left: Bill Egen, Vice Chairman, PSA and Boeing Company; Quayle; Dr. Paul G. Kaminski, former Under Secretary of Defense (Acquisition and Technology), and current President, Technovation; Retired Navy Rear Adm. Walter M. Locke, former Director, Joint Cruise Missiles Program Office, and former Chairman, PSA.