Innovation in Defense and Aerospace – Why is this so hard?

By Ken Krieg

Note to readers – While this paper draws largely on U.S. defense examples for convenience, I contend the problems have parallels in other governments and in commercial aviation

Why we need to innovate in defense and aerospace?

Dramatic shifts in customer needs and demand.

In defense, nature of warfare and conflict resolution is changing; nature of the current and potential adversaries and how they will and do fight is shifting rapidly. Governments are asking for more, but likely have less to spend on it.

In commercial, assuming that global economies recover at some point, nature of commercial and private flight is changing; more people, quicker turns, more crowded airspace; more convenience; longer, faster. Airlines are asking for more, but likely to have less to spend on it.

In addition, pressures from external influencers to reduce footprint of defense and aerospace through much less energy consumption – in defense for operational and logistical reasons; in commercial for cost; in both for carbon footprint reduction.

At the same time, program complexity and cost have been increasing, especially in defense but arguably also in commercial. Problems of physical limits given knowledge today versus desire have led to some advances at great cost especially in defense. As programs have grown in complexity, cycle times have lengthened significantly.

In the face of that, some frustration growing on the part of governments (more) and shareholders (some) for the length of time and the challenges in developing programs (that bundle a number of innovations).

And, consequently as scale has grown, fewer prime integrators in competition globally leading to both an odd dynamic of a mixing of shareholder and national interests in ways many other markets have avoided and different incentive structures for innovation than in other markets.

What is in it for companies to innovate?

"An established company which, in an age demanding innovation, is not able to innovate, is doomed to decline and extinction."
-- Peter Drucker

Innovation done well leads to business growth, profitability, improved market position, attractiveness to new talent in the competition for human capital. It provides an engine for sustaining and regenerating a company and a market.

Tom Peters captured this thinking more than 20 years ago in his book, "In Search of Excellence." Peters eschewed the notion of complicated processes in favor of simplicity, and for nurturing ideas and creativity versus attempting to bound innovation by a defined approach that would win praise from a Six Sigma Black Belt. Similarly, W. Chan Kim and Renee Mauborgne, in a Harvard Business Review piece in the mid 1990s, noted that "less successful companies took a conventional approach: their strategic thinking was dominated by the idea of staying ahead of the competition.

"In stark contrast," they wrote, "the high-growth companies paid little attention to matching or beating their rivals … they sought to make their competitors irrelevant through a strategic logic we call value innovation."

Companies that invest in process innovation are competing with others to reach a benchmark. Companies that seek innovation to create new opportunities, new products, new … are investing in organic growth and a future. Unfortunately the timeline between a decision to invest and reinvest tends to be far distanced from its results as expressed in revenue growth. This was calibrated in a study from the Northern Ireland Economic Research Centre, which noted that in general German firms focused on productivity innovation while U.K. and Irish firms adopted more innovative behavior that led to growth in productivity simultaneously with growth in employment or meaningful work. The study's author, Stephen Roper, contended that while the German approach was less risky, the U.K. and Irish approach led to a more far-reaching and wider technological growth pattern.

Then why is so hard to innovate in defense and aerospace?

1. Scale, maturity, complexity – mega programs.

2. Governments and Airlines are not the most innovative buyers. Not easy to bring new ideas to the table. Who funds them? What kind of scale is necessary for a return on investment? What contract vehicle does the government use to buy?

3. Innovation is highly competitive in an open market (e.g., consumer electronics over the last 20 plus years). And while real innovation is – at its heart – an attempt to render the competition obsolete (at least for now), it is countered over time by other competitors in a healthy and vibrant market (on cost or on competitive innovation).

Not clear that defense is a healthy and vibrant market as defined by classic definition of highly competitive, open markets. How does one innovate in a mature, semi-regulated, capital intense market? And is it even possible?

You see substantial innovation in segments of the defense industry where cycle times are shorter, project complexity is lower, multiple players exist or barriers to entry are more limited – sensors and small unmanned air vehicles as two examples.

4. Bundle too many desires in the next major program that will launch (eventually). The resulting programs have faced significant integration and complexity risk.

5. Finally, at the same time, at least in governments, we have built regulatory and process structures that do not always incentivize innovation – limit profit potential, IR&D approaches, etc.

Might it be that by how buyers buy and the heroic scale of today's programs – commercial (380 and 787), defense (FCS, JSF, Space Radar), we have ended up constraining innovation in the sector? Or is this just the rational outcome of a matured industry?

So how should we think about innovation then?

The chart below tries to picture innovation from the strategic perspective. It juxtaposes a suppliers use of continuous innovations (block upgrades, multiple variants) and the more discontinuous innovation caused by invention with the consumers viewpoint of the degree to which that need has been articulated or fully understood. Like all two-by-two matrices, it simplifies the world at some risk. But it is designed to help one think about strategy, culture and innovation simultaneously.

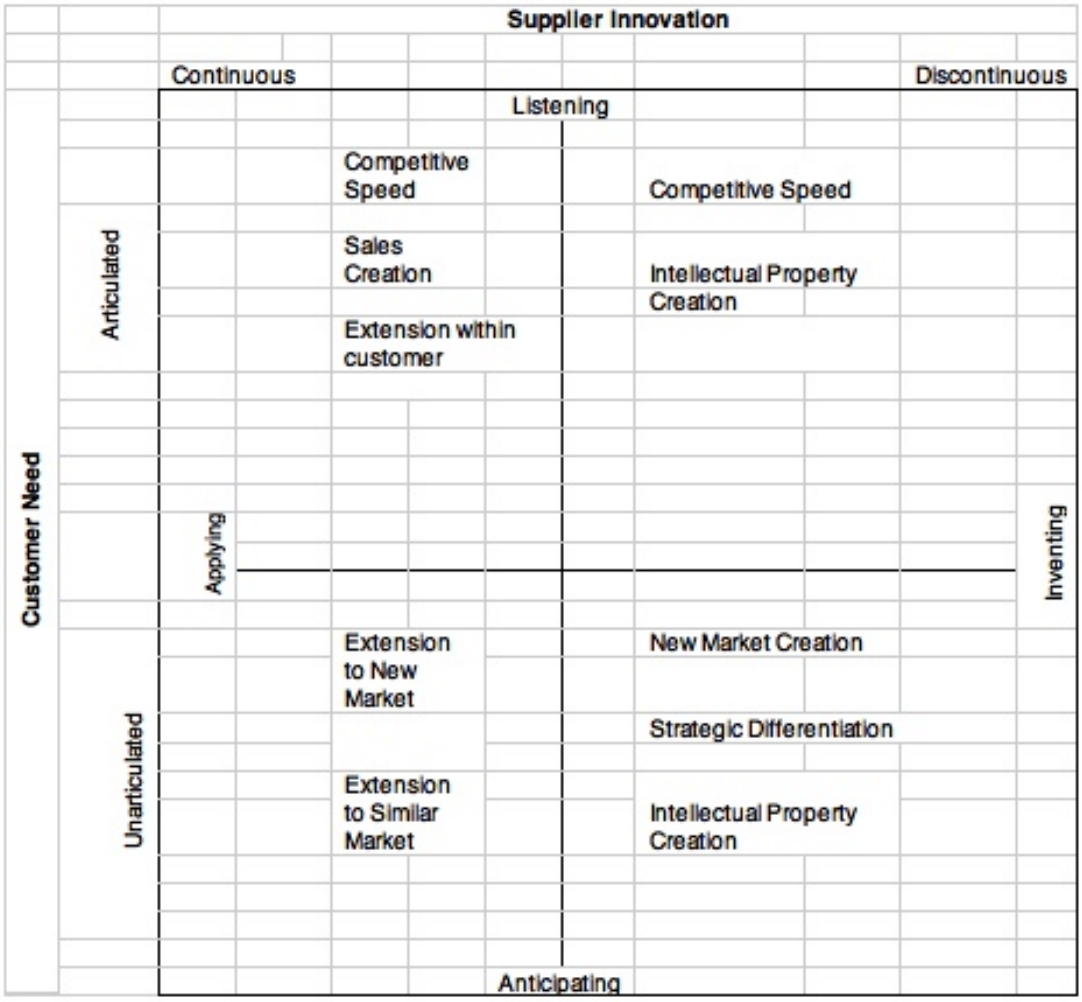
In defense, we seem to spend a lot of time and program-related dollars on customer articulated needs (the primary way the government knows how to buy) with sustaining programs operating in the continuous supplier innovation and big, new programs often falling "well to the right" in the discontinuous supplier innovation box.

Too often, at least in government programs, the government fully articulates the need in such a way that it requires multiple discontinuous inventions, without always being willing to admit how much that might cost and then wonders why the resulting process is so hard.

Struck by the US Government and industry satellite decisions on the late 90's and early 00's. Given limited funds and aging satellites, government bundled many needs into a few satellite programs. Significant reaches in technology and design; often bundled a number of innovations (and sensor developments) in the same package; changed traditional responsibilities significantly; and, in a number of cases awarded the contract to the lowest price bidder who was not the incumbent in the technology. Results speak for themselves.

A number of very good innovations did come from the lower right hand quadrant (DARPA and ACTDs spend much of their time in that space). The challenge there may be one of transition from idea to prototype to program. The "valley of death" in innovation is a problem in all industries; it is particularly challenging in DoD when one considers how dominant defined programs are in the requirements, resources, acquisition processes.

Also struck by the notion that we placed a lot of programs in the US DoD in one time period in this upper right hand box when we were just coming off a low point in industry spending, hiring, etc; when the industry was very busy consolidating and working through business processes, etc. without understanding the systemic risk to the overall portfolio that those individual decisions summed to. (On that last thought, hindsight is always 20-20 and I suggest it, not as a criticism but as a suggestion for improvement going forward.)



A recent Aviation Roundtable of government and industry professionals explored this challenge of innovation in defense and aerospace and concluded that more could be done to foster an environment conducive to innovation – and in particular, what the suppliers could do to improve their performance.

The group concluded that

Innovation is a standard element of their organization's value streams.

Participants identified " stages" to innovation: initial idea, apply idea, test idea, sell the idea, build the idea, and support the idea.

However, they refrained from identifying a solid process at stage zero on the basis that it needs to be as free form as possible at this stage to assure maximum results. Overall, stage zero innovation should be based on a loose regimen with pre-set and defined decisions points to secure additional support, personnel, tooling or funding.

They agreed that

- Standard business practices should be tailored to encourage innovation.
- Compensation did matter
- Aggregation of ideas or knowledge management was key within companies
- Risk assessment, understanding and acceptance (management)
- Acceptance of failure was important in big reaches
- Mentoring for future innovation leaders was necessary.

They also agreed that some culture and competency conditions were necessary

- Senior leaders' competencies for fostering innovation:
    - Trust and acceptance that failure is acceptable part of innovation;
    - Ability to attract, retain and develop key talent;
    - Ability to anticipate customer need;
    - Ability to identify and apply resources to innovate solutions
    - Ability to execute innovation
    - Ability to set and communicate a vision relative to innovation as a value.
- Program Management competencies for innovation:
    - Ability to align innovation/ideas with program requirements for today and future;
    - Identification and applying resources for opportunities;
    - Identify and manage risks; and
    - Bridge current program with future vision for the organization and the customer value stream.
- Engineering management competencies for innovation:
    - Ability to align innovation to overall business value and strategy
    - Create a culture that accepts failure in an environment that values innovation
    - establish organizational "ethos" that is adaptable, flexible, creative, passionate and patient.

<u>So What Should Change to Facilitate Innovation in Defense and Aerospace?</u>

If the theses are valid, then shifting the outcome will require changes in both customers and suppliers.

For example, both customers and suppliers should think about how they value and incent innovation. Is innovation a program based activity or more independent? If it is more independent, how do you then translate it back to programs (cross the "valley of death")?

Do we innovate in too many areas or place too many bets in one program? Or can we improve our capacity to manage high-complexity programs? And, if we can, do we want to better understand and manage the portfolio of innovation we are trying to accomplish?

Do the processes in both government and industry support innovation to outcome or not? If not, how should they change?

Are we attracting the talent to the industry and the government that we need to innovate in the future?

These questions are far from exhaustive, but they frame some areas that might be worthwhile for examination.