# CRA Insights:
## Aerospace & Defense

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## The Power of the Network: How A&D Companies Can Organize to Stimulate Innovation

*The second issue in a series about innovation in aerospace and defense*

Our recent study of innovation, performed in collaboration with *Aviation Week & Space Technology*, was inspired by a range of circumstances that have contributed to a perception that innovation in this industry is in a state of crisis.[1]

Our research confirmed some of these circumstances but also gave us a new perspective on others. Overall, our findings suggest that innovation in aerospace and defense is not, in fact, in crisis. Rather, it is being transformed. This transformation, driven by fundamental changes in the underlying market and business landscape, is taking place along several dimensions—in how innovation creates value, how innovation is financed, how it is enabled by a robust human resource and talent base, and how it is sustained and stimulated by organizational structures.

In this article, we focus on what we learned from the study about how distinct organizational forms may catalyze innovation in aerospace and defense companies. Our findings culminate in two key observations about how the most innovative aerospace and defense companies organize for success: their organizations are comprehensive in their vision of innovation and balanced in the functions they comprise. What turns out to be distinctive about how successful companies organize for innovation is the critically important role of a coordinating mechanism—a network—that links and aligns both internal and external sources of innovation and provides the company with crucial future growth options that protect its business model from blind-siding disruptions.

### Successful organizations take a holistic view of innovation.

What do we mean by holistic? A holistic approach recognizes that innovation does not end with a technology demonstration or a prototype development. Rather, innovation extends well into and through tooling and industrialization, marketing, manufacturing, and operations. Equally, innovation does not begin with technology development aimed at a specific and quantified market opportunity, but rather it is founded on conceptualization, basic research, and fundamental scientific inquiry. Lockheed Martin's legendary Skunk Works, a design and development bureau known for its first-of-a-kind aircraft—from the

[1] Our findings, which contributed to Aviation Week's reporting, are documented in a white paper entitled Innovation in Aerospace and Defense. The full contents of the paper can be accessed here.

U-2 to the SR-71 to the F-117—was organized around the entire innovation lifecycle. It combined a science laboratory, development and prototype shop, manufacturing and assembly line, and a customer support organization. More generally, while it is not necessary, and often inefficient or impossible, to create an organization that spans the entire innovation lifecycle like Skunk Works, it is just such a holistic view of innovation that allows the innovative company to plan in explicit terms how it can address and engage each stage of the innovation lifecycle. This engagement may be realized, for example, through a centralized organizational structure; through distributed, subordinated functions; or through links, direct or indirect, with external entities such as academia, customers, suppliers, and other industry partners. However realized, successful aerospace and defense firms hold a vision for innovation that comprehends the full lifecycle of technology development and business model deployment.

## Successful organizations balance the key functions necessary to innovate.

What do we mean by balance? A balanced approach integrates the three competing imperatives that must be managed and traded off in any organizational form: hierarchical control, individual autonomy, and spontaneous cooperation.[2] A tension among these three imperatives as they bear on innovation is a characteristic feature of nearly all the aerospace and defense companies we interviewed. So, a balanced approach devotes resources and top-down strategic direction to early-stage technology research ("control") while also providing operating business units with a tangible connection and input channels by which they can influence and contribute to the innovation agenda ("autonomy"). At the same time, the "cooperation" mode stimulates creativity through the interaction of individuals and groups working in collaborative teams.

To implement this balanced approach in the real world of aerospace and defense, effective innovating organizations are carefully designed around the three functions of control, autonomy, and cooperation. While the detailed implementation of these elements varies in different organizations, the defining characteristics remain the same:

1. A "centralized" element, which shapes innovation activity from the top down, according to a direction set by a central entity, such as a central R&D laboratory or a technology strategy team led by the Chief Technology Officer. The control function is necessary to ensure that innovation initiatives are moving the company along a particular long-term path of evolution that is consistent with the context of a corporate vision broader than day-to-day operations. For instance, at BAE Systems, this function is exercised by the Strategic Capability Solutions group, which employs over 100 corporate-level staff to target both transformational technologies and business capabilities in the "white space" not covered by business-unit-level innovation.

2. A "distributed" element, which shapes innovation activity from the bottom up, according to directions set by individuals or operating groups, such as business unit-level development organizations, which focus their innovations on today's core markets and core customers. Without it, the company is at risk of gradual, but accelerating, deterioration of near-term competitiveness in its core business. At EADS, for instance, each of the company's divisions includes robust integral research, technology, and development teams that focus on prototyping, demonstrating, and engineering new or improved products for serial production.

3. A "networked" element, which shapes innovation activity across the organization, according to indications that arise from internal and external connections, both across multiple instances of the distributed elements as well as between the distributed and centralized elements. By stimulating cooperation and collaboration, the networked element ensures that the distributed elements do not result in projects that are idiosyncratic and that the centralized element does not promote projects that are irrelevant to the market. As importantly, the networked element facilitates formal links to academia, industrial partners, and other external sources of innovation. For instance, MBDA employs its Technology Network to establish connections, for each of several discrete technology areas, among a broad range of stakeholders, including internal technical experts from multiple divisions, universities, research laboratories, small and medium enterprises, and other suppliers, to stimulate innovation in missile systems.

[2] Keidel, Robert W. Seeing Organizational Patterns: *A New Theory and Language of Organizational Design*. San Francisco: Berrett-Koehler Publishers, 1995.

## The network is the most important element of A&D innovation organizations today.

The head of an innovation group in one company we surveyed remarked simply that "innovation is all about networking." After all, the discipline of systems engineering, familiar to most aerospace enterprises, is itself a structured and formalized approach to networking within the context of a particular system. Taken more broadly, networking is about disseminating and "socializing" information between and among relevant stakeholders, whether they are within the specific group working on a project; the larger organization to which the group belongs; the company as a whole; or the company's suppliers, partners, and academic stakeholders. Done indiscriminately, the dissemination and exchange of information through networks is as likely to waste time or even compromise competitively significant data as it is to create value. However, applied deliberately, in accordance with a predefined technology strategy, networking accelerates and improves the innovation process.

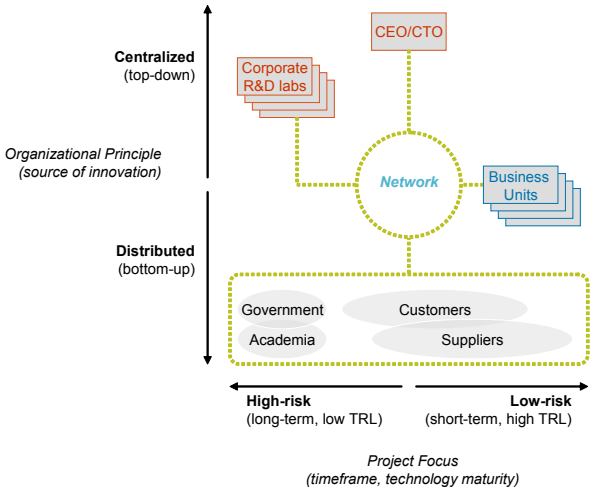
The network institutionalizes connections both within the enterprise and across its boundaries. As illustrated in Figure 1, it harnesses, coordinates, and balances multiple sources of innovation, both internal and external, to a company. The sharper the definition of that network's structure and of its operating practices, and the stronger the links it creates between internal and external resources, the more value the company is likely to derive from its innovation processes. While the manifestation in aerospace and defense companies of this innovation network varies widely, its importance is widely acknowledged. Its key principles can be observed, for example, in the operation of the Global Innovation Networks at EADS, the Key Technology Domains at Thales, the Technology Network at MBDA, and the Capability Augmentation Program at BAE Systems.

## What lessons should companies draw about networks in innovation organizations?

**First, the network must open a link to the outside world.**

As one of the executives we interviewed described it, "we are living in an age of distributed intelligence," today more than ever. The magnitude and accessibility of information available to laypersons, technical researchers, business developers, and customers has grown dramatically over the past several decades. Just as in the information technology revolution, as well as in the evolution of defense platforms into network-centric systems, so is the innovation process being altered by the dramatically expanded range and depth of global information flow. For forward-thinking companies, this dynamic has prompted an adjustment of the organization to access information and innovative ideas literally from around the world in a process described by Harvard's Henry Chesbrough as "open innovation."[3] Whether by improving internal knowledge-sharing networks; by taking advantage of information systems; or sometimes also by physically establishing offices, centers, laboratories, or university partnerships worldwide, such investments have been made by a range of aerospace and defense companies from United Technologies' Pratt & Whitney to General Electric, Boeing to EADS, and Cobham to BAE Systems.

Figure 1. Role of the network in an innovation organization




**Second, the network should be used to defend against disruptive innovations.**

The network can help to prevent a company from being blindsided by a disruptive new technology of the kind famously documented by Clayton Christensen.[4] As Christensen convincingly documents, while a company's resources are properly focused in its core business and core customers, an innovation may appear which, while not in direct competition with the company, instead targets a niche market that is competitively insignificant by size and oriented on features other than those of primary importance to the

[3] Chesbrough, Henry W. *Open Innovation: The New Imperative for Creating and Profiting from Technology*. Harvard Business Press, 2003.
[4] Christensen, Clayton M. *The Innovator's Dilemma*. Harvard Business School Press, 1997.

core market. However, as the new technology evolves, it may come to challenge the incumbent's offering, having "caught up" to the originally significant product attributes while retaining the superior "secondary" attributes that had allowed it to grow in a niche market in the first place. Such a challenge does not happen routinely and is rarely easy to foresee, but when it does occur, it can fundamentally change the market landscape. We can certainly observe this competitive dynamic playing out in aerospace and defense. Consider the now-familiar example of a UAV: the combination of a basic remotely-piloted aircraft platform with GPS, EO/IR sensors, datalink capability, and precision-guided anti-tank missiles—none of which were revolutionary as an individual technology—created a transformative military capability in General Atomics's Predator UAV family. Similarly, the combination of the Internet with digital command and control networks and hacking algorithms is creating a new front of cyber warfare in both military and not strictly military—as illustrated by Google's recent standoff with China—operations. While neither of these examples occurred overnight, they both represent unexpected business model evolutions that created entirely new market segments through a recombination of extant technologies and capabilities. Indeed, this evolution of difficult-to-predict disruptive technologies is accelerating. The age of distributed intelligence is creating an environment of incubation for disruptive innovations worldwide, as any given technology now faces multiple potential development paths and myriad possibilities for recombination with other technologies or value delivery mechanisms. Consequently, a company that works without an external network, striving to innovate solely through incremental improvements to its existing offerings for its existing customers, risks a dramatic and unexpected loss from a disruptive technology development.

**Third, the innovation network should be viewed as a way to buy options and insurance.**

Real innovation combines an invention with a value-creation mechanism or business model. Without innovation, firms risk losing their ability to compete, while a company whose organization stimulates and sustains innovation is developing options for future growth beyond its core. Furthermore, the innovative company also is paying premiums on an insurance policy against disruptions to its business model—that is, disruptive innovations that can redefine the market in which it operates rendering its core business obsolete. Such an insurance policy is realized generally by continued investments in the development and testing of new ideas, but it is particularly strengthened by collaboration and networking. Short of staffing the innovation organization with prophets, the aerospace and defense enterprise's best defense against the risk of its products or business model being rendered obsolete is to develop an organization with a strong network of open innovation, which maintains the firm's situational awareness of evolving technologies and business models both near and far from its core business. Employed in this way, networking is critical to providing a company with strategic resilience: the ability to identify and anticipate changes brought about by innovation, internal and external, as well as the capacity to absorb those changes into its business model by building them into growth options. The purpose of these growth options, and the value of organizing for innovation, is not to reset the company's direction, but to preserve for it the freedom of making direction-changing choices in the future.

## About Innovation in Aerospace & Defense

CRA has partnered with *Aviation Week & Space Technology* to explore the critical issue of innovation in today's A&D industry. This newsletter is a digest of a **chapter** in CRA's White Paper *Innovation in Aerospace & Defense*, which is described in more detail in Aviation Week's October 26, 2009, special double issue on innovation and available on the Aviation Week website. For a copy of the full paper, **click here**.

## About CRA

Aerospace and defense consulting at CRA combines deep industry knowledge, rigorous analytics, and trusted objectivity to guide executive decisions about critical strategic choices. Our consultants provide broad perspective and thorough understanding of the complex strategic landscape in which aerospace and defense firms operate, based on experience drawn from leading aerospace and defense companies, financial institutions, government agencies, and prior service in the Armed Forces. To learn more, please visit **www.crai.com/aerospace**.