Managing A&D engineering talent

Creating a competitive advantage through the workforce
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The decade-long growth cycle in defense spending that began in 2001 is over, and top-down budget pressures are shifting focus to affordability in order to meet shifting priorities. Defense spending will continue to decline in coming years, with an expected 40 percent drop in the investment accounts (procurement and research, development, testing, and evaluation) from the 2008 peak. In this environment, executives face the challenge of how to create shareholder value while minimizing financial, market position, and day-to-day operational risk.

The aerospace and defense (A&D) engineering workforce is a major element in this challenge. Most A&D programs now are in either the production or sustainment phase, with requirements that can be handled by engineering staffs that are smaller and, in some cases, have less experience. The reductions in investment portend a decline in the number of major new development programs. Further, much of the procurement infrastructure was built for the Cold War, and little has been done to address the weight of requirements and redundancies that accumulated over time, resulting in excessive processes and procedures, and incrementally more labor hours. Additionally, the nature of the work is changing — less new development and longer sustainment tails require different (and less) engineering effort. As a result, many aerospace and defense executives are realizing that they have more engineers, and a different mix, than they need. This leads to program budget overruns, overengineered products (a result of legacy customer and supplier incentives), and excessive engineering changes. The defense industry also faces challenges in recruiting and retaining junior talent. Promising young engineers who used to flock to the sector now perceive more interesting opportunities and career development potential in other industries, creating a potential gap in the workforce.

Addressing these challenges requires making difficult choices around core capabilities and undergoing a comprehensive transformation that addresses all workforce areas within A&D firms — the “what,” “who,” “how,” and “how well” of work — along with a continuous mind-set to ensure that these changes take root. It is not an easy undertaking, but firms that can successfully revamp their workforce will be better able to develop and deliver the products that meet customer needs, and attract the talent they need to succeed in the long term.
Engineering has always been the critical capability in aerospace and defense. At the height of the Cold War and when Americans were landing on the moon, no function was more important in A&D than engineering. To be a rocket scientist has a broader cultural meaning now, but it started in the 1960s, ’70s, and ’80s as a literal description of an occupation with an unrivaled status among engineers.

Engineering remains the most critical capability in the defense industry, but the nature of that work is changing — a result of altered threats, reduced government spending, legacy incentives, and the natural life cycle of programs. Today, the defense industry employs more engineers than it needs. In fact, the number of aerospace engineers in the U.S. did not dramatically change between 1999 and 2010 — even as total employment in the industry declined 12 percent over the same period. Moreover, many of the engineers are more capable than their current work requires. The result is a mismatch between the engineering skill sets that exist and A&D companies’ business and technical requirements.

The path to addressing these problems begins with defense leaders (customer and contractor) who understand the primary trends affecting the engineering function in the industry — including the decline in new product and new systems development, and the shift toward production and sustainment programs. These leaders need to develop new strategies for maintaining their critical engineering capabilities, especially now that A&D no longer exerts the pull it once did on new engineering graduates.
Three engineering workforce challenges

A&D executives face three primary challenges regarding workforce size and composition:

1. Determining the “right” number of engineers
2. Developing the engineering capabilities needed for future competitiveness
3. Attracting and retaining talent

1. Determining the “right” number of engineers. The optimal number of engineers and the mix of capabilities they should have are not static. Instead, they should evolve with a company’s product portfolio and program life cycles. Traditionally, large development programs in A&D have created a relatively steady demand for engineers: As one program ended, a new one began. As a result, a sufficient base existed to absorb the engineering capability, and new engineers could “cut their teeth” sufficiently. In today’s environment, however, there are few large development programs, and sustainment or evolution programs tend to require fewer engineers and different capabilities (see Exhibit 1).

Exhibit 1
New aircraft programs are increasingly rare

Source: Strategy& analysis
Legacy incentive systems, which often rely on continually enhancing the product, can lead to an increased number of engineering hours, and they have outcomes that are difficult to measure (intentionally or otherwise). Given the changing work requirements, many A&D companies are saddled with too many engineers and a mismatch between their capabilities and the nature of the work. Unless workforce capacity is explicitly measured and adjusted based on market-back needs, the engineering staff (i.e., supply) will not be aligned with the workload (i.e., demand). Additionally, the defense industry typically relies on a model in which continuous improvement and product enhancement are supported by both customers and contractors. Although some level of continuous improvement is desirable, excessive design changes can increase cost (even for mature programs), impact schedules, and inject instability throughout production and the supply chain.

2. Developing the engineering capabilities needed for future competitiveness. The landscape in A&D is evolving, which has significant implications for the industry’s engineering needs. Some of the biggest development programs are transitioning into production, and other programs will likely have longer sustainment cycles than originally planned. At the same time, budget pressures are curtailing customers’ ability to fund sustaining efforts with a high degree of product enhancement.

The development phase of a program requires different engineering skill sets, and typically a different number of engineers, than the production ramp-up and stable production phases (see Exhibit 2). As a result, we are
undergoing a shift of the underlying engineering capabilities required in A&D, with a greater emphasis on those related to affordability, production efficiency, and total life-cycle cost management. Capabilities that A&D firms will need to build include the following:

- Assessing system performance and analyzing standard subsystem specifications (using standard designs instead of those with unique requirements)
- Controlling change and assessing its value through incremental improvements, versus maintaining stable designs
- Working with “true requirements” versus legacy requirements and making decisions that result in more affordable products
- Managing a fragmented supply base, often with blurred lines of accountability

3. Attracting and retaining talent. A&D’s twin challenges of a mature engineering workforce (and impending substantial increase in attrition due to retirement) and intense competition for younger talent from other industries have been widely discussed. A focus only on the size of the engineering workforce masks a bigger challenge: a mismatch of skills. Exhibit 3 shows a common situation in A&D engineering departments today: an excess of highly experienced, often highly capable engineers, and a shortage of early- and mid-career talent. Additionally, the “hiring
“drought” in the 1990s is working its way through the system. During the downturn in the early 1990s, many junior engineers were downsized. Even after hiring resumed in the mid-1990s, talented engineers were lured away by technology firms. This decade-long drought is now impacting most aerospace companies. Coupled with the aging workforce, it creates sizable concerns regarding the next tier of leadership.

If not addressed, this kind of suboptimal capability mix can lead to a self-perpetuating cycle of mismatched resources and needs. The problem of having a workforce that is overly capable, and has a potential talent gap in the number of employees with 15 to 20 years of experience, is exacerbated by external market forces. Nowadays, many top-tier newly minted engineers head for other industries (such as consumer products or technology), which they perceive as offering more interesting and more creative work, better opportunities for career growth, and often higher compensation. Because of the difficulty of recruiting top talent from universities, it has become harder for A&D companies to ensure they have the right talent at the right levels of their organizations to successfully compete in the future.
Steps to better align the engineering workforce with external needs

As the A&D industry continues to evolve, companies must also evolve. However, undertaking a large engineering transformation, while maintaining critical skills and technical performance, is a challenge. To avoid a potentially dangerous across-the-board approach to cost reduction, companies must consider the full range of transformation actions available, including “what,” “who,” “how,” and “how well” (see Exhibit 4).

**What:** Optimize product designs and collaborate with customers to offer cost-effective solutions that meet their requirements. Product complexity is typically the most difficult aspect to address, yet it can have the largest impact on affordability. Savings primarily come through production and sustainment costs — but if implemented at the right time, design simplification or standardization can also result in lower engineering development costs. The market is shifting away from exquisite customized systems to more product-focused or product-line-focused solutions, which are often derived from existing designs that result in a solution that is good enough to meet...
requirements, and more affordable. In addition, given that customers feel the growing pressure to buy affordable systems, now is the time for contractors to work jointly with their customers to determine appropriate opportunities to relax the requirements themselves, enabling a less expensive development program.

**Who:** Design an operating model that maximizes scale and enables productivity. Addressing product complexity is effective during the design phase, but for more mature programs, contractors must use other tactics. Independent of the product life-cycle phase, they can often gain significant efficiencies by evolving a company’s engineering operating model — the structure and decision rights associated with how engineers are managed and deployed. The challenge here is finding the right balance between enabling scale by pooling resources, and maintaining the organizational agility associated with more localized or program-level control. This is not a one-size-fits-all answer; different models apply based on function, critical capabilities, product, and other factors. In any model, though, the foundation should be a robust, market-based supply-and-demand planning capability — not just by discipline, but also by skill level.

**How:** Segment work by complexity and implement lean engineering processes. Another approach to improving engineering productivity involves implementing lean concepts, which are already familiar in many manufacturing settings but have not been widely applied to engineering. Not all aspects of lean that work in factories will apply to the engineering environment, but many do. A simple but often overlooked quick win is measuring engineering “yield” (meaning first-time quality) and reusing engineering designs. Other examples that have been proven to work include work-cell prioritization, “pull systems” (which prevent work from being done until there is a formal request), and complexity segmentation. In this last approach, routine or repeatable work (e.g., basic CAD) is separated from the more specialized, expertise-based tasks (e.g., aerodynamic design). This “engineering factory” approach offers several advantages. For example, it facilitates virtual teams executing standard work products or processes, and enables companies to apply a virtual and variable workforce model, allowing expansion and contraction to manage workload variation.

**How well:** Minimize lower-value-add activities, allowing engineers to focus on core engineering. A&D companies can also improve productivity by increasing the amount of time that engineers spend on activities that really matter. We consistently find that most engineers spend less than half of their time on core engineering activities. The rest of their time is devoted to tasks such as attending meetings, preparing briefings, and updating documentation. Although some level of noncore tasks is inevitable, there are often ways to reduce the impact, enabling engineers to focus more on engineering work. This can also be a symptom of a broader mismatch of workforce supply and demand. Though many productivity improvements do not require addressing the operating model, a broader look at workforce planning and structure can often facilitate or enable more tactical improvements.
Conclusion

Workforce productivity is an inherently difficult undertaking, especially for a critical function such as engineering. Recognizing the issue and implementing changes are only the first steps. Once changes have been made, it is just as critical to overcome institutional inertia and establish a process to ensure that the organization does not revert to flawed ways of working. In this environment, companies must create a better value proposition for talent, and instill a culture of performance management. Companies that effectively pursue and maintain transformation will be able to create a competitive advantage with respect to engineering talent — not just in developing more affordable products in the near term, but also by creating a model that can successfully attract and retain required talent over the longer term.
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