

It's been an eventful year. As is our custom at Booz & Company, we take a few moments at this time of year to reflect upon the future and how it might affect the aerospace and defense industry. It is also our custom to share these views openly with our clients and others in industry, in the hope that it contributes to an effective dialogue around the issues of importance to us all.

As the financial storm gathered strength in 2008 and began to afflict the broad economy, leaders across many industries hurriedly battened down the hatches. Some of these embattled executives may look with envy upon the aerospace and defense (A&D) industry, with its backlog of work built up over this decade and the near-term promise of stable, fairly robust profits.

While the industry's immediate prospects are indeed comforting, the long-term outlook for our industry is sobering. We are quickly approaching the end of a long period of relatively smooth sailing in what remains a slow-growth, intensely competitive, and highly cyclical capital-goods business. Each of the industry's four major segments must steel itself for the next stage in the cycle.

Defense and Space: Given a new administration and new priorities in Washington, it's possible we'll see a replay of the 1992-94 era, when \$165 billion was cut from the five-year defense plan in one fell swoop, and four or five major defense programs were cancelled each year. By 2015, spending on investment accounts could fall by as much as 20 percent.

Commercial Aircraft: Most commercial aircraft producers are still busily working through large backlogs. But new orders have plummeted and cancellations are rising. There's also the danger of sudden shocks, inflicted either by humans (such as 9/11) or nature (such as avian flu).

General Aviation: These are anxious times for builders of business jets. This segment's strong growth has been driven by a new customer base — the high-net-worth individual. We do not know how demand will hold up for this segment in an economic decline.

Some business jet manufacturers have already scaled back plans to boost production.

First-Tier Suppliers: Makers of aircraft engines, electronic systems, and structural products are vulnerable to any demand fluctuations in the defense, commercial aircraft, and general aviation segments because they can't create primary demand. Some believe the services market will cushion first-tier suppliers from a decline in original equipment (OE) sales. However, that cushion may be less reliable than hoped. We believe the services market will undergo significant changes in the years ahead, a subject we will discuss later in this letter.

These circumstances raise two sets of questions for the A&D industry. One is fairly obvious; the other less so. The first is defensive in approach: How to manage through a downturn when demand slackens and pricing comes under intense pressure? Do you cut costs, for instance, or jettison less profitable lines of business? How do you cope with an investment community that is so suddenly risk-averse – no small concern for an industry built on taking big bets. These questions are not for the faint of heart. Nevertheless, many of them are typically asked during a downturn, and the industry has some experience addressing them.

The less obvious set of questions, which the industry has less experience answering, addresses how to play offense in a tough economic climate. What if weathering the storm weren't enough? What if executives sought to turn the downturn to their advantage?

To go on offense, executives need to focus on capabilities. Looking across their enterprise, they must ask themselves what capabilities they have or can acquire that will allow them to thrive in the downturn and position themselves for the next upturn. Long-term strategic commercial success depends on the selection, development, and exploitation of these market-driving capabilities, which we define as a distinctive combination of skills, tools, and processes. It's the kind of success measured in decades rather than years.

We have identified five business themes that will take center stage over the next five years. To succeed, A&D companies must develop capabilities around each theme.

1. Build a New Model for Program Risk Management
2. Adapt Business Models to the "New Demographics"

3. Reduce Addiction to the Hydrocarbon Supply Chain
4. Flip the Mission from Products to “Through-Life” Solutions
5. Scrutinize Defense Businesses in the Portfolio

Build a New Model for Program Risk Management

Widespread, well-publicized difficulties in the execution of major programs have plagued the A&D industry for the past decade. Large commercial aircraft, military spacecraft, naval surface combatants – none of these projects has been immune. Management errors, lack of self-discipline on the part of customers, computer IT integration problems, and shortages of skilled labor have all received blame. Each does play a role from time to time, yet even taken together they don’t fully explain the breadth and depth of the problem.

Outdated risk-management techniques, which have not evolved with the shifting structure of the A&D industry, are the root of the problem. In the old days, technically astute buyers worked closely with vertically integrated prime contractors; the lines of communication were direct and exchanges were frequent and so the two sides could easily identify and work through problems that arose and keep the project on track. Neither of these conditions – the astuteness of customers, nor the vertical integration of suppliers – exists to the same extent today.

On the customer side, the days are largely gone when airline management at a Lufthansa or United Airlines were filled with engineers who would delve deeply into the intricacies of new airliner requirements, technology choices, and program design. Even more apparent and lamented is the decline of technological expertise within the U.S. government at a time when the complexity of the task has risen, especially as we seek to develop “systems of systems.” The government has tried to make up for this deficit by hiring outside contractors, but these experts often have mixed motives and conflicts of interest. The propensity of customers, especially in the Department of Defense, to change specifications during the development process has long been a fact of life, but now customers often lack the capability to make their own internal trade-offs regarding cost, schedule, and technical risk.

Besides the diminishing expertise on the customer side, project snafus result from the business model implemented by many prime contractors and systems integrators. Rarely are these prime contractors as vertically integrated, with expertise close at hand, as they were two decades ago.

Instead, complicated systems are now being developed by complex networks of industry consortia, often spanning continents and sharing responsibility for cost controls, schedule maintenance, and risk management. The greater the complexity of a supplier network, the greater the incidence of large program failures. By comparison, Cessna in business aircraft and Electric Boat in submarines both still operate with high degrees of vertical integration and both continue to execute with great success.

This increased failure rate shouldn't be surprising. Ironically, the industry (with much consulting help) tore down the vertical walls between functional stovepipes in their own organizations in the 1990s, only to erect new barriers in the form of complex supplier networks. Worse, this diffuse network of suppliers is now responsible for project integration. Project management depends on clear, unbiased, and easily exchanged data on major integration issues and risks. That's become more difficult as the data must flow across different companies with different incentives. Exchange of simple data on risks, for example, can now result in prolonged contract disputes.

One way to address this problem would be for companies to revisit past decisions regarding vertical integration. But that may not be practical, or even wise from a broader financial perspective. Without recreating vertical structures, companies can institutionalize cost, schedule, and technology risk management to reduce the friction between organizations on large and complex programs. It's a tough nut to crack, but worth it. The supplier that solves this dilemma and builds a track record of excellent execution is sure to attract many weary customers.

Adapt Business Models to the "New Demographics"

Booz & Company analysis indicates that global GDP should increase more than threefold in the ensuing decades, from \$42 trillion in 2007 to \$139 trillion by 2050. Such a rising tide lifts all boats, but perhaps some boats more than others: Within this dramatic overall growth, emerging markets are forecast to increase their share of GDP from 26 percent to more than 60 percent, reaping an enormous dividend in absolute and relative wealth. The World Bank expects the middle-class population worldwide to grow from 400 million last year to 1.2 billion in 2020 – with all the purchasing power that represents.

These are the new demographics of the 21st century, and it's hardly a revolutionary observation that A&D market growth in the years ahead will come largely from emerging industrial giants such as Brazil, Russia, India, and China (BRIC). What is underappreciated is how much these emerging markets will upset the structure of the industry as we know it today. In many A&D segments, especially on the commercial side, a series of more-or-less comfortable duopolies has developed; each has a similar strategy for pricing, product lines, and supply chain, and each has generated returns commensurate with its cost of capital.

But what will happen when more competitors enter the picture, which is sure to happen as the BRIC nations evolve? Historically, in aerospace markets with three or four competitors, only the strongest earned its cost of capital. This could become especially problematic because some new entrants in places such as China are likely to pursue broad national agendas – such as establishing national prestige and lifting up the middle class – that are linked to, but extend beyond, pure economic motives.

How will pricing, product-line, and supply chain strategy evolve as more A&D companies enter the picture? Inevitably some new players will be partners in some instances, and competitors in others. How does a company engage in a supply chain strategy with a partner, and then disengage in instances when that same company is a competitor? Such deft adjustments are no mean feat.

Moreover, how can existing A&D players follow this migration to new markets? We argue that as the industry makeup changes, existing companies must alter their organizational “DNA” – the unique profile of a company determined by its decision rights, motivations, information flows, and structures – to become truly global companies. Instead of being a national (or in some cases, regional) business that competes globally, companies must become global companies that operate internationally. We've seen automotive and energy companies make this transition. In A&D, the situation is complicated by national concerns around export controls and security. But the journey must begin.

Reduce Addiction to the Hydrocarbon Supply Chain

Global warming concerns have moved from the scientific and environmental fringes to the top of the political and business agenda. This is a special concern to the A&D industry because transport in total contributes about 12 percent of total greenhouse gas emissions today, a

number that will climb as nations such as India and China grow. Consider that, on a per capita basis, India generates one-twentieth as much greenhouse gas from transportation today as does the United States.

Defense is also a major consumer of hydrocarbon products, especially in times of war. Each soldier deployed in Iraq and Afghanistan directly or indirectly consumes about 16 gallons of fuel per day. In fact, the U.S. Department of Defense is currently the largest purchaser of oil in the world, consuming more petroleum than the nation of Greece. Hydrocarbon dependence also drives U.S. defense budgets, with some estimates indicating that \$44 billion of the defense budget goes to securing energy supplies for the U.S. and its allies.

The A&D industry and its customers are not in denial about consumption and are considering two ways to reduce greenhouse gas emissions. The first is improving fuel efficiency for aircraft, ships, vehicles, and infrastructure. But while there have been impressive strides in fuel efficiency over the past five decades, it's getting hard to squeeze more efficiencies from the same technology platforms. Still, the economic incentives are compelling. Fuel prices account for 40 percent of airline operating costs, and with U.S. airlines likely to lose a total of \$5 billion this year, the benefits of greater efficiencies are clear. The U.S. Congress, for instance, is considering whether a new class of cruisers should be powered by nuclear or conventional means.

Adopting de-carbonized fuel is the other approach the industry is taking. Alternative fuels such as coal-to-liquid and gas-to-liquid offer the advantage of reducing dependence on vulnerable oil supplies; unfortunately they don't decouple the industry from the hydrocarbon supply chain and reduce its impact on global warming. Some consider algae-biomass a promising long-term candidate that could potentially integrate into the existing fuel infrastructure.

Change will likely come slowly, however, measured in decades rather than years. Aerospace and defense products are long-lived, with some product life-cycles approaching 100 years. What's unclear is how the industry will react if rising oil prices, coupled with carbon-based taxes (direct or indirect via cap-and-trade), make existing products economically obsolete well before they become functionally obsolete.

Although it's tempting to defer investment in hydrocarbon substitutes, especially when the price of oil has plummeted from around \$145 per barrel in the summer to less than \$60 per barrel by mid-November, we strongly counsel against delay. It's a worthy investment. Regulatory regimes are on the way that are sure to make hydrocarbons a costly way to do business in the future.

Flip the Mission from Products to "Through-Life" Solutions

For years the A&D industry has divided activity into OE sales and the "aftermarket." Ironically, many companies treat the aftermarket as an afterthought, shortchanging such business activities as customer support, spare parts, and overhaul services. For some companies, however – such as those that make aircraft engines and landing gear – a great portion of their total profits are derived from the aftermarket.

We believe one of the biggest challenges of the next 10 years will be to harmonize the business model of the OE industry with the services industry. The evolution to a true solutions-based business model is another example of an instance in which A&D companies must alter their DNA. Going forward, companies will need an integrated view of the life cycle of aerospace and defense products – which can extend for decades. Companies must also learn to optimize service and operating economies across the whole of the A&D platform – call it "through-life" integration – displacing the airline and government agency operators that have traditionally performed this role (and perhaps are least-well-equipped to do so).

A bit of good news is that other companies – IBM comes to mind – have made this transition and their lessons are available and applicable to many A&D segments. These companies have succeeded by "flipping the mission." Whereas in the past these companies saw aftermarket revenues as simply a nice adjustment to OE sales, these companies are now in the business of providing life-cycle solutions. Product sales are just one piece of the total solutions equation. By selling products, they gain access to the through-life revenue streams. Most industry participants see the value of this approach; unfortunately they are mired in an operating model designed primarily to reward OE sales. Today, companies make investment decisions based on expected sales margins (often low in service businesses) rather than the return on investment more relevant to service businesses. Spares pricing, product upgrades, and parts-repair

investments are made with a time horizon in years rather than the decades that are relevant to these businesses.

Unfortunately, it's difficult, perhaps impossible, to flip the mission to a through-life approach in piecemeal fashion. A company must jump in with both feet. It must train its sales staff differently, define market share differently, measure profits differently, and alter the time frame for financial performance. That's just for starters, and it's why a change in organizational DNA is necessary.

Scrutinize Defense Businesses in the Portfolio

Going into the next downturn, executives must decide how to position their portfolios of businesses – what to jettison, what to acquire, and where to invest. Portfolio strategy should always be top of mind, but now more than at any time in the past two decades, the structure of such portfolios needs serious rethinking. In particular, companies across the industry must rethink the future role of defense in their portfolios.

Most of the industry falls into one of two groups: those whose primary focus is the defense industry, and those with broader operations that include some defense-focused expertise. (There are relatively few “pure play” commercial aerospace companies.) For those in the first group, the pressing question is how to cope with the next cyclical downturn when many strategies used in the past – consolidation, exiting, migrating, and hunkering down – are either no longer tenable, or were never successful in the first place.

Opportunities for peer consolidation in defense are limited due to monopoly concerns, barring a major shift in customer sentiments. At the same time, opportunities for acquisitions up and down the value chain are hampered by customer concerns over conflict of interest. As for the migration strategy, defense primes attempt this at their peril. The last time they tried to move out of the A&D category into the commercial market, in the 1990s, their track record was one “unblemished by success,” as Norm Augustine put it.

Exiting non-core parts of the business through the sale of business units is still an option, and can be a good one, but only when freed-up capital and resources are invested elsewhere. As for hunkering down – and by that we mean not investing anywhere, cutting costs, and holding onto cash – in order to ride out a downturn, that's proven debilitating.

Companies that pursued this strategy in the mid-1990s significantly underperformed competitors. Moreover, virtually all companies that attempted such a strategy ended up exiting the business anyway, typically at lower values than they might have achieved had they acted more quickly.

For those companies with broad operations that include some defense-focused expertise, the portfolio strategy question is specific: After the current cyclical peak in the defense business, should I exit what has become a highly cyclical, complicated, low-growth market? In many cases the military market represents less than 10 percent of profits, yet to participate at all in this small segment requires a huge management and administrative commitment.

We believe that when thinking through a portfolio strategy, whether currently focused on defense, or with only a small defense-focused unit, it's helpful to link that strategy to a company's underlying capabilities. The stronger and more diverse those underlying capabilities are, the broader and more profitable a company's portfolio can be. Do you have a low-cost product manufacturing capability via offshoring agreements? Do you effectively manage large complex engineering programs? Do you have a culture of innovation and risk taking? Are you equally at home competing in all global markets? All of these capabilities are the building blocks of a portfolio strategy. Defining the capabilities you have and want to acquire will reveal the types of businesses your company should pursue.

The Winds of Change

More than most industries in today's fraught financial markets and global economic slowdown, A&D companies have the luxury of near-term stability. But as they work through their backlogs, they should think seriously about their path forward. The seas are relatively calm, but we know a tougher passage awaits. The industry's position today reminds us of how ship captains in the 19th century managed their voyages from Europe around Cape Horn into the Pacific. The first few weeks occurred in the relatively calm waters of the central and south Atlantic, but all on board knew the difficult journey they would face when the ship rounded the tip of South America and steered into the teeth of the prevailing westerly winds.

Smart captains took that time in the Atlantic's calm waters to prepare for the difficult times ahead. Lightweight sails were switched out for heavier canvas, cargo was secured against shifting, hatches were strengthened, new crew hands were brought up to full readiness, and overall the ship was made more secure. All in all, it is an approach the captains of today's A&D industry should consider.

We hope this letter helps as you consider these important issues, and we would be pleased to discuss any of these topics with you more fully.

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